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<table>
<thead>
<tr>
<th>ID</th>
<th>NAME</th>
<th>TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1016</td>
<td>SCHEHRAZAD SELMANE</td>
<td>TIME SERIES ANALYSIS OF TUBERCULOSİS İN MEDEA PROVINCE IN ALGERIA</td>
</tr>
<tr>
<td>1002</td>
<td>ALI BAŞHAN</td>
<td>NUMERICAL SOLUTION OF MKDV EQUATION BY DIFFERENTIAL QUADRATURE METHOD BASED ON QUARTIC B-SPLINE</td>
</tr>
<tr>
<td>1022</td>
<td>AIDA SAHMUROVA</td>
<td>THE LOCAL AND GLOBAL DYNAMICS MODEL OF A CANCER TUMOR GROWTH</td>
</tr>
<tr>
<td>1023</td>
<td>OCTAVIAN AGRATINI</td>
<td>A CLASS OF MARKOV OPERATORS AND THEIR APPROXIMATION PROPERTIES</td>
</tr>
<tr>
<td>1024</td>
<td>KADIR TURHAN</td>
<td>SYNTHESIS OF SUBSTITUTED 4-THIAZOLIDINONE COMPOUNDS VIA ONE-POT MULTICOMPONENT REACTION</td>
</tr>
<tr>
<td>1026</td>
<td>VELI SHAKHMUROV</td>
<td>NONLOCAL CAUCHY PROBLEM FOR SCHRÖDINGER TYPE EQUATIONS WITH GENERAL ELLIPTIC PART</td>
</tr>
<tr>
<td>1028</td>
<td>FIZELENI LEKLI</td>
<td>COMMUTATIVE IDEAL THEORY AND DEDEKIND DOMAINS</td>
</tr>
<tr>
<td>1029</td>
<td>EBRU BONCUKÇU</td>
<td>A COMPREHENSIVE OVERVIEW AND LATEST STUDIES ON THE MATHEMATICAL MODELS ABOUT TB DISEASE IN TURKEY</td>
</tr>
<tr>
<td>1030</td>
<td>ZAYED, AHMED</td>
<td>MULTIDIMENSIONAL BANDLIMITED SIGNALS FROM DISCRETE DATA</td>
</tr>
<tr>
<td>1031</td>
<td>MUHAMET KASTRATI</td>
<td>STATISTICAL RELATIONAL LEARNING: A STATE-OF-THE-ART REVIEW</td>
</tr>
<tr>
<td>1032</td>
<td>FATMA TÜLAY TUĞÇU</td>
<td>SYNTHESIS OF PYRIDINYL SUBSTITUTED IMINOTHIAZOLIDIN-4-ONE COMPOUNDS VIA ONE-POT METHOD</td>
</tr>
<tr>
<td>1033</td>
<td>NELDA KOTE</td>
<td>PART OF SPEECH TAGGING AND STEMMING TOOLS FOR ALBANIAN LANGUAGE: A STATE-OF-THE-ART SURVEY</td>
</tr>
<tr>
<td>1034</td>
<td>ABDULLAH AHMAD ABDULLAH</td>
<td>THE STABILITY OF MARANGONI CONVECTION IN A HORIZONTAL LAYER OF NANOFUID</td>
</tr>
</tbody>
</table>
1037  RESUL KARA  NERSELERİN İNTERNETİNİN GELECEĞİ ÜZERINE / A STUDY ON THE FUTURE OF THE INTERNET OF THINGS

1038  FATIH KAYAALP  ATTRIBUTE SELECTION METHODS ON DIAGNOSIS OF BREAST CANCER AND ORTHOPEDICS

1039  HALUK OZPARLAK  ALLEVIATION OF NACl TOXICITY IN BEAN (PHASEOLUS VULGARIS L.) LEAVES BY THE EXOGENOUS APPLICATION OF NARINGENIN

1040  MIRSAT YESILTEPE  TESTING USING HASH OR HMAC IN WEB SERVICES

1041  FATIH KAYAALP  CLASSIFICATION OF R, G, AND B VALUES FROM FACE IMAGES USING WEIGHTED K-NEAREST NEIGHBOR CLASSIFIER TO PREDICT THE SKIN OR NON-SKIN

1042  SEVGI KOCAOBA  BIOSORPTION OF SOME HEAVY METALS FROM AQUEOUS SOLUTIONS

1043  HASAN HÜSEYIN DOĞAN  EVALUATION OF THE ANTIVIRAL ACTIVITY OF BALLOTA GLANDULOSISSIMA EXTRACTS AGAINST RESPIRATORY SYNCYTIAL VIRUS (RSV)

1044  KASTRIOT ZOTO  FIXED POINT THEOREMS AND APPLICATIONS FOR A CLASS OF CONTRACTIVE MAPPINGS IN METRIC-LIKE SPACES

1045  KENAN YILDIRIM  ON THE CONTROL OF DAMPED BOUSSINESQ EQUATION

1046  HIQMET KAMBERAJ  AUTOMATION OF MOLECULAR PROPERTIES USING MACHINE LEARNING APPROACHES

1047  MARGARITA IFTI  TOWARD THE COMPLETE SET OF DIFFERENTIAL EQUATIONS THAT DESCRIBE REGULATORY NETWORKS

1048  ORGEST ZAKA  LATIN SQUARES, AFFINE PLANES AND STEINER TERNARY SYSTEMS

1049  ARBEN BAUSHI  DIOPHANTINE APPROXIMATION AND EXPANSIONS IN NON-INTEGER BASES

1050  SINAN ALKAN  SOME RARE AND INTERESTING FUNGI SPECIES IN TURKEY

1051  SCHEHRASADE SELMANE  FORECASTING OF SCORPION STINGS: THE CASE OF TOUGGOURT IN ALGERIA

1052  MANJOLA BANI  THE ENVIRONMENTAL IMPACT OF THE OLIVE PROCESSING INDUSTRY IN LUSHNJA DISTRICT

1053  ARTION KASHURI  SOME HERMITE-HADAMARD TYPE INEQUALITIES FOR N-TIME DIFFERENTIABLE FUNCTIONS WHICH ARE GENERALIZED (S,M,Φ)-PREINVEX

1054  ARTUR STRINGA  TWO CHARACTERIZATIONS OF STRICT CONVEXITY IN LINEAR 2–NORMED SPACES
<table>
<thead>
<tr>
<th>Page</th>
<th>Author/Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1064</td>
<td>LEDIA SUBASHI SOME RESULTS ON MULTI-VALUED FRACTALS IN EXTENDED B-METRIC SPACE.</td>
</tr>
<tr>
<td>1068</td>
<td>TURGUT AK INVESTIGATION OF SOME PHYSICAL BEHAVIORS OF DISPERSIVE SHALLOW WATER WAVES</td>
</tr>
<tr>
<td>1070</td>
<td>NAZMIYE EBRU DUYSAYAK DEVELOPMENT OF A SOFTWARE PLATFORM FOR SURGERY SIMULATORS</td>
</tr>
<tr>
<td>1073</td>
<td>ZINE LABIDINE MAHRI ANALYSIS OF THE EFFECT OF INHABITANT BEHAVIOR ON THE ENERGY CONSUMPTION IN THE RESIDENTIAL SECTOR</td>
</tr>
<tr>
<td>1074</td>
<td>BOURSAS ABDERRAHMANE STUDY OF THE THERMAL BEHAVIOR OF THE OPTIMIZATION OF A RURAL HOUSE LOCATED IN SOUTH MEDITERRANEAN EVIDENCES OF DISTRIBUTION SPECIFICS FOR DAILY EURO-ALBANIAN CURRENCY EXCHANGE RATES</td>
</tr>
<tr>
<td>1075</td>
<td>ELMIRA KUSHTA</td>
</tr>
<tr>
<td>1077</td>
<td>ARDA AYDIN EVALUATION OF LIGHTNING CONDITIONS INCOMMERCIAL DAIRY FARMS</td>
</tr>
<tr>
<td>1078</td>
<td>ARDA AYDIN TECHNOLOGICAL SOLUTIONS FOR THE DEVELOPMENT OF LIVESTOCK IN BALKAN COUNTRIES; SOUND ANALYSIS EXAMPLE</td>
</tr>
<tr>
<td>1079</td>
<td>MEHMET FATIH KARAASLAN THE EXISTENCE AND UNIQUENESS OF THE SOLUTION FOR FREDHOLM INTEGRO-DIFFERENTIAL EQUATION USING HDG METHOD</td>
</tr>
<tr>
<td>1080</td>
<td>MELTEM UZUN ON GENERALIZED SOLUTIONS OF NONLINEAR SYSTEMS</td>
</tr>
<tr>
<td>1082</td>
<td>ELIF SEGAH ÖZTAŞ SOME DNA CODES OVER F_2</td>
</tr>
<tr>
<td>1084</td>
<td>HAMDI TEMEL PREPARATION OF MODIFIED BIODEGRADABLE STARCH FILMS, INVESTIGATION OF BARRIER AND PHYSICAL PROPERTIES</td>
</tr>
<tr>
<td>1085</td>
<td>MUHAMMET KURULAY ANALYSIS OF NONLINEAR FRACTIONAL-ORDER VOLterra INTEGRO-DIFFERENTIAL EQUATION</td>
</tr>
<tr>
<td>1086</td>
<td>HAMDI TEMEL BIOLOGICAL ACTIVITY STUDIES OF NEW SYNTHESIS BORON COMPOUNDS</td>
</tr>
<tr>
<td>1088</td>
<td>FERDOUS TAOUFIC HYPERGRAPHS : FOOD NETWORKS</td>
</tr>
<tr>
<td>1089</td>
<td>ZINE LABIDINE MAHRI A THERMAL COMFORT EVALUATION USING A STATISTICAL ANALYSIS OF INTERIOR TEMPERATURE FOR A BUILDING LOCATED IN CONSTANTINE, ALGERIA IMPLEMENTATION OF A DATA COMPARATIVE MODEL TO ENSURE PRODUCT QUALITY FOR ANALYTICAL SOLUTIONS</td>
</tr>
<tr>
<td>1090</td>
<td>DENIS SAATCIU</td>
</tr>
<tr>
<td>1092</td>
<td>ELONA SHEHU RISK ASSESSMENT OF SPECULATION IN SECTORS OF ALBANIA’S ECONOMY: 2005 –2018</td>
</tr>
<tr>
<td>Page</td>
<td>Authors</td>
</tr>
<tr>
<td>------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>1093</td>
<td>CRISTINA GENA DASCALU</td>
</tr>
<tr>
<td>1094</td>
<td>AMBRA KRAJA</td>
</tr>
<tr>
<td>1095</td>
<td>SOFIJE HOXHA</td>
</tr>
</tbody>
</table>
NUMERICAL SOLUTION OF mKdV EQUATION BY DIFFERENTIAL QUADRATURE METHOD BASED ON QUARTIC B- SPLINE

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Abstract:

The main aim of this study is to obtain numerical solution of the modified Korteweg-de Vries (mKdV) equation. Firstly, mKdV equation is discretized by Crank-Nicolson scheme for time integration and then quartic B-spline based differential quadrature method implemented for space integration. To measure the accuracy of the method the error norms $L_2$ and $L_{\infty}$ are calculated and reported. Besides those, the three lowest invariants computed and tabulated.

Keywords: Partial differential equations, Differential quadrature method, mKdV, B-spline

General area of research: Mathematics

ICFAS2019-ID: 1002

1. INTRODUCTION

One of the well-known nonlinear differential equation formulated by two Dutchmen Korteweg and de Vries (KdV) equation in its simplest form [1] is given by

$$q_t + aqq_x + \beta q_{3x} = 0,$$

(1)

with $q = q(x,t)$ is a differentiable function. We shall assume that the solution $q(x,t)$, along with its derivatives, tends to zero as $|x| \to \infty$ [2].

The KdV equation is used to model the height of the surface of shallow water in the presence of solitary waves [3]. The KdV equation also describes the propagation of plasma waves in a dispersive medium. One of the most important KdV type equation is known as modified KdV (mKdV) which was first introduced by Miura [4] given as follows

$$q_t + aq^2q_x + \beta q_{3x} = 0.$$

(2)

The mKdV equation is identical to the KdV equation in that both are completely integrable and each has infinitely many conserved quantities. The mKdV equation appears in electric circuits and multi-component plasmas[5,6]. KdV equation and mKdV equation have been solved by many different methods numerically and analytically[7–17].

Differential Quadrature Method (DQM) was first introduced by Bellman et al. [18] to obtain numerical solution of partial differential equations. Many researchers have developed different types of DQMs utilizing various base functions such as spline functions[19], Hermite polynomials[20], radial basis functions[21], harmonic functions[22], Sinc functions[23], Fourier Expansion Basis[24], B-spline functions [25,26] and modified B-spline functions[27–29].
In this work, quartic B-spline based Crank-Nicolson-Differential Quadrature Method (QA-DQM) is going to be applied to obtain numerical solutions of mKdV equation.

2. QUARTIC B-SPLINE DIFFERENTIAL QUADRATURE METHOD

Let us take the uniform grid distribution \( a = x_1 < x_2 < \cdots < x_N = b \) of the finite domain \([a, b]\) into account. Assuming that any given function \( f(x) \) is smooth enough throughout the solution domain of problem, its derivatives in terms of \( x \) at a nodal point \( x_i \) can best be approached by a linear combination of all the functional values over the solution domain, that is,

\[
f^{(r)}_x(x_i) = \frac{d^{(r)} f}{dx^{(r)}} \bigg|_{x_i} = \sum_{j=1}^{N} w^{(r)}_{ij} f(x_j), \quad i = 1, 2, \ldots, N, \ r = 1, 2, \ldots, N - 1
\]

where \( r \) represents the order of derivative, \( w^{(r)}_{ij} \)'s denote the weighting coefficients of the \( r \)th order derivative approximation, and \( N \) represents the number of nodal points in the given solution domain. Here, the index \( j \) indicates the fact that \( w^{(r)}_{ij} \) is the corresponding weighting coefficient of the value of the function \( f(x_j) \).

Let \( \varphi_m(x) \) be the quartic B-splines with nodal points at the points \( x_i \) where the uniformly distributed \( N \) grid points are chosen as \( a = x_1 < x_2 < \cdots < x_N = b \) on the real axis. Then, the quartic B-splines \( \{ \varphi_{-1}, \varphi_0, \ldots, \varphi_{N+1} \} \) constitute a basis for all functions described throughout \([a, b]\). The quartic B-splines \( \varphi_m(x) \) are described by the relationships:

\[
\varphi_m(x) = \frac{1}{h^4} \begin{cases} 
(x - x_{m-2})^4, & [x_{m-2}, x_{m-1}] \\
(x - x_{m-2})^4 - 5(x - x_{m-1})^4, & [x_{m-1}, x_m] \\
(x - x_{m-2})^4 - 5(x - x_{m-1})^4 + 10(x - x_m)^4, & [x_m, x_{m+1}] \\
(x_{m+3} - x)^4 - 5(x_{m+2} - x)^4, & [x_{m+1}, x_{m+2}] \\
0, & otherwise
\end{cases}
\]

where \( h = x_m - x_{m-1} \) for all \( m \) [30].

Table 1. The value of quartic B-splines and derivatives functions at the nodal points.

<table>
<thead>
<tr>
<th>( x )</th>
<th>( x_{m-2} )</th>
<th>( x_{m-1} )</th>
<th>( x_m )</th>
<th>( x_{m+1} )</th>
<th>( x_{m+2} )</th>
<th>( x_{m+3} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \varphi^0_m )</td>
<td>0</td>
<td>1</td>
<td>11</td>
<td>11</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>( \varphi^1_m )</td>
<td>0</td>
<td>4/h</td>
<td>12/h</td>
<td>-12/h</td>
<td>-4/h</td>
<td>0</td>
</tr>
<tr>
<td>( \varphi^2_m )</td>
<td>0</td>
<td>12/h^2</td>
<td>-12/h^2</td>
<td>12/h^2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>( \varphi^3_m )</td>
<td>0</td>
<td>24/h^3</td>
<td>-72/h^3</td>
<td>72/h^3</td>
<td>-24/h^3</td>
<td>0</td>
</tr>
</tbody>
</table>

Substitution of each quartic B-spline function into the DQM equation (3) for a fixed \( x_i \) and \( r = 1 \) gives

\[
\frac{d \varphi_m(x_i)}{dx} = \sum_{j=m-1}^{m+2} w^{(1)}_{ij} \varphi_m(x_j)
\]

After using the value of \( \varphi_m \) at the first nodal point \( x_1 \), we obtained linear equation system (5) which contains \( N+3 \) equations and at the same time \( N+6 \) unknowns given in the matrix form as below.
As it can be seen, this unsolvable equation system (6) needs three additional equations. By using
\[
\frac{d^2 \varphi_{-1}(x_1)}{dx^2} = \sum_{j=2}^{N+2} w_{1j}^{(1)} \varphi'_{-1}(x_j),
\]
\[
\frac{d^2 \varphi_N(x_1)}{dx^2} = \sum_{j=N-1}^{N+3} w_{1j}^{(1)} \varphi'_N(x_j),
\]
\[
\frac{d^2 \varphi_{N+1}(x_1)}{dx^2} = \sum_{j=N}^{N+3} w_{1j}^{(1)} \varphi'_{N+1}(x_j),
\]
additional equations, three unknown terms \(w_{1-2}^{(1)}, w_{1N+2}^{(1)}\) and \(w_{1N+3}^{(1)}\) are eliminated. So, the equation system has \(N+3\) equations and \(N+3\) unknowns given in the matrix for as below
\[
\begin{bmatrix}
8 & 14 & 2 & \\
1 & 11 & 11 & 1 & \\
\vdots & \vdots & \vdots & \vdots & \\
1 & 11 & 11 & 1 & \\
2 & 14 & 8 & \\
30 & 42 & \\
\end{bmatrix}
\begin{bmatrix}
w_{1-2}^{(1)} \\
w_{1-1}^{(1)} \\
\vdots \\
w_{1N+2}^{(1)} \\
w_{1N+3}^{(1)}
\end{bmatrix}
= \begin{bmatrix}
-4/h \\
-12/h \\
12/h \\
4/h \\
0 \\
\vdots \\
0
\end{bmatrix}
\] (6)

By the same process, for the \(x_m\) nodal points, \(2 \leq m \leq N - 1\) we obtained
\[
\begin{bmatrix}
8 & 14 & 2 & \\
1 & 11 & 11 & 1 & \\
\vdots & \vdots & \vdots & \vdots & \\
1 & 11 & 11 & 1 & \\
2 & 14 & 8 & \\
30 & 42 & \\
\end{bmatrix}
\begin{bmatrix}
w_{m-1}^{(1)} \\
w_{10}^{(1)} \\
\vdots \\
w_{1N-1}^{(1)} \\
w_{1N}^{(1)} \\
w_{1N+1}^{(1)}
\end{bmatrix}
= \begin{bmatrix}
0 \\
-7/h \\
-12/h \\
12/h \\
4/h \\
0 \\
\vdots \\
0
\end{bmatrix}
\] (7)

\[
\begin{bmatrix}
8 & 14 & 2 & \\
1 & 11 & 11 & 1 & \\
\vdots & \vdots & \vdots & \vdots & \\
1 & 11 & 11 & 1 & \\
2 & 14 & 8 & \\
30 & 42 & \\
\end{bmatrix}
\begin{bmatrix}
w_{m-1}^{(1)} \\
w_{mn-2}^{(1)} \\
\vdots \\
w_{mn-1}^{(1)} \\
w_{mn}^{(1)} \\
w_{mn+1}^{(1)} \\
w_{mN+1}^{(1)}
\end{bmatrix}
= \begin{bmatrix}
0 \\
0 \\
-4/h \\
-12/h \\
12/h \\
4/h \\
0 \\
\vdots \\
0
\end{bmatrix}
\] (8)
equation system. And for the final nodal point \(x_N\) we obtained
By using Thomas algorithm, equation systems (7)-(9) have been solved easily.

By the same process for $r = 2$ gives below

$$
\begin{bmatrix}
8 & 14 & 2 \\
1 & 11 & 11 & 1 \\
1 & 11 & 11 & 1 \\
\vdots \\
1 & 11 & 11 & 1 \\
2 & 14 & 8 \\
30 & 42
\end{bmatrix}
\begin{bmatrix}
w_{N-1}^{(1)} \\
w_{NN-3}^{(1)} \\
w_{NN-2}^{(1)} \\
\vdots \\
w_{NN-1}^{(1)} \\
w_{NN}^{(1)} \\
w_{NN+1}^{(1)}
\end{bmatrix}
= 
\begin{bmatrix}
0 \\
\vdots \\
0 \\
-4/h \\
-12/h \\
9/h \\
53/h
\end{bmatrix}
$$

(9)

equation system (9).

By the same process, for the $x_m$ nodal points, $2 \leq m \leq N - 1$ we obtained

$$
\begin{bmatrix}
8 & 14 & 2 \\
1 & 11 & 11 & 1 \\
1 & 11 & 11 & 1 \\
\vdots \\
1 & 11 & 11 & 1 \\
2 & 14 & 8 \\
30 & 42
\end{bmatrix}
\begin{bmatrix}
w_{1N-1}^{(2)} \\
w_{1N-2}^{(2)} \\
w_{1N-1}^{(2)} \\
\vdots \\
w_{1N}^{(2)} \\
w_{mN}^{(2)} \\
w_{mN+1}^{(2)}
\end{bmatrix}
= 
\begin{bmatrix}
18/h^2 \\
-12/h^2 \\
-12/h^2 \\
\vdots \\
12/h^2 \\
0 \\
0
\end{bmatrix}
$$

(10)

By the same process, and for the final nodal point $x_N$ we obtained

$$
\begin{bmatrix}
8 & 14 & 2 \\
1 & 11 & 11 & 1 \\
1 & 11 & 11 & 1 \\
\vdots \\
1 & 11 & 11 & 1 \\
2 & 14 & 8 \\
30 & 42
\end{bmatrix}
\begin{bmatrix}
w_{N-1}^{(2)} \\
w_{NN-3}^{(2)} \\
w_{NN-2}^{(2)} \\
\vdots \\
w_{NN-1}^{(2)} \\
w_{NN}^{(2)} \\
w_{NN+1}^{(2)}
\end{bmatrix}
= 
\begin{bmatrix}
0 \\
\vdots \\
0 \\
12/h^2 \\
-12/h^2 \\
-30/h^2 \\
6/h^2
\end{bmatrix}
$$

(12)
equation system (12). The obtained equation systems (10)-(12) for second order weighting coefficients have been solved easily, again.

Then to get the weighting coefficients of the 3rd order derivatives, we used 1st order and 2nd order weighting coefficients. By using the matrix multiplication approach, rth order weighting coefficients have been calculated as shown below [31]:

\[ [A^{(r)}] = [A^{(1)}][A^{(r-1)}] = [A^{(r-1)}][A^{(1)}], \]

where \([A^{(1)}], [A^{(r-1)}]\) and \([A^{(r)}]\) represent the weighting coefficients matrices of the 1st order, \((r-1)\)th order and rth order derivatives, respectively.

3. NUMERICAL DISCRETIZATION

We have discretized the equation (2) using forward finite difference and Crank-Nicolson type schemes. Firstly Eq. (2) is discretized as,

\[
\frac{q^{n+1} - q^n}{\Delta t} + \alpha \frac{(q^2 q_x)^{n+1} + (q^2 q_x)^n}{2} + \beta \frac{(q_{3x})^{n+1} + (q_{3x})^n}{2} = 0. \tag{13}
\]

Equation (13) is arranged as follows:

\[
2q^{n+1} + \Delta t \left[ \alpha (q^2 q_x)^{n+1} + \beta (q_{3x})^{n+1} \right] = 2q^n - \Delta t \left[ \alpha (q^2 q_x)^n + \beta (q_{3x})^n \right]. \tag{14}
\]

Then, Rubin and Graves type linearization technique [32] is used at the left hand side of the Eq. (14) to linearize the nonlinear terms as given below:

\[
(q q_x)^{n+1} = (q^{n+1} q_x^n + q^n q_x^{n+1} - q^n q_x^n). \tag{15}
\]

Accordingly, we have obtained

\[
2q^{n+1} + \Delta t \left[ \alpha ((q^n)^2 q_x^{n+1} + 2q^n q_x^n q_x^{n+1}) + \beta (q_{3x})^{n+1} \right] = 2q^n + \Delta t \left[ \alpha (q^n)^2 q_x^n - \beta (q_{3x})^n \right]. \tag{16}
\]

Let us define some terms to use in Eq. (16) as

\[
P_i^n = \sum_{j=1}^{N} w_{ij}^{(1)} q_j^n = q_{x_i}^n, \quad R_i^n = \sum_{j=1}^{N} w_{ij}^{(3)} q_j^n = q_{3x_i}^n, \tag{17}
\]

where \(P_i^n\) and \(R_i^n\) are the 1st order and 3rd order derivative approximations of q functions at the nth time level on points \(x_i\), respectively. By the substitution of definition (17) in Eq. (16), we obtain

\[
2q_i^{n+1} + \Delta t \left[ \alpha \left( (q_i^n)^2 \sum_{j=1}^{N} w_{ij}^{(1)} q_j^{n+1} + 2q_i^n P_i^n q_i^{n+1} \right) + \beta \sum_{j=1}^{N} w_{ij}^{(3)} q_j^{n+1} \right] = S_i^n \tag{18}
\]

where

\[
S_i^n = 2q_i^n + \Delta t \left[ \alpha (q_i^n)^2 P_i^n - \beta R_i^n \right], \quad \text{for} \quad i = 1, 2, ..., N.
\]

Then we have reorganized Eq. (18) for each grid points as follows:
\[
2 + \Delta t \left[ \alpha \left( (q^n_i)^2 w^{(1)}_{ii} + 2 a q^n_i p^n_i \right) + \beta w^{(3)}_{ii} \right] q^n_{i+1} + \\
\sum_{j=1,i \neq j}^{N} \Delta t \left[ \alpha \left( (q^n_i)^2 w^{(1)}_{ij} + \beta w^{(3)}_{ij} \right) q^n_{j+1} \right] = S^n_i.
\] (19)

By implementing the system of Equations (19) on \( x_i \), \( i = 1, 2, \ldots, N \) grid points, \( N \) equations consisting of \( N \) unknowns which are denoted by \( q^n_i \) will be obtained. The boundary conditions have been applied to the system of Equations (19) and the first and last equations are eliminated from the systems. As a last step equation systems solved by Gauss elimination method.

### 4. EXPERIMENTAL RESULTS

In this section, the well-known test problem namely single soliton will be investigated. The accuracy of the numerical method is checked by using the error norms \( L_2 \) and \( L_\infty \), respectively:

\[
L_2 = \sqrt{\frac{1}{h} \sum_{j=1}^{N} \left| q_j^{\text{exact}} - q_j^{\text{numerical}} \right|^2}, \quad L_\infty = \max_j \left| q_j^{\text{exact}} - q_j^{\text{numerical}} \right|.
\] (20)

Besides those, the following lowest three invariants will be computed.

\[
l_1 = \int_a^b qdx, \quad l_2 = \int_a^b q^2dx, \quad l_3 = \int_a^b \left[ q^4 - \frac{6\beta}{\alpha} (q^x)^2 \right] dx.
\] (21)

The mKdV equation has an analytic solution given in the following form:

\[
q(x, t) = kp. \text{sech} \left( kx - kx_0 - k^3\beta t \right),
\] (22)

where

\[
p = \sqrt{\frac{6\beta}{\alpha}}
\]

which represents a single soliton originally located at \( x_0 \) moving to the right with velocity \( k^2\beta \). Solitons may have positive or negative amplitudes depending on the sign of \( k \) but all of them have positive velocities.

We take as initial condition Eq. (22) at \( t = 0 \) of the form

\[
q(x, 0) = kp. \text{sech} \left( kx - kx_0 \right),
\] (23)

and to allow comparison with quadratic finite element method [20] we use \( \alpha = 3, \beta = 1, kp = c = 1.3, x_0 = 15 \) and \( 0 \leq x \leq 200 \). For the present case, the obtained solution is going to move toward the right having a constant speed with unchanged amplitude. We have plotted the graphs of the numerical solution of single soliton with \( t = 0.05 \) and \( N = 1001 \) from \( t = 0 \) to \( t = 10 \), in Figure 1. To make a comparison quantitatively, the error norms \( L_2 \) and \( L_\infty \) have been computed and compared with earlier work [20] in Table 1 until \( t = 10 \), respectively. It is clearly seen from
Table 1 that by using the same parameters except time increment $\Delta t = 0.05$ present results are better than quadratic finite element method. Then three lowest invariants $I_1, I_2$, and $I_3$ are computed with the same parameters $t = 0.025$ and $N = 1001$ and compared with earlier works [20] in Table 2 until $t = 10$. It seen from Table 2 that the three lowest invariants are almost constant. The maximum error value of single soliton at time $t = 10$ for the simulation region $0 \leq x \leq 200$ is given in Figure 2.

Fig.1. Simulation of single soliton at various time.

Fig.2. Error value of single soliton between exact and numerical solution at time $t=10$. 

ICFAS2019-ID: 1002
Table 2. $L_2$ and $L_\infty$ error norms and invariants of single soliton

<table>
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<tr>
<th></th>
<th>$\Delta t$</th>
<th>$N$</th>
<th>$t$</th>
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<th>$L_\infty \times 10^3$</th>
<th>$I_1$</th>
<th>$I_2$</th>
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<td>4.443666</td>
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5. CONCLUSIONS

Fourth-order B-spline functions namely quartic B-splines used as base functions with differential quadrature method. Third order nonlinear partial differential equation namely mKdV equation firstly discretized in time via special type of finite difference method namely Crank-Nicolson scheme. After that for space integration quartic B-spline based differential quadrature method implemented. To measure accuracy of the method single soliton is used as a test problem. Present results show that the new method obtained better solutions than quadratic finite element method. Simulations of single soliton wave plotted. Besides those three lowest invariants are computed and reported. So, fourth order quartic B-spline based QA-DQM may be useful for other nonlinear partial differential equations.

6. ACKNOWLEDGEMENTS

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REFERENCES

SYNTHESIS OF SUBSTITUTED 4-THIAZOLIDINONE COMPOUNDS VIA ONE-POT MULTICOMPONENT REACTION

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Abstract:

Heterocyclic compounds are an important part of chemistry and life sciences and have a very important role in our biological system. The thiazolidinone and its derivatives, which are among the heterocyclic compounds, have an important place in the nature of macrocyclic complex drugs, their application in the industry and because of their biological properties such as antitubercular, antibacterial, antifungal, antimicrobial, anticancer, antitumor, antiviral, antimalarial, and anti-HIV. In particular, 4-thiazolidinone derivatives have occupied a unique place in the field of medical chemistry as they exhibit various biological activities such as antibacterial, anti-inflammatory and anticancer. It also has interesting activity profiles such as serine/threonine-protein kinase (PIK1), cystic fibrosis transmembrane conductivity regulator (CFTR) inhibitors. In the light of literature researches made, synthesis of some new thiazolidinone derivatives that may have biological activity is aimed in this study.

The study consists of two steps. In the first step, substituted thioureas, which were planned to use as substrates in the principal reactions, were prepared by the reaction of aryl isothiocyanate with substituted amines. In the second step which is the main part of the study, cyclocondensation of each of the previously prepared substituted thioureas with chloroacetic acid and thiophen-2-carboxaldehyde was achieved by the technique of one-pot multicomponent reaction; and six new substituted 5-[(2-thienylmethylidene]-1,3-thiazolidin-4-one compounds have been obtained. Structures of all the synthesized compounds have been determined and characterized by infrared, nuclear magnetic resonance, mass spectral data results and elemental analyses.

Keywords: Thiazolidinone, One-pot reaction, Multicomponent reaction, Cyclocondensation, Thiourea.

General area of research: Chemistry
ICFAS2019-ID: 1024

1. INTRODUCTION

Heterocyclic compounds are an integral part of the chemical and life sciences and constitute a considerable quantum of the modern research that is being currently pursued throughout the world. Thiazolidinone derivatives belonging to an important group of heterocyclic compounds have recently attracted attention with their versatile properties and have been one of the important research focal points. Diverse biological activities such as antibacterial, pesticidal, antifungal, insecticidal, anticonvulsant, tuberculostatic, anti-inflammatory, antithyroid, antiviral, SHP-2 inhibitor and a calcium antagonist, potentiation of pentobarbital-induced sleeping time, etc., have
been found to be associated with thiazolidinone derivatives. 1-4 Especially 4-thiazolidinones have always become a center of attraction for researchers due to their efficacy against various pharmacological uses. The derivatives of 4-thiazolidinone nucleus have occupied a unique place in the field of medicinal chemistry due to the wide range of biological activities like antibacterial, antitubercular, anticancer, anti-inflammatory, antioxidant, anticonvulsant, antiviral, antimicrobial and antifungal. They have interesting activity profiles mainly cox-1 inhibitors, inhibitors of the bacterial enzyme, non-nucleoside inhibitors of HIV Type 1 Reverse Transcriptase (HIVRT) and antihistaminic agents. 5-10

In this study, six new 4-thiazolidinone derivatives, which can show biological activity, were synthesized and their structures were characterized by FTIR, 1H NMR, 13C NMR, MS spectroscopic methods and elemental analyses.

2. MATERIAL AND METHODS

2.1. Instruments

Fourier Transform Infrared (FTIR) spectra of the starting materials and the obtained products were taken on the “Perkin Elmer Spectrum One” FTIR spectrophotometer by ATR technique. Nuclear magnetic resonance (1H NMR) spectra were obtained from a “Bruker 400 MHz” spectrophotometer in chloroform-D (CDCl3) using the tetramethylsilane (TMS) standard according to the solubility of the materials. Mass (MS) spectra were obtained with 70 eV “Hewlett Packard GC/MS 6890/5973”. CHN analyses were performed on “Thermo Finnigan Flash Ea 1112 Series”. Melting points were determined with Gallenkamp melting point apparatus and were uncorrected.

2.2. General procedure for the synthesis of 4-thiazolidinone derivatives

A mixture of 4-butylaniline (1 mmol) and substituted phenylisothiocyanate (1.2 mmol) was stirred in CH2Cl2 at room temperature for 24 hours to synthesize thioureas [(1-(4-butylphenyl)-3-phenylthiourea (T1); 1-(4-butylphenyl)-3-(4-methylphenyl)thiourea (T2) and 1-(4-chlorophenyl)-3-(4-butylphenyl)thiourea (T3)].11-13 The crude product was concentrated under vacuum and recrystallized from ethanol (Figure 1).

Figure 1. Synthesis of thiourea derivatives (T1-T3)

Then, to synthesize the test compounds (C1-C6), the appropriate thiourea (1 mmol), chloroacetic acid (1.2 mmol) and thiophene-2-carboxaldehyde (1 mmol) was stirred with a magnetic stirrer at 40 °C for 24 h. The resulting isomer mixtures were purified by column chromatography (dichloromethane/hexane: 4/1).14-18 This pathway of synthesis is summarized in Figure 2.
2.2.1. 3-(4-Butylphenyl)-2-(phenylimino)-5-(2-thienylmethyl)-1,3-thiazolidin-4-one (C₁)

Yellow crystal; mp.156-7 °C, FTIR (ATR) (ν cm⁻¹) 3033 (aromatic ring, =C–H), 2956 and 2853 (aliphatic, CH₃ and C–H), 1708 (amide, C=O), 1637 (imine, C=N), 1591 and 1510 (aromatic and heteroaromatic ring, C=C), 1366 (C-N), 1354 and 1467 (CH₃, C–H), 1171 and 1148 (substituted ring, C–H), 862 (C=S), 834 and 772 (substituted ring, out of plane C–H);¹H NMR (400 MHz, CDCl₃) δ (ppm) 0.95 (3H, t), 1.41 (2H, m), 1.65 (2H, m), 2.67 (2H, t), 6.99 (2H, brd), 7.14 (1H, dd), 7.16 (2H, brd), 7.34 (1H, dd), 7.36 (5H, m), 7.55 (1H, brd), 8.00 (1H, s);¹³C NMR (100 MHz, CDCl₃) δ (ppm) 14.13, 22.68, 33.49, 35.66, 119.88, 121.35-148.53, 150.86, 166.55; MS: m/z [M-H]+ calcd. for C₂₄H₂₂N₂O₂S₂ (418.574 g/mol) 420(M+1), 419(M+), 418(M+2), 375, 250, 207, 140, 96; Anal. calcd.: C, 68.87; H, 5.30; N, 6.69; S, 15.32. Found: C, 68.72; H, 5.37; N, 6.64; S, 15.39.

2.2.2. 2-[(4-Butylphenyl)imino]-3-phenyl-5-(2-thienylmethylidene)-1,3-thiazolidin-4-one (C₂)

Yellow crystal; mp. 141-2 °C, FTIR (ATR) (ν cm⁻¹) 3085 (aromatic ring, =C–H), 2951 and 2852 (aliphatic, CH₃ and C–H), 1707 (amide, C=O), 1640 (imine, C=N), 1593 and 1496 (aromatic and heteroaromatic ring, C=C), 1365 (C-N), 1353 and 1272 (CH₃, C–H), 1179 and 1146 (substituted ring, C–H), 859 (C=S), 829 and 771 (substituted ring, out of plane C–H);¹H NMR (400 MHz, CDCl₃) δ (ppm) 0.95 (3H, t), 1.37 (2H, m), 1.62 (2H, m), 2.62 (2H, t), 6.91 (2H, brd), 7.15 (1H, dd), 7.17 (2H, brd), 7.35 (1H, brd), 7.47 (1H, dd), 7.48 (2H, dd), 7.52 (2H, dd), 7.56 (1H, brd), 8.00 (1H, s);¹³C NMR (100 MHz, CDCl₃) δ (ppm) 14.19, 22.58, 33.80, 35.37, 119.88, 121.10-148.53, 150.86, 166.46; MS: m/z [M-H]+ calcd. for C₂₄H₂₂N₂O₂S₂ (418.574 g/mol) 420(M+2), 419(M+1), 418(M+), 417(M-1), 375, 250, 207, 140, 96; Anal. calcd.: C, 68.87; H, 5.30; N, 6.69; S, 15.32. Found: C, 68.74; H, 5.27; N, 6.68; S, 15.49.

2.2.3. 3-(4-Butylphenyl)-2-[(4-chlorophenyl)imino]-5-(2-thienylmethylidene)-1,3-thiazolidin-4-one (C₃)

Light yellow crystal; mp. 120-1 °C, FTIR (ATR) (ν cm⁻¹) 3072-3033 (aromatic ring, =C–H), 2950 and 2856 (aliphatic, CH₃ and C–H), 1712 (amide, C=O), 1635 (imine, C=N), 1601 and 1510
(aromatic and heteroaromatic ring, C=C), 1367 (C=N), 1269 (CH₃, C–H), 1171 and 1148 (substituted ring, C–H), 828 (C–S), 789 (substituted ring, out of plane C–H); 1H NMR (400 MHz, CDCl₃) δ (ppm) 0.94 (3H, t), 1.40 (2H, m), 1.64 (2H, m), 2.66 (2H, t), 6.92 (2H, brd), 7.15 (1H, dd), 7.32 (2H, brd), 7.34 (4H, brs), 7.35 (1H, brd), 7.58 (1H, brd), 8.01 (1H, s); 13C NMR (100 MHz, CDCl₃) δ (ppm) 13.97, 22.49, 33.30, 35.46, 119.13, 122.58-146.89, 151.52, 166.25; MS: m/z [M-H]+ calcd. for C₂₄H₂₁ClN₂O₂S₂ (453.019 g/mol) 454 (M+1), 453 (M +), 452 (M-1), 409, 284, 241, 168, 140, 131, 77, 43; Anal. calcd.: C, 63.63; H, 4.67; Cl, 7.83; N, 6.18; S, 14.16. Found: C, 63.59; H, 5.27; Cl, 7.76; N, 6.21; S, 14.22.

2.2.4. 2-[(4-Butylphenyl)imino]-3-(4-chlorophenyl)-5-(2-thienylmetylidene)-1,3-thiazolidin-4-one (C₄)

Light yellow crystal; mp. 123-4 °C, FTIR (ATR) (ν cm⁻¹) 3023 (aromatic ring, =C–H), 2920 and 2870 (aliphatic, CH₃ and C–H), 1705 (amide, C=O), 1638 (imine, C=N), 1596 and 1505 (aromatic and heteroaromatic ring, C=C), 1364 and 1353 (C-N), 1260 (CH₃ and C–H), 881 (C–S), 828 (substituted ring, out of plane C–H); 1H NMR (400 MHz, CDCl₃) δ (ppm) 0.94 (3H, t), 1.37 (2H, m), 1.62 (2H, m), 2.66 (2H, t), 6.89 (2H, brd), 7.15 (1H, dd), 7.17 (2H, brd), 7.35 (1H, brd), 7.42 (2H, brd), 7.50 (2H, brd), 7.57 (1H, brd), 8.00 (1H, s); 13C NMR (100 MHz, CDCl₃) δ (ppm) 14.00, 22.39, 33.60, 35.17, 119.28, 120.83-145.35, 149.65, 166.04; MS: m/z [M-H]+ calcd. for C₂₄H₂₁ClN₂O₂S₂ (453.019 g/mol) 454 (M+2), 453 (M+1), 452 (M+), 409, 284, 241, 168, 140, 131, 77, 43; Anal. calcd.: C, 63.63; H, 4.67; Cl, 7.83; N, 6.18; S, 14.16. Found: C, 63.60; H, 5.29; Cl, 7.76; N, 6.20; S, 14.21.

2.2.5. 3-(4-Butylphenyl)-2-[(4-metylphenyl)imino]-5-(2-thienylmetylidene)-1,3-thiazolidin-4-one

Yellow crystal; mp. 152-3 °C, FTIR (ATR) (ν cm⁻¹) 3069 (aromatic ring, =C–H), 2954 and 2856 (aliphatic, CH₃ and C–H), 1712 (amide, C=O), 1638 (imine, C=N), 1595 and 1506 (aromatic and heteroaromatic ring, C=C), 1366 and 1353 (C-N), 1260 (CH₃ and C–H), 839 (C–S), 796 (substituted ring, out of plane C–H); 1H NMR (400 MHz, CDCl₃) δ (ppm) 0.94 (3H, t), 1.40 (2H, m), 1.64 (2H, m), 2.35 (3H, s), 2.66 (2H, t), 6.88 (2H, brd), 7.13 (1H, dd), 7.16 (2H, brd), 7.32 (2H, brd), 7.34 (1H, brd), 7.36 (2H, brd), 7.54 (1H, brd), 7.98 (1H, s); 13C NMR (100 MHz, CDCl₃) δ (ppm) 13.98, 21.03, 22.50, 33.31, 35.47, 119.76, 120.96-145.74, 150.45, 166.42; MS: m/z [M-H]+ calcd. for C₂₅H₂₄N₂O₂S₂ (432.601 g/mol) 434 (M+2), 433 (M+1), 432 (M⁺), 389, 264, 221, 168, 140, 131, 77, 43; Anal. calcd.: C, 69.41; H, 5.59; N, 6.48; S, 14.82. Found: C, 69.35; H, 5.54; N, 6.72; S, 14.88.

2.2.6. 2-[(4-Butylphenyl)imino]-3-(4-metylphenyl)-5-(2-thienylmetylidene)-1,3-thiazolidin-4-one (C₆)

Yellow crystal; mp. 111-2 °C, FTIR (ATR) (ν cm⁻¹) 3029 (aromatic ring, =C–H), 2924 and 2854 (aliphatic, CH₃ and C–H), 1716 (amide, C=O), 1639 (imine, C=N), 1599 and 1504 (aromatic and heteroaromatic ring, C=C), 1366 (C-N), 1261 (CH₃ and C–H), 879 (C-S), 836 (substituted ring, out of plane C–H); 1H NMR (400 MHz, CDCl₃) δ (ppm) 0.94 (3H, t), 1.37 (2H, m), 1.61 (2H, m), 2.40 (3H, s), 2.62 (2H, t), 6.89 (2H, brd), 7.14 (1H, dd), 7.16 (2H, brd), 7.33 (5H, brs), 7.55 (1H, brd), 7.99 (1H, s); 13C NMR (100 MHz, CDCl₃) δ (ppm) 13.98, 21.03, 22.50, 33.31, 35.47, 119.76, 120.96-145.74, 150.45, 166.42; MS: m/z [M-H]+ calcd. for C₂₄H₂₃N₂O₂S₂ (432.601 g/mol) 434 (M+2), 433 (M+1), 432 (M⁺), 389, 264, 221, 168, 140, 131, 77, 43; Anal. calcd.: C, 69.41; H, 5.59; N, 6.48; S, 14.82. Found: C, 69.35; H, 5.54; N, 6.72; S, 14.88.
3. RESULTS AND DISCUSSION

The IR spectra of all the synthesized thiourea derivatives (T₁-T₃) for the first stage of our study exhibited N–H stretching vibrations in the region between 3470–3160 cm⁻¹. The vibrations in the region 1265–1225 and 1180–1120 cm⁻¹ were assigned to C=S stretching. The N–H amide absorption bands were observed at 1380–1308 cm⁻¹. These IR bands were common to all the synthesized thiourea derivatives and are in agreement with the absorptions reported in the literature for thioureas.¹⁹,²⁰ Thiol-thione tautomerism was indicated by the signals between 1.5–2.4 ppm in the ¹H-NMR of all synthesized compounds and were in accordance with the signals reported in the literature.²⁰

Two isomer products were obtained from the multicomponent reactions with the arylthioureas. Since the groups attached to both nitrogen atoms in the arylthioureas are aromatic, the thion-thiol tautomer can give cyclocondensation reaction with chloroacetic acid in the two structures obtained when it is written. Thus, two isomer products are synthesized.²¹

When the infrared spectra of the compounds are examined, the C=C and C=N stretching bands, which are characteristic for nitrogen-containing heterocyclic compounds as well as the substituted ring out-of-plane =CH bending vibration with an aromatic =CH stretching band is observed at the values specified for themselves and at the sources.²²-²⁴

However, more importantly, in the products formed in the reaction, although the free NH stretching band between 3085 and 3023 cm⁻¹ in the infrared spectrum of the arylthiourea compounds obtained in the first stage of the work and the chloroacetic acid used as the starting material in the last step are present in the OH band between 3400-2800 cm⁻¹ in the infrared spectrum bands were not observed. This shows us indicates the formation of the ring.

¹H nuclear magnetic resonance spectra of the synthesized products were dissolved in CDCl₃ and taken according to TMS standard. When a general systematic review of the ¹H NMR spectra is performed, the proton resonances of the heteroaromatic and aromatic rings in the structure of the compounds are observed as multiple peaks in their respective regions.²⁴,²⁵

Mass spectral analyzes of the compounds have been carried out in order to give certainty to this determined structure. When the MS spectra of the compounds are examined, the observed molecular ion peaks determine the molecular weights of the synthesized products. Both these molecular ion peaks and their general fragmentation, which are also supported by their sources, prove the proposed structures of the compounds.²³,²⁴,²⁶

The synthesis studies gave six new thiazolidinone derivatives (C₁-C₆). The structures and purities of these compounds were elucidated based on the analysis of their physical and spectroscopic data. Chemical properties of these newly synthesized compounds are summarized in Table 1.
Table 1. Chemical properties of the newly synthesized thiazolidinone derivatives.

<table>
<thead>
<tr>
<th>Structure</th>
<th>Name</th>
<th>Formula</th>
<th>FW</th>
</tr>
</thead>
<tbody>
<tr>
<td>(C1)</td>
<td>3-(4-butylphenyl)-2-(phenylimino)-5-(thiophen-2-ylmethylidene)-1,3-thiazolidin-4-one</td>
<td>C_{24}H_{22}N_{2}O_{2}S_{2}</td>
<td>418.574 g/mol</td>
</tr>
<tr>
<td>(C2)</td>
<td>(2Z,5Z)-2-[(4-butylphenyl)imino]-3-phenyl-5-(thiophen-2-ylmethylidene)-1,3-thiazolidin-4-one</td>
<td>C_{24}H_{22}N_{2}O_{2}S_{2}</td>
<td>418.574 g/mol</td>
</tr>
<tr>
<td>(C3)</td>
<td>2-[(4-chlorophenyl)imino]-3-(4-butylphenyl)-5-(thiophen-2-yl methylidene)-1,3-thiazolidin-4-one</td>
<td>C_{24}H_{21}ClN_{2}O_{2}S_{2}</td>
<td>453.019 g/mol</td>
</tr>
<tr>
<td>(C4)</td>
<td>3-(4-chlorophenyl)-2-[(4-butyl phenyl)imino]-5-(thiophen-2-yl methylidene)-1,3-thiazolidin-4-one</td>
<td>C_{24}H_{21}ClN_{2}O_{2}S_{2}</td>
<td>453.019 g/mol</td>
</tr>
</tbody>
</table>
4. CONCLUSION

As a result, in study, six new 4-thiazolidinone derivatives (C₁-C₆) were synthesized by a multicomponent one-pot method and the structures of the compounds were clarified by spectroscopic methods.

REFERENCES

SYNTHESIS OF PYRIDINYL SUBSTITUTED IMINOTHIAZOLIDIN-4-ONE COMPOUNDS VIA ONE-POT METHOD

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Abstract:

Iminothiazolidin-4-one, a saturated form of thiazole with carbonyl group on fourth carbon, has been considered as a magic moiety (wonder nucleus) which possess almost all types of biological activities like sedative, anti-inflammatory, antitubercular, anticancer, antitumor, anti-HIV, antibacterial, antifungal, analgesics, hypothermic, anesthetic, nematicidal and CNS stimulant. Present article is sincere attempt to review chemistry, synthesis, spectral studies and applications of iminothiazolidin-4-one.

The study consists of two steps. In the first step, substituted thioureas which were planned to use as substrates in the principal reactions, will prepare by the reaction of aryl isothiocyanate with substituted amines. In the second step which is the main part of the study, cyclocondensation of each of the previously prepared substituted thioureas with chloroacetic acid and hetaryl carboxaldehyde is achieve by the technique of one-pot multicomponent reaction; and new substituted 2-(pyridin-2-ylimino)-5-(thiophen-2-ylmethylidene)-1,3-thiazolidin-4-one compounds obtained.

Structures of all the synthesized compounds have been determined and characterized by infrared, nuclear magnetic resonance, mass spectral data results.

Keywords: Iminothiazolidinone, Thiourea, One-pot reaction, Multicomponent reaction, Cyclocondensation

General area of research: Chemistry

ICFAS2019-ID: 1032

1. INTRODUCTION

Iminothiazolidin-4-ones are important pharmacophores which evoked the sizeable attention in recent few years as they capable with broad array of useful pharmacological properties. Their scaffold is found in a large number of heterocyclic compounds with a wide variety of biological properties. In particular, imino-4-thiazolidinone derivatives have been identified as anti-inflammatory, antimicrobial, anticancer, antitumor, anti-HIV, antibacterial, antihypertensive, antithrombotic [1-12].

Furthermore, thioureas are important building blocks in the synthesis of iminothiazolidin-4-ones, that posses a broad spectrum of biological activity. They have attracted much attention due to their pharmaceutical and pesticidal activity. A variety of thiourea derivatives and their metal complexes exhibit analgetic, anti-inflammatory, antimicrobial, anticancer and antifungal activities [13-15].
In this article, we present the synthesis and characterization of a new substituted 2-(pyridin-2-ylimino)-5-(thiophen-2-ylmethylidene)-1,3-thiazolidin-4-one.

2. MATERIAL AND METHODS

Reagents purchased from Merck were as follows: dichloromethane, chloroform, chloroacetic acid, thiophene-2-carboxaldehyde, p-chloro isothiocyanate, pyridin-2-amine, 5-chloropyridin-2-amine, 6-methylpyridin-2-amine, silica gel 60 (0.063-0.200 mm), and sea sand. All reagents were used as purchased from the manufacturer. Dichloromethane, chloroform, and n-hexane were used after purification for column chromatography. TLC was carried out on aluminum sheets pre-coated with silica gel 60 F254 purchased from Merck, and the spots were visualized with UV light (254/366 nm) using a Camag UV lamp.

NMR (1H and 13C) spectra were saved on a Bruker 500 MHz NMR spectrometer at Yildiz Technical University CDCl3 was used as a solvent. FTIR spectra were recorded on a Philips PU 9714 ATR spectrometer using a Perkin-Elmer Spectrum One program at Yildiz Technical University, Instrumental Analysis Laboratory. Melting points were obtained with a Gallenkamp Melting Point Apparatus in open capillaries with no correction.

2.1 Preparation of Thiourea (1-3)

A mixture of the appropriate amine (1 mmol) and p-chloro isothiocyanate (2.4 mmol) was stirred in CH2Cl2 at room temperature for 24 hours. The crude product was concentrated under vacuum and recrystallized from ethanol. General synthesis of thioureas is summarized in Figure 1.

![Figure 1. Synthesis of thiourea derivatives.](image-url)
2.2 Preparation of Pyridinyl Substituted Iminothiazolidin-4-one Derivatives (4-6)

To synthesize pyridinyl substituted iminothiazolidin-4-one compounds, the appropriate thiourea (1 mmol), chloroacetic acid (2.4 mmol) and thiophene-2-carbaldehyde (2 mmol) were stirred at room temperature for 4 hours and then heated at 70 °C for 6 hours. The product was purified by column chromatography. General synthesis of these compounds is summarized in Figure 2.

3. RESULTS AND DISCUSSION

Thioureas and iminothiazolidin-4-one derivatives were obtained from the present study. The structures and purities of these compounds were elucidated based on the analysis of their physical and spectroscopic data.

1-(4-Chlorophenyl)-3-pyridin-2-ylthiourea (1)[16]: White crystal, m.p. 195-6 °C; FTIR (near)\(\gamma_{\text{max}}/\text{cm}^{-1}\): 3210, 3168, 3075, 3031, 1599, 1531, 1346, 1143, 829.

1-(4-Chlorophenyl)-3-(6-methylpyridin-2-yl)thiourea (2)[17]: White powder, m.p. 202-3 °C; FTIR (near)\(\gamma_{\text{max}}/\text{cm}^{-1}\): 3195, 3183, 3109, 3044, 2778, 1622, 1586, 1537, 1345, 1152, 852, 826.

1-(4-Chlorophenyl)-3-(5-chloropyridin-2-yl)thiourea (3)[18]: White powder, m.p. 207-8 °C; FTIR (near)\(\gamma_{\text{max}}/\text{cm}^{-1}\): 3209, 3154, 3086, 3027, 1619, 1596, 1524, 1348, 1179, 827.
3-(4-Chlorophenyl)-2-(pyridin-2-ylimino)-5-(thiophen-2-ylmethylidene)-1,3-thiazolidin-4-one (4): C_{19}H_{12}ClN_{3}O_{2}, yellow crystal, m.p. 238-9 °C; FTIR (near)γmax/ cm⁻¹: 3060, 1699, 1605, 1570, 1460, 1365, 1197, 890, 785; ¹H NMR (500 MHz, CDCl₃): δ (ppm) 7.06 (d, J=7.7 Hz, 1H), 7.07 (d, J=7.7 Hz, 1H), 7.20 (dd, J=5.1; 3.8 Hz, 1H), 7.40 (d, J=8.3 Hz, 2H), 7.44 (d, J=3.7 Hz, 1H), 7.54 (d, J=8.3 Hz, 2H), 7.60 (d, J=5.1 Hz, 1H), 7.64 (t, J=7.7 Hz, 1H), 8.02 (s, 1H), 8.50 (s, 1H); ¹³C NMR (100 MHz, CDCl₃): δ (ppm) 112.70, 118.60, 120.47, 121.69, 121.81, 126.26, 128.99, 129.46, 129.83, 131.76, 132.92, 137.24, 139.37, 139.41, 145.77, 145.85, 153.16; MS (m/z): 399(M+2), 398(M+1), 397 (M+), 230, 140, 96, 78.

3-(4-Chlorophenyl)-2-[(6-methylpyridin-2-yl)imino]-5-(thiophen-2-ylmethylidene)-1,3-thiazolidin-4-one (5): C_{20}H_{14}ClN_{3}O_{2}, yellow crystal, m.p. 247-8 °C; FTIR (near)γmax/ cm⁻¹: 3062, 2917, 1696, 1601, 1585, 1544, 1492, 1364, 1234, 1176, 1156, 851, 804, 772; ¹H NMR (500 MHz, CDCl₃): δ (ppm) 2.66 (s, 3H), 6.89 (d, J= 7.1 Hz, 1H), 6.93 (d, J= 6.9 Hz, 1H), 7.14 (dd, J = 5.0, 3.7 Hz, 1H), 7.34 (d, J= 8.0 Hz, 2H), 7.39 (d, J= 3.7 Hz, 1H), 7.50 (d, J= 8.1 Hz, 2H), 7.55 (d, J= 7.2 Hz, 1H), 7.67 (d, J= 3.7 Hz, 1H), 8.00 (s, 1H); ¹³C NMR (100 MHz, CDCl₃): δ (ppm) 23.74, 118.45, 119.75, 122.42, 125.16, 128.38, 129.32, 129.69, 131.23, 132.84, 133.90, 138.27, 138.54, 156.04, 156.44, 160.03; MS (m/z): 413(M+2), 412(M+1), 411 (M+), 244, 140, 96, 72, 65.

3-(4-Chlorophenyl)-2-[(5-chloropyridin-2-yl)imino]-5-(thiophen-2-ylmethylidene)-1,3-thiazolidin-4-one (6): C_{19}H_{11}Cl_{2}N_{3}O_{2}, yellow crystal, m.p. 288-9 °C; FTIR (near)γmax/ cm⁻¹: 3076, 1704, 1583, 1563, 1542, 1456, 1368, 1162, 862, 830, 782; ¹H NMR (500 MHz, CDCl₃): δ (ppm) 7.04 (d, J= 4.2 Hz, 1H), 7.22 (dd, J= 5.1, 3.7 Hz, 1H), 7.37 (d, J= 8.6 Hz, 2H), 7.46 (d, J= 3.7 Hz, 1H), 7.51 (d, J= 8.6 Hz, 2H), 7.64 (dd, J= 8.5, 2.6 Hz, 1H), 7.67 (d, J= 5.1 Hz, 1H), 8.03 (s, 1H), 8.51 (d, J= 2.5 Hz, 1H); ¹³C NMR (100 MHz, CDCl₃): δ (ppm) 120.79, 122.70, 125.69, 128.02, 128.98, 129.02, 129.49, 129.92, 131.48, 132.95, 135.60, 137.97, 138.22, 145.40, 154.51, 156.30, 166.50; MS (m/z): 433(M+2), 432(M+1), 431 (M+), 262, 140, 112, 96, 76.

4. CONCLUSIONS

In conclusion, this study reports an appropriate and reliable synthesis of pyridinyl substituted iminothiazolidinones (4 - 6) starting from previously prepared thioureas (1 - 3), chloroacetic acid and thiophene-2-carbaldehyde via one-pot synthesis.

Acknowledgements

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REFERENCES


PART-OF-SPEECH TAGGING AND STEMMING TOOLS FOR ALBANIAN LANGUAGE: A STATE-OF-THE-ART SURVEY

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Abstract:

Over the last decade, language preprocessing tools as part-of-speech tagger, morphological analyzer, stemmer, and lemmatizer have become very popular Natural Language Processing (NLP) approaches. These tools are widely used in researches to preprocess text documents. Referring to different researches, preprocessing the text before used in different NLP approaches as in information retrieval, content and document categorization, sentiment analysis, etc. increase the performance of these systems. In this paper, we present a review of recent research on preprocessing tools for the Albanian language. This is archived by reviewing all the articles published in the last years. The articles are classified based on a scheme that consists of two main topics: part-of-speech tagger and stemming tools. There are insignificant works done to implement these tools for the Albanian language. And as a conclusion of our work and to our knowledge there is not an official published preprocessing tool for the Albanian language. Our future work will be to develop a preprocessing tool (a part-of-speech tagger and a lemmatizer) for the Albanian language.

Keywords: Part-of-speech tagger, POS tagger, Lemmatize, Stemming, Albanian language

General area of research: Engineering Applications, Artificial Intelligence, Natural Language Processing

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1. INTRODUCTION

The Albanian language is an independent branch of the Indo-European language family. It is the official language in Albania and Kosovo, and the official regional language in North Macedonia and Ulcinj, Montenegro. Also, it is spoken in some areas in southern Italy, Sicily, Greece, Romania, and Serbia, and by Albanian communities all over the world. Since the Albanian language is officially spoken in small and developing countries, there are few researches to develop Natural Language Processing (NLP) tools. Some researchers have worked to create part-of-speech taggers and stemmers, but to our knowledge, no one of these tools is available for use. Another problem is the non-existence of the high-quality public annotated corpora in the Albanian language to be used for NLP purposes.
This paper presents a review of researches which present preprocessing tools like part-of-speech tagger, and stemmer for the Albanian language. All the papers related to this topic were extracted from searches made on three major research databases for computer science: IEEE Xplore, Google Scholar, and CiteSeerX using the keywords: Albanian morphological tagger, Albanian part-of-speech tagger, Albanian lemmatizer, and Albanian stemmer. From the search, we extracted a total of 19 papers. Also, we present a short review of these preprocessing tools for English. The structure of the paper is as follows: Section 2 presents the review of the part-of-speech tagging and stemming methods; Section 3 presents the literature review for the part-of-speech tools of Albanian; Section 4 presents the literature review of the stemming tools for Albanian, and in Section 5 we conclude our work.

2. POS TAGGING AND STEMMING METHODS

Part-of-speech (POS) tagging, stemming and lemmatization are linguistic procedures performed in computational linguistic throw a wide range of algorithms. The aim of a POS tagger is to define for each word in a sentence a morphosyntactic class based in lexical and contextual information. The aim of stemmer and lemmatizer is to transform a word in a sentence by removing affixes into its root (stem) and lemma respectively. In NLP these tools have an important role in preprocessing natural language text documents. These tools can be rule-based or statistical. The rule-based algorithms are developed based on a set of language-dependent morphological rules. The language dependency is one of the most important disadvantages of these algorithms which has led the researchers to focus on developing statistical techniques. Statistical techniques eliminate the language dependency problem and can be used for different languages. These algorithms use supervised or unsupervised statistical techniques to assign the tag to a word in a sentence or to remove the affixes of a word to generate its root or lemma. The most important disadvantage of supervised techniques is the need for having annotated corpora. The creation of an annotated corpus is time-consuming and requires specialized persons to do it. The performance of these tools varies greatly from the languages it is used. More complex languages require powerful techniques to have good performance in POS tagging, stemming, and lemmatization.

One of the first and most widely used part-of-speech tagger for English is the E. Brill's tagger [1] introduced in 1992. This is a simple rule-based tagger that assigns to each word the respective tag based on the Penn Treebank tagset. This method requires a reduced store space, and the identification of the errors is easy. One disadvantage is that the tagging process is slow.

The TnT tagger [2] is a supervised POS tagging technique. It is an implementation of the Viterbi algorithm for the second order Hidden Markov Model (HMM) model. HMM model and Viterbi algorithm are statistic approaches, which when are used to POS tagging assign the most probable tag to a word. This model combines the lexical and contextual model to increase the tagging accuracy. A tagged corpus is used to learn from and to generate the most probable tag to be assigned to a word. TnT tagger is implemented by the authors in two language models, English, and German in three different corpora with the accuracy of 96.7%.

Stanford Log-linear POS Tagger [3] is a maximum entropy-based part-of-speech tagger implemented in Java programming. Throw years it is improved and implemented in different languages. This model enhances the performance of tagging by enriching the information sources...
used to tag. On the Penn Treebank, the overall accuracy of this tagger is 96.86% and 86.91% for unseen words.

In 1968, Lovins developed the first context-sensitive, longest-match stemming algorithm for English. It is a rule-based algorithm with two phases: elimination of the ends and treatment of the remaining stem. In the first phase is removed the longest matched ending of the word from a predefined list of 294 endings. Each of these endings is linked to one of the 29 context-sensitive conditions of the algorithm. Then in the second phase, the stem is treading to solve some linguistic exceptions like double consonants or irregular plurals utilizing one of the 35 transformation rules. This stemmer is very fast but too many rules needed to be implemented for each ending. The algorithm can have a high number of errors due to a limited number of predefined endings [4].

The Dawson’s stemmer [5] is an extension and improvement of the Lovin’s stemmer based on two modifications. The endings list is extended to a list of 1200 endings and in addition is utilized the partial matching technique that matches stems that are equal within certain limits, instead of the recording technique used by Lovin that use several transformations based on the letters of a stem. Due to a large number of endings used, the algorithm requires more time and storage to be executed.

One of the most used stemming algorithms in Information Retrieval is Porter’s stemmer [6]. This stemmer presents a simple technique to conflation. In the 1980s this algorithm was developed to stem text in the English language but later in the 1990s, it results in an interesting method for text preprocessing in different languages like German, French, Russian, etc. The rule-based Porter’s algorithm is implemented in five steps, has around sixty suffixes, two rules responsible for recording and one context-sensitive rule to decide if a suffix should be removed or not. The performance of the algorithm in terms of computation complexity is high. Then in 2001, Porter created the Snowball framework [7] which includes an improved version of the algorithm for English and a series of algorithms for other languages as German, French, Russian, etc.

The N-gram stemming algorithm is the first language-independent stemming algorithm developed by Mayfield and McNamee in 2013 [8]. The experimental results of using this proposed model in different languages demonstrate that the selection of a single n-gram as a stem of a word is effective.

The latest researches are focused on developing and implementing neural network models for parsing, POS tagging, stemming and lemmatization. In the framework of the different shared tasks, there are implemented and evaluated a large set of parsing tools. Analyzing these tools is not in our focus because we are focused to analyze in detail the implementation of these tools for the Albanian language.

3. LITERATURE REVIEW: PART-OF-SPEECH TAGGERS FOR THE ALBANIAN LANGUAGE

The Albanian language is a difficult language with complex grammar, and morphological tagging is particularly challenging. In this section, we present and analyze the attempts of researchers to
develop grammatical tagging tools for the Albanian Language. Table 1 shows all the selected papers for this review.

The authors in [9] present a morphological tagger for standard Albanian language that covers the main inflection types of the language. This analyzer uses verb inflector described by Trommer in his M.A. thesis to generate sub-regular and irregular word forms and simple morphological rules for inflection open-class patterns. The architecture of the tagger is composed of a tokenizer and a simple morphological analyzer. The tokenizer is a script implemented in Python. The morphological analyzer has three components, an operative lexicon, a set of morphological rules and a rule interpreter. There are 340 morphological rules that indicate the relation between input lexicon and output derived forms. A rule is a quintuple of the form <left_context, remove, add; lexicon_category; tag >, where left_context and remove are regular expressions, and add, lexicon_category and tag are strings. The rule interpreter uses these rules to deduce possible lexical entries for a given word form. The tags of this analyzer consist of sets of attribute-value pairs conform to EAGLE guidelines standard adapted to the description of the Albanian language. The tag set contains 17 labels: v, n, a, part, prsp, reflp, demp, posp, indp, relp, intp, pa, adv, prep, ptl, conj, seq. The morphological analyzer is evaluated in terms of accuracy in two corpora, the first one contains text from a novel, and the second contains news articles, each of them has 500 tokens (words). The precision per token is 97% - 98%, and the recall is 94%-95%. The precision per word types is 96% - 97%, and the recall is 92%-93%.

In paper [10] and [11], the authors present an electronic dictionary using Finite State Transducers with NooJ’s graphs to automatic process text in the Albanian language. They analyze the word, and not the text giving a special focus to agglutinated, mixed or ‘XY’ words that are not part of the dictionaries. To build the flexed forms dictionary is used the Albanian-French dictionary that contains 4951 words. In the paper is not specified the number of used tags, but from the theoretical part of the Albanian language included in the paper, we can conclude that they have used tags like noun, verb (active and non-active), adjective, preposition, adverbs, interjection, cardinal and ordinal numbers. Also, it is taken into consideration the words preceded by a particle, XY words with numbers, XY words created with affixes, XY words created by simple concatenation, and X-Y words created with a hyphen. The authors have not evaluated through experiment their proposed system, and you cannot tell anything about its performance.

The publications [12] and [13] are master theses which present statistical part-of-speech tagging models for Albanian language using the OpenNLP tool. In [12] the authors have used two types of tagset, a basic one and a large one that contains additional features of the basic tagset. The experimental evaluation indicates that this model performs better in the small tagset reaching an accuracy of 70%. In [13] the authors have trained and evaluated two models, a Maxent model, and a Perceptron model. They have used and compare the performance of the models for three tagsets, a small tagset with 100 tags, a medium tagset with 150 tags, and a large tagset with 220 tags. The corpus contains 10000 words collected from different resources. The average accuracy of the two models is nearly 60%. The proposed POS taggers are statistical models, and their performance depends on the level of morphological and grammatical complexity of the sentences and the number of tokens in the corpus used for training and testing. So, we cannot determine if they are or not good models. The models and the corpora are not published online.
The Saint-Petersburg linguists' team has created the Albanian National Corpus using the morphological parsing tool, UniParser. In paper [14] the authors present this morphological analysis tool. UniParser is used to create annotated corpora in different languages like Albanian, Kalmyk, Lezgian, Ossetic, Greek, and Buryat. In the paper, the general architecture of the system is described taking into consideration the creation of Ossetic model. There is no information about the Albanian model and its performance. Papers [15-20] explain the annotation process of the Albanian corpus. This corpus contains text extracted from fiction — short stories, novels, plays; non-fiction — memoirs, essays, journalism, official, religious and scientific texts and include about 16.6 million tokens. To each token is assigned the lemma, grammatical features of the lexeme, grammatical features of the word form and the equivalent in English. The tagset contains in total 62 tags including the standard tags: noun, adjective, numeral, adjective numeral,
Table 1: List of articles

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<td>2004</td>
<td>Morphological tagger</td>
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<td>13</td>
<td>2012</td>
<td>POS tagger</td>
<td>Novels, newspapers, academic books</td>
<td>10000</td>
<td>60%</td>
<td>100, 150, 200 tags</td>
<td>No, No</td>
</tr>
<tr>
<td>14 – 20</td>
<td>2011 – 2015</td>
<td>POS tagger and Lemmetazer</td>
<td>Book and journal article</td>
<td>16.6 milion</td>
<td>—</td>
<td>62 tags</td>
<td>No, Yes, but cannot downloaded</td>
</tr>
<tr>
<td>21</td>
<td>2013</td>
<td>POS tagger and Lemmetazer</td>
<td>No training corpus, but they use a dictionary and rules. Test corpus: 30 articles.</td>
<td>Dictionary with 32000 words</td>
<td>After the first tagging process: 80% - 88%, after the second tagging process: 88%- 93%</td>
<td>22 tags</td>
<td>No, No</td>
</tr>
<tr>
<td>22</td>
<td>2018</td>
<td>Lemmatizer and morphological analyzer</td>
<td>Wikipedia</td>
<td>589 lemmas and 33483 words form</td>
<td>—</td>
<td>Unimorp Schema</td>
<td>Yes, Yes</td>
</tr>
<tr>
<td>23 – 24</td>
<td>2018, 2016</td>
<td>POS tagger</td>
<td>2020 sentences</td>
<td>31584</td>
<td>85.96% -95.10%</td>
<td>79 tags</td>
<td>No, No</td>
</tr>
<tr>
<td>28</td>
<td>2012</td>
<td>Rule-based Stemmer</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>No, No</td>
</tr>
<tr>
<td>29</td>
<td>2014</td>
<td>Rule-based Stemmer</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>No, No</td>
</tr>
</tbody>
</table>
verb, adverb, pronominal clitic, preposition, conjunction, particle, preverb, prepositional article, interjection, pronoun and tags about gender, animacy, number, case, definiteness, article position, transitivity, voice, verbal representation, mood, tense, person and pronominal clitics. The morphological tagging in the corpus is done automatically by using the morphological analyzer UniParser. Based on four existing Albanian dictionaries, the authors have manually compiled all the information about lexemes and inflectional paradigms as a grammatical wordlist in files. The parser assigns separately each token of the processed text with a tag considering the information in these files. This process does not consider the syntactic context of the word form when determining the grammatical features of it. The Albanian model of the parser is not published online. The corpus is available online for different kinds of linguistic research, but it cannot be downloaded.

The author in paper [21] presents a model for a morphological tag of text in Albanian language using the NLTK toolkit. The proposed model is an unsupervised method that uses a dictionary with around 32000 words with the corresponding POS tags of the words and a set of regular expressions rules to assign POS tags to a new text. The tagger’s architecture has 6 phases. The first phase, the tokenizer, tokenizes the sentences and then tokenizes the sentences and then tokenizes the words. Then the lemmatizer converts only nouns and verbs into their lemma. This lemmatizer is based on rules to remove or replace suffixes of the words. After that, start the tagging process using the NLTK option for cascading taggers with backoff. Initially, the text is tagged using a Unigram tagger based on the dictionary. This tagger is used as a baseline tagger for the next step, the regular expression tagger. The dictionary is extended to recognize cardinal numbers, punctuations and counties e towns. The regular expression tagger determines the correct tag to a token by using a series of regular expressions and affixes. After defining the pattern used to outline the RegexpTagger, the text is tagged with backoff-UnigrammTagger as a baseline. If there is a word that is not in the dictionary or cannot generated by the regular expression pattern, it is tagged with tag None. Then the lemma inverse module turns those words to their initial form. A new dictionary is generated, which is used as a model for the second lookup tagger – UnigrammTagger2. This tagger has the RegexpTagger as backoff. So, the text is retagged with UnigrammTagger2, which has as a baseline the RegexpTagger, which again is based on the first, lookup tagger. The tagset used by the author contains 22 tags. The model is evaluated through experiments using as test a set of 30 random opinions, economic, and culture articles. After the first tagging process, the accuracy of the model is 80% - 88%, and after the second step, the accuracy is improved to 88% - 93%. There are some of the untagged words as the words non-found in the dictionary, the irregular verbs, nouns, and adjectives. A solution to this problem may be the definition of hashes for all irregular words that have high/medium probability to occur in documents. The model of the part-of-speech tagger and the corpus are not available online.

A small annotated morphological corpus of Albanian inflected words is created under the UniMorph project. The corpus is annotated conforming the UniMorph schema where each inflected word is represented by its lemma and a set of UniMorph features representing its morphological structure. This corpus contains 589 lemmas and 33483 words forms in total [22]. This corpus is used in different CoNLL-SIGMORPHON 2017 shared task to train and test models for morphological analysis. All the models and other research information are described in different papers published by the research group. The trained models and the annotated corpus can be downloaded from the web page of the project.
In paper [23], the authors present a corpus in Albanian language annotated with part-of-speech tags. The corpus is used to train and test six statistical POS taggers. This is an extended version of the corpus presented by the same authors in [24]. The corpus contains 2020 sentences, 31584 tokens, and is manually annotated by two native Albanian speakers trained for this purpose. The sentences in the corpus are selected to have as much as possible diversity of linguistic phenomena. They have used three tag sets, one full tag set specified by the authors and the corresponding mapping tag set to Google UPOS and Universal Dependencies UPOS. The full tagset has in total 79 tags divided into 16 main tags classes: noun (4 tags), verbs (14 tags), adjective (5 tags), adverb (3 tags), pronouns (14 tags), preposition (1 tag), conjunction (6 tags), number (2 tags), particle (19 tags), interjection (1 tag), article (1 tag), pronominal (3 tags), abbreviation (2 tags), punctuation (2 tags), 1 tag for the non-linguistic element and 1 tag for emoticon. The authors do not include any tag for the number, gender, definiteness, and case for the name. But they have taken into consideration and implemented tags for different words that are preceded by an article. The accuracy of the five taggers: HMM-based HunPos tagger, OpenNLP tagger, TreeTagger, SoMeWeTa tagger, and Stanford POS Tagger is evaluated in five scenarios combining the three tagset in training and testing phase. The models' accuracy varies from 85.96% to 95.10%. The best tagger is SoMeWeTa that achieves the best accuracy of 95.10% using in training and testing the Google UPOS and 91.00% using in training and testing the full tagset. But unfortunately, the five trained taggers models and the annotated corpus are not yet available online.

We can conclude that there is no reliable and useful morphological tagging tool for the Albanian language. Most of the developed systems are not available online or cannot be downloaded to be used for NLP purposes.

4. LITERATURE REVIEW: STEMMERS FOR THE ALBANIAN LANGUAGE

The Albanian language has complicated inflectional paradigms, which make the development of stemming and lemmatization tools difficult. There are some attempts to develop rule-based stemming tools which we will discuss in detail below.

From our search, we can determine that Karanikolas in paper [25] presents the first stemming algorithm for the Albanian language. The author has developed a rule-based stemming algorithm based on the principle of the longest-match suffix removal. He defined a list of suffixes and a list of 470 stopwords based on five Albanian grammatical books. The proposed algorithm finds the root of a word in three steps. The first step removes the longest suffix that matches the ending of the word. Then the generated word is used in the second step to remove another matched longest suffix. And the final step keeps only the first of a sequence of multiple ending consonants from the word generated by the second step. The evaluation of the algorithm was done manually using a small text corpus. The author collected 15 text documents in Albanian languages. The volume of the text documents was reduced by applying on it the stopword removal and removing the double occurrence of a word. The final corpus used to generate the stems using the implemented algorithm contains only 5000 words. Then 500 words are randomly selected to evaluate the performance of the algorithms by two experts. The experts have used a translator to define if the stem is correctly generated or not. The results show an accuracy of 80%. The evaluators indicate that there are uncovered rules for finding the root of the words in Albanian. It is important to emphasize that the author and the evaluators are not native Albanian speakers. In papers [26] and
[27] the author has described in detail the data model, the ranking model, and the algorithm of the stemmer.

In paper [28] is presented the first stemming algorithm for the Albanian language developed by native speakers. JStem algorithm is a rule-based stemming algorithm implemented using Java Programming. The proposed stemmer is based on the word formation with affixes. The algorithm has a sequence of 5 steps, each consisting of a set of rules. In total, the algorithm contains 134 rules that remove the suffixes and prefixes of a word to generate its root and a stopwords list. Each step contains a set of rules implemented as if-else conditions. In a step, only one of the conditions can be executed. The algorithm removes the first longest possible suffixes and prefixes matched. The rule is not applied if the resulting root is shorter than 2 characters. The suffix removal rules are checked twice only in some special cases. There are not included rules for plural formation, feminine, masculine, and neutral gender formation. The algorithm is used to preprocess text used in topic document classification. The experimental evaluation indicates that the use of this algorithm to preprocess the text improves the accuracy of the classification algorithms. The accuracy of the algorithm is not evaluated.

The Albanian language has a high number of composite words. The rule-based stemmer mentioned above does not include rules to find the roots of composite words. In paper [29], the authors present a rule-based stemming algorithm to find the roots of composite words. It is an extension of the JStem algorithm presented in [28]. The algorithm contains a set of rules that are generated by analyzing the morphology structure of composite words in the Albanian language. It is implemented in Java Programming. Each of the rules is composed by a set of if conditions based on the way a composite word is formed. Based on the way the composite word is created in the Albanian language, the algorithm contains rules for six composite word groups. These are composite words formed by two words linked by a separating dash, with prefixes, with numerals, by productive nouns associated with verbs or adjectives, with international prefixes and formed randomly by associating two different words. Firstly, the algorithm splits the composite word and then use the rules in the stemming algorithm in [28] to find the root of the word.

5. CONCLUSION AND FUTURE WORK

In this paper, we present a review of recent researches on preprocessing tools like part-of-speech tagger, and stemmer for the Albanian language. In languages like English, Italian, German, Greek, etc., there are different opensource and well-developed preprocessing tools. The actual situation in the Albanian language is not promising. There are some attempts to develop preprocessing tools for this language, but there is not an official preprocessing tool ready to be used. Also, there is a lack of resources, as annotated corpora in this language. These tools have an important role in NLP, and for the Albanian language, an urgent need is to develop preprocessing tools. As future work, we plan to develop and implement a statistical part-of-speech tagger and lemmatizer for the Albanian language. Based on the latest researches, we will focus on implementing a neural model for this approach. This will be a challenge for us because firstly, we will need to create an annotated corpus and then develop and implement the model.
REFERENCES


PERFORMANCE ANALYSIS OF FILTER BASED FEATURE SELECTION METHODS ON DIAGNOSIS OF BREAST CANCER AND ORTHOPEDICS

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Abstract:

Developing technology makes great contributions to human life on different domains in the title of artificial intelligence or machine learning. One of these domains is human health. In this study, it was aimed to help doctors by designing models using classifier algorithms on 2 datasets named Vertebral Column and Breast Cancer. In order to evaluate the performance analysis of filter based feature selection on model performance metrics, 3 different filter based feature selection methods (correlation based, information gain and ReliefF) were applied on datasets and 2 different classification algorithms (C4.5 and Random forest) were applied on the datasets with selected features. For comparing the performances of the models, the Mean Absolute Error (MAE), Root Mean Square Error (RMSE) and Kappa values were taken into consideration as well as Accuracy, Precision, Sensitivity and F-measure criteria obtained from the confusion matrix. The obtained results show that the correlation based feature selection method is more successful than other methods in reducing the number of features.

Keywords: Feature selection, filter-based, breast cancer, vertebral column

General area of research: Computer

ICFAS2019-ID: 1038

1- INTRODUCTION

With the development of technology, its contribution to many areas, especially human health, has increased so much. Artificial Intelligence which is one of the results of this technology development, gives the scientist ability to deploy intelligence to machines such as people. Efficient use of technology in the field of health, from physicians to assistant health personnel, is very important in terms of patient health. In this study, it is aimed to determine the best model to help health workers by using models based on classifying algorithms on spine and breast cancer datasets with applying different feature selection methods. C4.5 and Random forest are used as classification algorithms. The model performances are evaluated by applying feature selection algorithms to the models to be prepared for the stated purpose. In this study, 3 different filter based feature selection algorithms are applied to 2 different datasets separately. These methods include the correlation-based feature selection algorithm (CFS), the Information gain algorithm, and the
reliefF feature selection algorithm. In the study, models are designed with classification algorithms before and after the feature selection processes and the results are evaluated. While determining the most successful classifying model, the mean absolute error (MAE), root mean squares error (RMSE) and Kappa values are taken into consideration as well as accuracy, precision sensitivity, and f measure criteria obtained from the confusion matrix.

In this study, hybrid models are designed by classification algorithms after filter based feature selection by using data of patients with vertebral column and breast cancer disease. The data set of the vertebral column [1] and breast cancer [2] was taken from the UCI machine learning data warehouse. Information about the datasets used in the study is described in the second chapter. In the third section under the method, data pre-processing, feature selection methods and classifier algorithms used in the study are mentioned. Performance metrics and experimental results are given in fourth section with tables and graphics. And the results are summarized and evaluated at the fifth section in the name of conclusions.

2- MATERIAL AND METHOD

2.1 Data Sets

The datasets used in the study are taken from the UCI machine learning data repository. Table 1 shows the breast cancer dataset’s features and data types. Table 2 shows the vertebral column dataset’s features and data types.

<table>
<thead>
<tr>
<th>No</th>
<th>Feature</th>
<th>Data Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Age</td>
<td>Numerical</td>
</tr>
<tr>
<td>2</td>
<td>BMI</td>
<td>Numerical</td>
</tr>
<tr>
<td>3</td>
<td>Glucose</td>
<td>Numerical</td>
</tr>
<tr>
<td>4</td>
<td>Insulin</td>
<td>Numerical</td>
</tr>
<tr>
<td>5</td>
<td>HOMA</td>
<td>Numerical</td>
</tr>
<tr>
<td>6</td>
<td>Leptin</td>
<td>Numerical</td>
</tr>
<tr>
<td>7</td>
<td>Adiponectin</td>
<td>Numerical</td>
</tr>
<tr>
<td>8</td>
<td>Resistin</td>
<td>Numerical</td>
</tr>
<tr>
<td>9</td>
<td>MCP-1</td>
<td>Numerical</td>
</tr>
<tr>
<td>10</td>
<td>Class</td>
<td>Categorical</td>
</tr>
</tbody>
</table>

The breast cancer dataset in Table 1 contains 10 features and 116 instances. Clinical features have been observed or measured for 64 patients with breast cancer and 52 healthy controls. There are 10 predictors, all quantitative, and a binary dependent variable, indicating the presence or absence of breast cancer. The predictors are anthropometric data and parameters which can be gathered in routine blood analysis. Prediction models based on these predictors, if accurate, can potentially be used as a biomarker of breast cancer. [1].
Table 2: Vertebral Column Dataset features and data types

<table>
<thead>
<tr>
<th>No</th>
<th>Feature</th>
<th>Data Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pelvic incidence</td>
<td>Numerical</td>
</tr>
<tr>
<td>2</td>
<td>Pelvic tilt</td>
<td>Numerical</td>
</tr>
<tr>
<td>3</td>
<td>Lumbar lordosis angle</td>
<td>Numerical</td>
</tr>
<tr>
<td>4</td>
<td>Sacral slope</td>
<td>Numerical</td>
</tr>
<tr>
<td>5</td>
<td>Pelvic radius</td>
<td>Numerical</td>
</tr>
<tr>
<td>6</td>
<td>Degree spondylolisthesis</td>
<td>Numerical</td>
</tr>
<tr>
<td>7</td>
<td>Class</td>
<td>Categorical</td>
</tr>
</tbody>
</table>

The breast cancer dataset in Table 2 contains 7 features and 310 instances. Dataset is containing values for six biomechanical features used to classify orthopaedic patients into 3 classes (normal, disk hernia or spondylolisthesis) or 2 classes (normal or abnormal). There are total of 310 patients with vertebral disease. 100 of 310 are non-voluntary survivors, 60 patients have Disk Hernia and 150 patients have Spondylolisthesis. In this study, the target classes were evaluated as normal abnormally in 2 groups [2].

2.2 Data Pre-processing

2.2.1. Z-Score Normalization

Any value of the z-score normalization variable is normalized by the known Z-transformation, depending on the mean and standard deviation of the variable. The equation required to implement this normalization method is shown in Equation (1) [3].

\[ x'_i = \frac{x_i - \mu}{\sigma} \] (1)

2.3. Feature Selection

Feature selection is a process to improve the performance in data mining methods. These processes are the determination of the relevant qualifications that have an impact on the analysis results and the elimination of irrelevant features that has no impact on the results through the dataset. Feature selection algorithms are filter based, spiral and embedded. By using statistical assumptions in filter based feature selection algorithms, the performance of the models to be established is tried to be increased. Filter based selection algorithms are independent of other feature selection algorithms and are independent of classifying algorithms. This has positive affect on the classification algorithms performance. Filter based feature selection algorithms include information gain [4], Correlation based [5], mutual information [6], Chi-square [7] and ReliefF [8]. In this study, we have used information gain, correlation based and relieff feature selection algorithms.
2.3.1. Correlation Based Feature Selection

Correlation based feature selection (CFS) is based on the correlation that shows the linear relationship between two random variables. The existence and degree of the linear relationship is calculated by the correlation coefficient called R. R is from -1 to +1.

- If R = -1, there is a completely negative linear relationship,
- If R = +1, there is a completely positive linear relationship.
- If R = 0, there is no relationship.

2.3.2. Information Gain

The information gain (IG) algorithm tends to choose variables with different values, despite the poor performance. To overcome the problems in this case, the Gain Ratio is used. Equations of the calculations are presented in Eq. (2) and Eq. (3) [5].

\[ \text{SplitInfo}_A(D) = \sum_{j=1}^{v} \frac{D_j}{|D|} \times \log_2 \left( \frac{|D_j|}{D} \right) \]  

(2)

\[ \text{GainRatio}(A) = \frac{\text{Gain}(A)}{\text{SplitInfo}(A)} \]  

(3)

2.3.3. ReliefF

ReliefF is an improved version of the Relief algorithm. This algorithm selects a model by taking a sample from the dataset and creates a model based on its proximity to the samples in its class and its distance from different classes [8].

Kononenko notes that RELIEF attempts to approximate the following difference of probabilities for the weight of an feature X [9].

\[ W_X = P(\text{different value of } X | \text{nearest instance of different class}) \]

\[ - P(\text{different value of } X | \text{nearest instance of different class}). \]  

(4)

By removing the context sensitivity provided by the “nearest instance” condition, features are treated as independent of one another; Equation 5 then becomes [9]

\[ \text{Relief}_X = P(\text{different value of } X | \text{different class}) - P(\text{different value of } X | \text{same class}), \]  

(5)

which can be reformulated as

\[ \text{Relief}_X = \frac{\text{Gini}' X \sum x \in X P(x)^2}{(1 - \sum c \in CP(c)^2) \sum c \in CP(c)^2}, \]  

(6)

where C is the class variable.
In the Breast Cancer Coimbra dataset, 6 features are selected from 10 features with CFS, 5 with IG and 6 with ReliefF. In the vertex column dataset, 4 features are selected with CFS, 4 with Information Gain, and 7 with ReliefF. The selected features are given in Table 3.

<table>
<thead>
<tr>
<th>Dataset Name</th>
<th>Selected Features with CFS</th>
<th>Selected Features with IG</th>
<th>Selected Features with ReliefF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast Cancer Coimbra</td>
<td>1, 5, 6, 7</td>
<td>6, 1, 3, 4, 7</td>
<td>6, 3, 2, 1, 5, 7</td>
</tr>
<tr>
<td>(10 features)</td>
<td>total 4 features</td>
<td>total 5 features</td>
<td>total 6 features</td>
</tr>
<tr>
<td>Vertebral Column</td>
<td>1, 3, 5, 10</td>
<td>3, 1, 5, 9, 10</td>
<td>1, 3, 8, 4, 5, 2, 10</td>
</tr>
<tr>
<td>(7 features)</td>
<td>total 4 features</td>
<td>total 5 features</td>
<td>total 7 features</td>
</tr>
</tbody>
</table>

### 2.4. Classification Algorithms

In order to increase classification performance in spine and breast cancer datasets, the feature selection processes are performed first. Then C4.5 and random forest decision tree algorithms are used for comparing the classification performances. These classification algorithms are detailed below.

#### 2.4.1. C4.5 Decision Tree classifier

The C4.5 Decision Tree algorithm was developed by Ross Quinlan [10]. Information gain and entropy is calculated in the Decision Tree. It is the most widely used machine learning classification algorithm [11].

#### 2.4.2. Random Forest classifier

Developed by Leo Breiman. A single decision was developed to combine the decisions of multivariate decision trees trained with different sets of education instead of producing a single set of training trees. In this algorithm, random property and boot selection are used when creating different training clusters [12].

### 3- EXPERIMENTAL RESULTS

#### 3.1. Performance Metrics

Accuracy, sensitivity, F-measure and precision metrics obtained from confusion matrix are used in evaluating the classifier models performances and shown in following equations from 7 to 10 [13]. Confusion matrix values are shown in Table 4 [13-14].
Other metrics used in the evaluation of the models generated by classification algorithms are Root Mean Square Error (RMSE), Kappa, MAE(Mean Absolute Error).

**Root Mean Square Error (RMSE);**

It is a quadratic metric that measures the magnitude of the error frequently used in finding the distance between the values of a model and the actual values (Equation 11)[16].

\[
RMSE = \sqrt{\frac{\sum_{j=1}^{n} e_j^2}{n}}
\]  

(11)

**Kappa;**

The kappa coefficient is a statistical method that measures the reliability of a comparative agreement between two evaluators [17]. Cohen's kappa measure measures the mismatch between two predictors, each of which separates the N material C from the mutually exclusive category. Since it is a categorical variable, it is a non-parametric type of statistics.

**Mean Absolute Error(MAE);**

The mean absolute error is the measure of the difference between the two continuous variables. The MAE(Equation 12) is the average vertical distance between each actual value and the line that best matches the data. MAE is also the average horizontal distance between each data point and the best matching line. Estimators with negative-oriented values perform better [16].
In order to construct a model for classifying algorithms after attribute selection, data are divided into training and test sections. In this study, the education and testing distinction was made by k-fold cross validation method. The visualized charts of this methods are shown in Fig.1.

\[
MAE = \frac{1}{n} \sum_{j=1}^{n} |e_j|
\]  

3.2. The Experimental Results

In this study, 3 datasets are obtained by using CFS, Information Gain and ReliefF feature selection algorithms in vertebral column and Breast cancer datasets. Then, two classification algorithms (C4.5 Decision Tree, Random Forest) are applied to the three obtained datasets besides the raw dataset. A comparison of the results of the models created by the given algorithms is given in Figures 2 to 5 thorough the given performance criteria above.

![Fig. 1. Test and training set separation with the 5-fold cross-validation method](image)

![Fig. 2. Random Forest Classifier results on Breast Cancer Coimbra Dataset with 5-fold cross validation](image)
The performance of the Random Forest classifier algorithm on the Breast Cancer dataset is shown in Figure 2. As it is clearly seen, the results for the data set obtained by the CFS method performed better than the other datasets in all performance criteria.

### Table 5. Random Forest Classifier results on Breast Cancer Coimbra Dataset with 5-fold cross validation

<table>
<thead>
<tr>
<th>Dataset</th>
<th>RMSE</th>
<th>MAE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Data</td>
<td>0.4888</td>
<td>0.3836</td>
</tr>
<tr>
<td>CFS</td>
<td>0.4197</td>
<td>0.3319</td>
</tr>
<tr>
<td>Info Gain</td>
<td>0.4207</td>
<td>0.3371</td>
</tr>
<tr>
<td>Relieff</td>
<td>0.476</td>
<td>0.35</td>
</tr>
</tbody>
</table>

MAE and RMSE are negative-oriented and the values are low and positive for the model. As with other performance criteria, CFS performed better. As seen in Table 5, it has lower RMSE and MAE values than the others.

![C4.5 Decision Tree Classifier](image)

**Fig 3. C4.5 decision tree classifier results on Breast Cancer Coimbra Dataset with 5-fold cross validation**

The performance of the C4.5 decision tree classifier algorithm in the Breast Cancer data set is shown in Figure 3. The results in the data set obtained by the CFS method performed better than the other data sets in all performance criteria.

### Table 6. C4.5 Decision Tree Classifier results on Breast Cancer Coimbra Dataset with 5-fold cross validation

<table>
<thead>
<tr>
<th>Dataset</th>
<th>RMSE</th>
<th>MAE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Data</td>
<td>0.5329</td>
<td>0.3937</td>
</tr>
<tr>
<td>CFS</td>
<td>0.4819</td>
<td>0.3182</td>
</tr>
<tr>
<td>Info Gain</td>
<td>0.501</td>
<td>0.3537</td>
</tr>
<tr>
<td>Relieff</td>
<td>0.4864</td>
<td>0.3883</td>
</tr>
</tbody>
</table>

As with the previous performance criteria given in Figure 4, CFS has also performed better in C4.5 decision tree classifier according to the values in Table 6 as it has lower RMSE and MAE values than the others.
The performance of the Random Forest classifier algorithm on the Vertebral Column dataset is shown in Figure 4. The results for the data set obtained by the CFS method performed better than the other data sets in all performance criteria.

<table>
<thead>
<tr>
<th>Dataset</th>
<th>RMSE</th>
<th>MAE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Data</td>
<td>0.3789</td>
<td>0.1774</td>
</tr>
<tr>
<td>CFS</td>
<td>0.281</td>
<td>0.1415</td>
</tr>
<tr>
<td>Info Gain</td>
<td>0.3211</td>
<td>0.1544</td>
</tr>
<tr>
<td>Relief</td>
<td>0.3074</td>
<td>0.1455</td>
</tr>
</tbody>
</table>

As with the previous performance criteria given in Figure 4, CFS has also performed better in Random Forest classifier according to the values in Table 7 as it has lower RMSE and MAE values than the others.
The performance of the C4.5 decision tree classifier algorithm in the Vertebral Column data set is shown in Figure 5. The results in the data set obtained by the CFS method performed better than the other data sets in all performance criteria.

<table>
<thead>
<tr>
<th>Dataset</th>
<th>RMSE</th>
<th>MAE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Data</td>
<td>0.3159</td>
<td>0.1748</td>
</tr>
<tr>
<td>CFS</td>
<td>0.2968</td>
<td>0.1339</td>
</tr>
<tr>
<td>Info Gain</td>
<td>0.3095</td>
<td>0.1654</td>
</tr>
<tr>
<td>ReliefF</td>
<td>0.308</td>
<td>0.158</td>
</tr>
</tbody>
</table>

As with the previous performance criteria given in Figure 5, CFS has also performed better in C4.5 decision tree classifier according to the values in Table 8 as it has lower RMSE and MAE values than the others..

4- CONCLUSIONS

Results of the experiments in order to evaluate the performance analysis of filter based feature selection algorithms on the results of classification algorithms with C4.5 Decision Tree and Random Forest on two datasets (Breast Cancer dataset and Vertebral Column dataset) taken from UCI machine learning repository has been presented in the study. 5-fold cross validation method has been used for dividing the dataset as training and testing.

Precision, sensitivity, F-measure, accuracy, kappa, RMSE and MAE performance criteria has been taken into consideration during the comparison of the models.

According to all the figures and tables related to the experimental results, the dataset obtained by Correlation Based Feature Selection method outperforms the other datasets (raw dataset, Information Gain and ReliefF) in all performance criteria.

When the experimental result figures and tables are examined it also seen that the performance criteria for raw dataset has the worst RMSE and MAE values. This also confirms the importance of feature selection processes before designing the model in machine learning as it has positive effect on the results.

REFERENCES

CLASSIFICATION OF R, G, AND B VALUES FROM FACE IMAGES USING WEIGHTED K-NEAREST NEIGHBOR CLASSIFIER TO PREDICT THE SKIN OR NON-SKIN

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Abstract:

In this study, it has been estimated whether there is skin or not by using RGB values obtained from the camera and weighted k-nearest neighbor (k-NN) classifier. The dataset used in the study has an unbalanced distribution and a linearly non-separable structure. This problem can also be called a big data problem. The Skin dataset was taken from the UCI machine learning repository. As the classifier, we have used the weighted k-NN method to handle this big data problem. For k value of weighted k-NN classifier, we have used as 1. To train and test the weighted k-NN classifier, 5-fold cross validation training-testing partition has been used. 100% classification accuracy has been achieved by the weighted k-NN classifier without using any feature extraction. As can be seen from the obtained results, the proposed method could be used to predict whether the image is skin or not.

Keywords: Weighted k-NN classifier, Skin or non-skin classification, RGB values

General area of research: Machine Learning, Computer Science

ICFAS2019-ID: 1041

1. INTRODUCTION

In this study, the images captured from the camera was determined to be skin or non-skin by using R, G and B components extracted from the color images. Recently, skin diagnostic methods have gained great importance. Determining the skin or non-skin is used in many areas such as face detection, facial recognition, face tracking, motion analysis, content-based image acquisition and human-computer interaction [1].

Skin determination is used in many places such as security points, airports and military areas to determine whether the person is alive or not. There are many papers related to this subject in literature. Yasar and Saritas have used artificial neural networks to detect skin from face images and achieved 99.06% success [2]. Jaisakthi and Mohanavalli obtained the 96. 68% classification performance by using the ensemble of classifiers in the detection of skin images [1].

In this presented study, the weighted k-NN classifier is used to determine whether the image obtained from the camera is skin or not.
2. MATERIAL AND METHOD

In this study, we used the Skin Segmentation dataset from UCI machine learning repository [3]. There are 245057 samples with 3 attributes in skin segmentation dataset. The attributes are R, G and B values extracted from the images captured from the camera. 50859 samples belong to the skin class and other 194198 belong to the non-skin class. The class distribution of the dataset is given in Figure 1. And class distributions are given according to R and B attributes in Figure 2. When these figures are examined, it is clearly seen that the skin segmentation data set has an unbalanced data distribution.

![Fig.1. The class distribution of Skin Segmentation dataset](image1.png)

![Fig.2. The class distribution of Skin segmentation dataset according R and B features](image2.png)
2.1. The Weighted k-NN Classifier

A schematic representation illustrating the operation of the k-nearest neighbor classifier is given in Figure 3 including 5 plus and 5 minus samples. If the data to be classified is shown as a red dot, five data closest to the red dot are selected as contents of a circle as the user has entered the k value as 5. The classes of the selected nearest points to the red point within the circle are checked. And the class of the red dot is specified by the Majority Voting method. In this example, the class of the red dot shown in the circle is determined as the class (-) \[4\].

![Fig.3. The schematic representation of k-NN classifier \[4\]](image)

In the weighted k-NN classifier, the distance between the data is based on weighting. Distance functions used in the study is given in Eq.1 below \[4\].

\[
D(x, p) = \begin{cases} 
\sqrt{(x - p)^2} & \text{Euclidean} \\
(x - p)^2 & \text{Euclidean Squared} \\
\text{Abs}(x - p) & \text{Cityblock} \\
\text{Max}\{|x - p|\} & \text{Chebyshev} 
\end{cases}
\]  

3. EXPERIMENTAL RESULTS

Weighted k-NN classifier model has been selected to classify the Skin Segmentation dataset. 5-fold cross validation is used to test the success of classifying the dataset having 3 attributes and 245057 samples. Schematic representation of 5-fold cross validation is given in Figure 4. Confusion matrix and ROC curves are used for evaluating the performance analysis of the weighted k-NN's classification model. The resulting confusion matrix values are given in Figure 5. And the ROC curve is given in Figure 6.
Fig. 4. The schematic representation of 5-fold cross validation [5]

Fig. 5. The obtained confusion matrix by the weighted k-NN classifier in the classification of skin images dataset
4. CONCLUSIONS

Skin detection is an important issue in image processing. Determining whether a person is alive or not in security cameras is an important and serious matter in terms of security. In this study, R, G and B values are extracted from the face images obtained from the camera and used as attributes. By combining these values with weighted k-NN method, 100% classification success has been achieved.

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BIOSORPTION OF SOME HEAVY METALS FROM AQUEOUS SOLUTIONS

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Abstract:

The present work proposes the use of a white rot fungi (\textit{Pleurotus ostreatus}) immobilized on bentonite as a new sorbent in trace metal determination. The procedure is based on the biosorption of Cr(III) and Cu(II) ions on a column of bentonite loaded with dried, dead fungi components prior to their determination by atomic absorption spectrophotometry. The effects of pH, amount of solid phase, eluent type and volume of the sample solution, flow rate of solution on the retention of the metal ions have been studied. The optimum pH values of quantitative sorption for Cr(III) and Cu(II) were found to be 5. These metal ions can be desorbed with 1 M HCl (recovery 95-100 \%). The effect of some interfere ions were also studied. The adsorption process is interpreted in term of Langmuir and Freundlich equations. The results indicate that with the advantages of high metal biosorption capacity and satisfactory recovery of Cr(III) and Cu(II).

\textbf{Key words:} Heavy metals, Waste treatment, Bentonite, Bioseparation, Environmental protection

\textbf{General area of research:} Chemistry

ICFAS2019-ID: 1042

1. INTRODUCTION

Heavy metals are important sources of environmental pollution and some of them are very toxic even at low concentrations. Metal surface treatment is one of the major metal working processes that generates a large amount of liquid and solid (sludge) wastes containing heavy metals (1). Waste streams containing low-to-medium level of heavy metals are often encountered in industries. Most of heavy metals must be removed from the contaminated water in order to meet increasingly stringent environmental quality standards due to their high toxicity and un-biodegradability. Among heavy metal pollutants, chromium plays a major role in polluting environment. Investigation on chromium contamination is also an important part of analytical chemistry, due to importance of the chromium species on the human health. Chromium exists in Cr(III) and Cr(VI) oxidation states in aqueous solutions. Chromium species are major water pollutants, usually as a result of some industrial pollution including tanning factories, steel works, industrial electroplating, wood preservation, etc. and artificial fertilizers (2,3)
Copper is one of the most valuable and prevalent metals used in the industry. Moreover, copper is an essential element in the human diet; however, intake in large quantities can be toxic. Copper is an essential trace element found in many living organisms, but at high levels it is potentially harmful and when discharged at high concentration into natural water resources could pose a serious environmental threat to marine ecosystems. Various industries produce wastewater containing dissolved copper ions (4).

Determination of trace metal ions is very important in the context of environmental protection, food and agricultural chemistry and high purity materials, and also for monitoring environmental pollution and commonly used procedures for removing metal ions from wastewater include chemical precipitation, ion exchange, membrane separation, reverse osmosis, evaporation and electrolysis (5-7). However, these techniques have certain disadvantages such as incomplete removal, high reagent and energy requirements, generation of toxic sludge or other waste products that require disposal (8).

The search for alternative and innovative treatment techniques has focused attention on the use of biological materials such as algae, fungi, yeast and bacteria for the removal and recovery technologies and has gained importance during recent years because of the better performance and low cost of these biological materials (9-12).

2. METHOD

Analytical reagent grade CrCl$_3$.6H$_2$O, CuSO$_4$.5H$_2$O, HCl, NaOH, chemicals from Merck (Germany), Cr(III) and Cu(II) atomic absorption spectrometry standard solutions (1000 mg/L) (Fluka Chemicals) were used for experiments. The stock solutions of Cr(III) and Cu(II) (1000 mg/L) were prepared in double distilled water using their salts, CrCl$_3$. 6 H$_2$O and CuSO$_4$.5H$_2$O. 1 M and 0.1 M HCl and NaOH solutions were used for pH adjustments.

A white rot fungi (*Pleurotus ostreatus*) was used in the experiments. 200 mg of dry was mixed *P. ostreatus* with 2 g of bentonite. The mixture was wetted with 2 mL of doubly distilled deionized water and thoroughly mixed. After mixing, the paste was heated in an oven at 80 °C for 24 h to dry the mixture. The wetting and drying step were repeated 4 times to maximize the contact between fungi and clay, thereby improving the immobilization efficiency. Then, fungi immobilized resin (0.2 g) was packed in a glass column (10 mm i.d and 200 mm length). Before use, 1 mol/L HCl solution and doubly distilled water were passed through the column in order to condition and clean it. Then, the column was conditioned to study the effect of pH.

The effects of experimental parameters, such as pH and flow rate of sample solution, amount of solid phase, eluent type, and concentration on the recovery of the metal ions were investigated.

A low cost sorbent, bentonite was used for the removal of Cr(III) and Cu(II) ions from aqueous solutions. Chemical composition of the bentonite sample was first identified by X-ray diffraction, differential thermal and IR spectrophotometric analysis. Chemical analysis of the sample was carried out on GE-SPG 7, X-ray fluorescence spectrophotometer. The results are summarized in Table 1. Bentonite was washed thoroughly with double distilled water to remove the dirt and other foreign matter and dried at 40 °C for a period 4–5 h. The samples were 200 mesh particle size.
Table 1. Physical properties of bentonite

<table>
<thead>
<tr>
<th>Component</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiO₂</td>
<td>53.72</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>19.12</td>
</tr>
<tr>
<td>CaO</td>
<td>5.28</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>4.93</td>
</tr>
<tr>
<td>Na₂O</td>
<td>3.64</td>
</tr>
<tr>
<td>MgO</td>
<td>3.29</td>
</tr>
<tr>
<td>TiO₂</td>
<td>0.85</td>
</tr>
<tr>
<td>K₂O</td>
<td>0.44</td>
</tr>
<tr>
<td>MnO</td>
<td>n.d. *</td>
</tr>
<tr>
<td>P₂O₅</td>
<td>n.d. *</td>
</tr>
<tr>
<td>L.O.I.**</td>
<td>8.75</td>
</tr>
</tbody>
</table>

* n.d.: not detected  
** L.O.I: Loss of ignition

3. EXPERIMENTAL RESULTS

The effects of pH, amount of solid phase, eluent type and volume of the sample solution, flow rate of solution on the retention of the metal ions have been studied. The pH value of the sample solutions was adjusted to a range of 1-7 with HCl or NaOH. The solutions were passed through the column at a flow rate of 2 mL/min. The results are given in Figure 1.

Fig. 1. Effect of pH on the recovery of Cr(III) and Cu(II) by *P. ostreatus* immobilized on bentonite

The uptake values were increased with increasing pH for all metals. In order to avoid the precipitation of metals, high pH values were not tested. The optimum pH was chosen as pH 5 for Cr(III) and Cu(II). These metal ions can be desorbed with 1 M HCl (recovery 95-100 %). The removal of the metals studied was examined in relation to the amount of *P.ostreatus* immobilized
on bentonite, which was varied from 0.05 to 0.4 g. It was found that the retention of metal ions increased with increasing the amount of the adsorbent up to 0.2 g. The effect of some interfere ions were also studied. Sample and eluent flow rates are important parameters to obtain quantitative retention and elution, respectively. Therefore, the effect of the flow rate of the sample and eluent solutions was examined under optimum conditions (pH, eluent type, etc.) by using a peristaltic pump. The solutions were passed through the column with the flow rates adjusted in a range of 1-7.5 mL/min. The optimum flow rate was found as 2.5 mL/min for metal ions and the results are given in Figure 2. The adsorption of -Cr(III) and Cu(II) ions decreased with increasing flow rate as expected.

![Fig. 2. Effect of flow rate on the recovery of Cr(III) and Cu(II) by P. ostreatus immobilized on bentonite](image)

The adsorption process is interpreted in term of Langmuir and Freundlich equations. The results indicate that with the advantages of high metal biosorption capacity and satisfactory recovery of and Cr(III) and Cu(II).

4. CONCLUSIONS

The present method was successfully applied to preconcentration of chromium and copper. The recoveries of analytes studied were quantitative (≥ 95 %). Each column can be used up to 15 successive analyses without considerable change in recoveries of metal ions. The good features of the proposed method showed that this method is a convenient and low cost one. Moreover, the preconcentration step and utilizing of AAS improve its sensitivity and selectivity.

In conclusion, the proposed method is very good as regards simplicity, sensitivity, selectivity, precision, accuracy and column stability.
REFERENCES


FIXED POINT THEOREMS AND APPLICATIONS FOR A CLASS OF
\( \alpha_{s,p} - (\Psi \times \Phi \times \Gamma \times \mathbb{M}) \) CONTRACTIVE MAPPINGS IN \( b \)-METRIC-LIKE SPACES

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Abstract:

In this work, we present some fixed point results in the setting of a complete \( b \)-metric-like spaces under more general contractive conditions, via \( \alpha \)-admissible mappings and altering distance functions. As a consequence of our main theorems, we derive many fixed point theorems for a mapping satisfying some type of nonlinear contractions. As application we apply our fixed point results to obtain existence of solution of boundary value problem for ordinary differential equation by mean of a \( b \)-metric-like. The obtained results generalize, extend and unify several work considered in the existing literature.

Keywords: \( \alpha_{s,p} \)-admissible mapping, \( \alpha_{s,p} - (\Psi \times \Phi \times \Gamma \times \mathbb{M}) \) contractive mapping, \( b \)-metric-like, fixed point.

1. INTRODUCTION

Recently many authors have investigated fixed point and have focused on different contractive conditions in metric and generalized metric spaces, such as \( b \)-metric spaces, dislocated metric spaces, \( b \)-dislocated metric spaces, \( b \)-metric like spaces and so on. The advantage is that they bring us much stronger applications.

By using \( b \)-metric like space as a generalized metric space and the concept of \( \alpha \)-admissible mappings we obtain some new fixed points theorems for a class of \( \alpha_{s,p} - (\Psi \times \Phi \times \Gamma \times \mathbb{M}) \) contractive mappings, that is a knew extension of Kannan type contraction, and is concerned with unique fixed point for a self mappings.

The following definitions are taken from literature in [1,2, 3].

Let \( T \) be a nonempty set and \( s \geq 1 \) be a given real number. Let \( \sigma_s : T \times T \to [0, \infty) \) be a mapping satisfying the following conditions for each \( x, y, z \in T : \)

1. \( \sigma_s(x, y) = 0 \) if and only if \( x = y \);
2. \( \sigma_s(x, y) = 0 \) implies \( x = y \);
3. \( \sigma_s(x, y) = \sigma_s(y, x) \);
4. \( \sigma_s(x, y) \leq \sigma_s(x, z) + \sigma_s(z, y) \);
5. \( \sigma_s(x, y) \leq s[\sigma_s(x, z) + \sigma_s(z, y)] \).

**Definition 1.** A pair \((T, \sigma_s)\) satisfying axioms I, III, and V is called a \(b\)-metric space with parameter \(s\).

**Definition 2.** A pair \((T, \sigma_s)\) satisfying axioms II, III, and IV is called a metric-like space.

**Definition 3.** A pair \((T, \sigma_s)\) satisfying axioms II, III, and V is called a \(b\)-metric-like space with parameter \(s\). (For short, we will write b.m.l space).

It is true that if \( x, y \in T \) and \( \sigma_s(x, y) = 0 \), then \( x = y \); however, the converse need not be true, and \( \sigma_s(x, x) \) may be positive for \( x \in T \).

**Definition 4.** [3] Let \((T, \sigma_s)\) be a \(b\)-metric-like space with parameter \(s\). Then
a) The sequence \( \{x_n\} \) is said to be convergent to \( x \) if \( \lim_{n \to \infty} \sigma_s(x_n, x) = \sigma_s(x, x) \);
b) The sequence \( \{x_n\} \) is said to be a Cauchy sequence in \((T, \sigma_s)\) if \( \lim_{n,m \to \infty} \sigma_s(x_n, x_m) \) exists and is finite;
c) \((T, \sigma_s)\) is said to be a complete \(b\)-metric-like space if, for every Cauchy sequence \( \{x_n\} \) in \( T \), there exists \( x \in T \) such that \( \lim_{n,m \to \infty} \sigma_s(x_n, x_m) = \lim_{n \to \infty} \sigma_s(x_n, x) = \sigma_s(x, x) \).

**Definition 5.** Let \(T\) be a non-empty set. Let \( f: T \to T \) and \( \alpha: T \times T \to R^+ \) be given functions. We say that \(f\) is an \(\alpha\)-admissible mapping if \(\alpha(x, y) \geq 1\) implies that \(\alpha(fx, fy) \geq 1\) for all \(x, y \in T\).

**Lemma 1([4]).** Let \((T, \sigma_s)\) be an \(a\)-metric-like space with parameter \(s \geq 1\). If a given mapping \( f: T \to T \) is continuous at \(z \in T\), then, for all sequences \(\{x_n\}\) in \(T\),

\[
\lim_{n \to \infty} \sigma_s(x_n, z) = \sigma_s(z, z) \Rightarrow \lim_{n \to \infty} \sigma_s(fx_n, fz) = \sigma_s(fz, fz).
\]

The following is a short revised version of a lemma in [4].

**Lemma 2** Let \((T, \sigma_s)\) be a \(b\)-metric-like space with parameter \(s \geq 1\), and suppose that \(\{x_n\}\) is \(\sigma_s\)-convergent to \(x\) with \(\sigma_s(x, x) = 0\). Then for each \(y \in T\), we have

\[
s^{-1} \sigma_s(x, y) \leq \liminf_{n \to \infty} \sigma_s(x_n, y) \leq \limsup_{n \to \infty} \sigma_s(x_n, y) \leq s \sigma_s(x, y).
\]
Lemma 3([4]). In a $b$–metric-like space $(T, \sigma_b)$ with parameter $s \geq 1$, for $x, y \in T$ and $\{x_n\} \subset T$ we have:

1. $\sigma_b(x, y) = 0 \Rightarrow \sigma_b(x, x) = \sigma_b(y, y) = 0$;
2. If $\lim_{n \to \infty} \sigma_b(x_n, x_{n+1}) = 0$, then $\lim_{n \to \infty} \sigma_b(x_n, x_n) = \lim_{n \to \infty} \sigma_b(x_{n+1}, x_{n+1}) = 0$;
3. $x \neq y \Rightarrow \sigma_b(x, y) > 0$.

Lemma 4([5]) Let $(T, \sigma_b)$ be complete $b$–metric-like space with parameter $s \geq 1$, let $\{x_n\}$ be a sequence such that $\lim_{n \to \infty} \sigma_b(x_n, x_{n+1}) = 0$.

If $\{x_n\}$ is not Cauchy, then there exists an $\varepsilon > 0$ and two subsequences $\{x_{n_k}\}$ and $\{x_{n_m}\}$ of $\{x_n\}$ with $n_k > m_k > k$, (positive integers) such that $\sigma_b(x_{n_k}, x_{n_m}) \geq \varepsilon$, $\sigma_b(x_{n_k}, x_{n_m-1}) < \varepsilon$, $\varepsilon/s^2 \leq \limsup_{k \to \infty} \sigma_b(x_{n_k-1}, x_{n_k}) \leq \varepsilon s$, $\varepsilon/s \leq \limsup_{k \to \infty} \sigma_b(x_{n_k-1}, x_{n_k}) \leq \varepsilon s^2$.

Definition 8([5]) Let $(T, \sigma_b)$ be a $b$–metric-like space, $f : T \times T \to T$ and $\alpha : T \times T \to R^+$ be given mappings, and let $p \geq 1$ be arbitrary constant. We say that $f$ is an $\alpha_{s^p}$–admissible mapping if $\alpha(x, y) \geq s^p$, implies $\min \{\alpha(f(x, y)), \alpha(y, f(x))\} \geq s^p$ for all $x, y \in T$.

We recall additional properties given in [4].

Let $(T, \sigma_b)$ be a complete $b$–metric-like space with parameter $s \geq 1$ and $\alpha : T \times T \to [0, \infty)$ be a function. Then:

$(H_{s^p})$ If, $\{x_n\}$ is a sequence in $T$ such that $x_n \to x \in T$ as $n \to \infty$ and $\alpha(x_n, x_{n+1}) \geq s^p$, then there exists a subsequence $\{x_{n_k}\}$ of $\{x_n\}$ such that $\alpha(x_{n_k}, x) \geq s^p$ for all $k \notin \mathbb{N}$.

$(U_{s^p})$ For all $x, y \in \text{Fix}(f)$, we have $\alpha(x, y) \geq s^p$, where $\text{Fix}(f)$ denotes the set of fixed points of $f$.

2. MAIN RESULTS

Definition 1 Let $f$ be an $\alpha_s$–admissible map on a $b$–metric-like space $(T, \sigma_b)$ with parameter $s \geq 1$. The self map $f$ is called an $\alpha_{s^p} – (\Psi \times \Phi \times \Gamma \times M)$–Kannan contraction, if there exists $(\psi, \varphi, (\beta, \gamma, \delta)) \in \Psi \times \Phi \times \Gamma \times M$ satisfying

$$
\psi(\alpha(x, y)\sigma_b(fx, fy)) \leq \beta[\sigma_b(x, y)]\varphi[\sigma_b(x, y)] + \gamma[\sigma_b(x, y)]\varphi[M_b(x, y)] + \delta[\sigma_b(x, y)]\varphi[M_b(x, y)]
$$

for all $x, y \in T$ where $\varphi(h) < \psi(h)$ for all $h > 0$, and for $i, j = 1, 2, 3 (i \neq j)$. 

ICFAS2019-ID: 1045
Theorem 1 Let \( f \) be an \( \alpha \)-admissible pair of self-mappings on a complete \( b \)-metric-like space \((T, \sigma_b)\) with coefficient \( s \geq 1 \). If \( f \) is an \( \alpha \)-\((\Psi \times \Phi \times \Gamma \times M)\) Kannan contraction, and the following conditions hold:

(i) there exists \( x_0 \in T \) with \( \alpha(x_0, fx_0) \geq s^p \);
(ii) properties \( H_{x_0}; U_{x_0} \) are satisfied.

Then \( f \) has a unique fixed point \( x \in T \).

3. APPLICATION

In this section, we consider an application for the existence of solution of boundary value problem of second order ordinary differential equation

\[
\begin{aligned}
-x''(u) &= H(u, x(u)), \ u \in [0,1] \\
x(0) &= x(1) = 0
\end{aligned}
\]

for given continuous functions \( H: [0,1] \times \mathbb{R} \to \mathbb{R} \).

REFERENCES

SOME RARE AND INTERESTING FUNGI SPECIES IN TURKEY

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Abstract:

TURKEY is a very rich country in terms of plant diversity due to its geographical location. Accordingly, it is a rich country in terms of number of species of fungi too. The systematic studies to determine the fungi growing in our country started in the 1850s and continue until today. Together with these studies, the number of fungi species identified in our country is increasing day by day.

Similarly, fungi are distributed worldwide, but there are species that are at risk of extinction, mainly due to degradation or habitat changes, but there are other major threats, such as pollution, climate change, and excessive collection of the fruiting bodies of edible species. Therewithal, species of fungi are threatened by habitat loss, loss of symbiotic hosts, and over-exploitation. As a result, many countries have now established national Red-List of fungus to reveal the threats and harms of mushroom diversity. Recently, fungal red-lists using IUCN categories and criteria have appeared in many European countries. Many fungi species are listed in this fungal red list among endangered species in the world.

New species and new records with increasing systematic efforts in recent years in Turkey have been identified. As a result of these intensive studies, many rare, interesting, endangered and sensitive species have been identified within the borders of the country.

In this study, it has been identified in studies up until the present day in Turkey around 30 rare and interesting species of fungi have been given information about. The identifications, localities, collection dates, habitats of these 30 species were tried to be introduced. This study was aimed to focus on some very interesting species, such as: *Morchella steppicola* Zerova, *Entoloma incanum* (Fr.) Hesler, *Daedaleopsis nitida* (Durieu & Mont.) Zmitr. & Malysheva, *Tuber aestivum* (Wulfen) Spreng. ect..

Such species that are both rare and interesting for mycobiota of Turkey, are the subject of our study. As a result, these species will also be used as candidates for preparing a Red List of Fungi from Turkey.

Keywords: Systematic, Fungi, Rare and Interesting, National Red-List, Turkey
General area of research: Biology
ICFAS2019-ID: 1055
1. INTRODUCTION

Fungi is just one of the major groups of organisms constitute a major component of Turkey's biodiversity as all other living things. Turkey, as a result of its geographical location and the diversity of vegetation, is home to the many species of fungi.

In recent years, many national and regional threatened mushrooms have been published. Earlier, the European Committee for the Conservation of Fungi held its first meeting in 1988 in Lodz (Poland). Red Data Lists on these meetings were extensively discussed (Jansen, 1989). As a result, Europe's threatened mushroom list was planned at this meeting.

It assesses the risk of extinction for organisms according to the internationally recognized criteria of the International Union for Conservation of Nature (IUCN). Therefore, fungal red-lists using IUCN categories and criteria have appeared in many European countries. Many fungi species are listed in this fungal red list among endangered species in the world.

Our goal in the creation of the red data list of the macrofungi offered is to draw special attention to the threatened species and to the areas where most of these species are located and to inform professional and amateur micologists about the state of the macrofungal species.

2. METHOD

The two main groups which contain macrofungi are the Ascomycota and Basidiomycota. Although most of the Ascomycota are microscopic species, it also contains some larger or cup-fungi, such as morels and truffles.

The beginning of the detection of macrofungi in our country dates back to 1850s. These studies, which were initiated with foreign researchers, are now being continued with approximately 30 local academic researchers working in various universities. As a result of these systematic studies, checklists were made on the basis of genus and ordo, and checklists covering all macrofungi were made too (Sesli and Denchev 2014, Solak et. al. 2007 ).

In this study, ecological and morphological characteristics of some of the macrofungi species determined only once or twice in the systematic studies carried out in our country since 1852 have been selected.

3. EXPERIMENTAL RESULTS

Which made a total of 30 species of rare and interesting fungi have been identified in this study are listed in Turkey. Table 1, respectively, the name of the fungi, and its author(s), phylum, fruit body, stipe, spores, habitats and literature are given. The current names of fungi and the systematics of the taxon are given in accordance with Kirk et al. (2008) and the Index Fungorum (www.indexfungorum.org; accessed 30.05 2019).
<table>
<thead>
<tr>
<th>Species</th>
<th>Phylum</th>
<th>Fruitbody</th>
<th>Stipe</th>
<th>Spores</th>
<th>Habitat</th>
<th>Literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypocrea lixii Pat.</td>
<td>Ascomycota</td>
<td>0.3×3.0 mm diam, smooth</td>
<td>None</td>
<td>3.0-5.6 x 2.8–5.2 μm, cylindrical</td>
<td>on rotting substrates of plants</td>
<td>Uzun et al. 2015a</td>
</tr>
<tr>
<td>Morchella steppicola Zerova,</td>
<td>Ascomycota</td>
<td>5×12 cm, with alveoles</td>
<td>10-18 x 2-4 mm, cylindrical</td>
<td>20-27 x 12-15 μm, ellipsoid,</td>
<td>on soil</td>
<td>Güngör &amp; Solak 2015</td>
</tr>
<tr>
<td>Melastiza chateri (W.G. Sm.) Boud.</td>
<td>Ascomycota</td>
<td>7-10 mm, conical</td>
<td>None</td>
<td>17-19 x 8-10 μm, elliptical with irregular reticulate ornamentation</td>
<td>on bare loamy or sandy ground</td>
<td>Akata et al. 2011</td>
</tr>
<tr>
<td>Perrotia flammea (Alb. &amp; Schwein.) Boud.</td>
<td>Ascomycota</td>
<td>0.5–3 mm, cup shaped,</td>
<td>None</td>
<td>11–16.9 x 2.6–4.2 μm, cylindrical to allantoid,</td>
<td>on dead branches</td>
<td>Uzun et al. 2015b</td>
</tr>
<tr>
<td>Trichoglossum hirsutum (Pers.) Boud.</td>
<td>Ascomycota</td>
<td>3–8 cm, black earth tongues</td>
<td>6 cm long and 2–3 mm thick</td>
<td>90-130 x 4-5 μm, cylindric-clavate,</td>
<td>in woodlands, on soil</td>
<td>Akata &amp; Kaya 2013</td>
</tr>
<tr>
<td>Tuber aestivum (Wulfen) Spreng.</td>
<td>Ascomycota</td>
<td>3-9 cm, globoz</td>
<td>None</td>
<td>24-48 x 16-38 μm, globoz, elliptical,</td>
<td>hypogeous fungi</td>
<td>Gezer et al. 2014, Türkoğlu et al. 2015, Alkan et. al. 2018</td>
</tr>
<tr>
<td>Aleurodiscus amorphus (Pers.) J. Schröt.</td>
<td>Basidiomycota</td>
<td>0.5–1 mm, disc to cup shaped,</td>
<td>None</td>
<td>25–30 x 20–22 μm, oval, echinulate</td>
<td>on dead branches</td>
<td>Doğan et al. 2011b</td>
</tr>
<tr>
<td>Amanita regalis (Fr.) Michael</td>
<td>Basidiomycota</td>
<td>7-16 (20) cm, subglobose to convex</td>
<td>9-20 x 1-2.5 cm, bulbose to the base</td>
<td>9-12 x 6-9 μm, ellipsoidal</td>
<td>on soil</td>
<td>Uzun et al. 2005</td>
</tr>
<tr>
<td>Rheubarbariboletus armeniacus (Quél.) Vizzini, Simonini &amp; Gelardi</td>
<td>Basidiomycota</td>
<td>4–10 cm, at first hemispherical then convex</td>
<td>6-8 x 1–2 cm, cylindric</td>
<td>11–17 x 4-6 μm, smooth</td>
<td>on soil, mycorrhizal with oaks</td>
<td>Akata et al. 2009</td>
</tr>
<tr>
<td>Calypella capula (Holmsk.) Quél.</td>
<td>Basidiomycota</td>
<td>2–4 mm broad, cupulate, stipitate, delicate,</td>
<td>Pseudostem up to 1.5 mm</td>
<td>6.5–8 x 4-4.5 μm, ellipsoidal with apiculus</td>
<td>on dead branches</td>
<td>Akata et al. 2014</td>
</tr>
<tr>
<td>Campanella caesia Romagn.</td>
<td>Basidiomycota</td>
<td>5–15 mm broad, cupulate or convex</td>
<td>None</td>
<td>8–9 x 4–5 μm, ellipsoid to oblong,</td>
<td>on dead branches</td>
<td>Akata et al. 2014</td>
</tr>
<tr>
<td>Chrysonoma chrysophylla (Fr.) Clémençon</td>
<td>Basidiomycota</td>
<td>1-4 cm, planoconvex with an inrolled margin</td>
<td>2-4 cm long and up to 3 mm thick</td>
<td>8.5-15.5 x 4.5–7 μ; smooth; elliptical</td>
<td>on the well decayed wood of conifers</td>
<td>Sésli et al. 2009</td>
</tr>
<tr>
<td>Clavariadelphus ligula (Schaeff.) Donk</td>
<td>Basidiomycota</td>
<td>1-3 cm high; about 5 cm wide, narrowly club shaped</td>
<td>None</td>
<td>16-21 x 5-7 μ; long-elliptical, smooth</td>
<td>on soil</td>
<td>Demirel et al. 2004a</td>
</tr>
<tr>
<td>Chondrogaster pachysporus Maire</td>
<td>Basidiomycota</td>
<td>8–23 mm in width, 7–11 mm high, depressed globose to subglobose,</td>
<td>None</td>
<td>2.5–16.5 x 6–9 μ, subfusoid, ellipsoid</td>
<td>hypogeous fungi</td>
<td>Unal et al. 2016</td>
</tr>
<tr>
<td>Cordyceps militaris (L.) Fr.</td>
<td>Basidiomycota</td>
<td>1-3 × 0.5-1.2 cm, club or clavate shaped</td>
<td>Pseudostem 3-4 × 0.5-1 cm</td>
<td>up to 300× 1 μm, part of spores 3-4 × 1 μm, smooth and hyaline.</td>
<td>parasite on larva or pupa of lepidopteran insects</td>
<td>Akata, et. al. 2016</td>
</tr>
<tr>
<td>Cortinarius sanguineus (Wulfen) Gray</td>
<td>Basidiomycota</td>
<td>2–5 cm, hemispherical, later low convex to almost plane,</td>
<td>4–10 × 0.3–0.8 cm, cylindrical or slightly clavate,</td>
<td>7–8.5 × 4.5–5.2 μm, amygdaloid to ellipsoid,</td>
<td>in mesic to damp mossy coniferous forests</td>
<td>Akata et al. 2010</td>
</tr>
<tr>
<td>Ditiotula radicata (Alb. &amp; Schwein.) Fr.</td>
<td>Basidiomycota</td>
<td>7-5 mm, subglobose to cylindric</td>
<td>Pseudostem 1-3 mm, clavate</td>
<td>9-13 x 4-5 μ, cylindrical, slightly curved, hyaline</td>
<td>on dead coniferous branches</td>
<td>Öztürk, Ö. et al. 2010</td>
</tr>
<tr>
<td>Entoloma incanum (Fr.) Hesler</td>
<td>Basidiomycota</td>
<td>1-5 cm, before hemispherical, then convex</td>
<td>2-8 × 0.1-0.4 cm, cylindric</td>
<td>10.5-14 × 7.5–10.5 μm, oblong</td>
<td>at the sides of meadows or roads</td>
<td>Demirel et al. 2004b, Kaya 2000, Kay &amp; Demirel 2000</td>
</tr>
<tr>
<td>Scientific Name</td>
<td>Kingdom</td>
<td>Common Name</td>
<td>Description</td>
<td>Size</td>
<td>Color</td>
<td>Location</td>
</tr>
<tr>
<td>-----------------------------------------------------</td>
<td>------------------</td>
<td>-------------</td>
<td>------------------------------------------------------------------------------</td>
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<td>--------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Flammulaster erinaceellus (Peck) Watling</td>
<td>Basidiomycota</td>
<td></td>
<td>1-4 cm, convex becoming flat 3-4 cm long; under 5 mm thick, covered with granular scales like the cap</td>
<td>6-9 x 4-5 µ; smooth; more or less elliptical</td>
<td>on the dead wood of hardwoods</td>
<td>Akata et al. 2010</td>
</tr>
<tr>
<td>Guepinopsis buccina (Pers.) L.L. Kenn.</td>
<td>Basidiomycota</td>
<td></td>
<td>1–5 mm across, 1–4 mm high, discoid to cupulate, central, up to 5×0.5 (1) mm, cylindrical</td>
<td>11–15 × 5–6 µ, smooth, subeylindrical</td>
<td>on wood of trunk of a deciduous tree</td>
<td>Akata et al. 2014</td>
</tr>
<tr>
<td>Daedaleopsis nitida (Durie &amp; Mont.) Zmitr. &amp; Malysheva</td>
<td>Basidiomycota</td>
<td></td>
<td>small hoof-shaped, 5-10 cm wide and up to 4 cm thick</td>
<td>None</td>
<td>9.9-12.9 × 3.6–4.5 µ, cylindric</td>
<td>on branches, trunk or stumps</td>
</tr>
<tr>
<td>Hydnocrisella himantia (Schwein.) R.H. Petersen</td>
<td>Basidiomycota</td>
<td></td>
<td>5 × 0.5 mm, cylindrical, slightly tapering towards the apex 2–4 cm long and 1–2 mm thick, fragile,</td>
<td>6–7 × 3–3.5 µ, ellipsoid, nonamyloid</td>
<td>on needle beds under spruce and hemlock</td>
<td>Solak et al. 2007</td>
</tr>
<tr>
<td>Mycetinis alliaceus (Jacq. : Fr.) Earle ex A.W. Wilson &amp; Desjardin</td>
<td>Basidiomycota</td>
<td></td>
<td>3–15 × 20–50 mm broad, at first strongly convex becoming campanulate to convex 8–60 mm long, central, 9.5–11.5 × 5.5–6 µ, ellipsoid to broadly ellipsoid, marasmioid, subamygdaliform</td>
<td>4.5–5.5 × 2–2.5 µ, ellipsoidal or ovoid, smooth, translucent (hyaline)</td>
<td>on decaying deciduous leaves, buried rotting wood, bark (including bark of living, standing trees)</td>
<td>Şen et al. 2012, 2014</td>
</tr>
<tr>
<td>Pseudocolus fusiformis (E. Fisch.) Lloyd</td>
<td>Basidiomycota</td>
<td></td>
<td>0.5 to 2.5 cm, egg- or pear-shaped puffballs, cracks open and forms a stalk with tapering arms</td>
<td>None</td>
<td>4.5–5.5 × 2–2.5 µ, ellipsoidal or ovoid, smooth, translucent (hyaline)</td>
<td>Akata &amp; Doğan 2011</td>
</tr>
<tr>
<td>Schizophyllum amplum (Lév.) Nakasone</td>
<td>Basidiomycota</td>
<td></td>
<td>3-10 mm, cup shape,</td>
<td>None</td>
<td>7.5-8.5 × 2.5 µ, twisted cylinder or sausage-shaped, flat thin-walled</td>
<td>Salix or Populus species on dead branches</td>
</tr>
<tr>
<td>Terana caerulea (Lam.) Kuntze</td>
<td>Basidiomycota</td>
<td></td>
<td>10 to 25cm tall and up to 20cm across, hemispherical and comprises many spade-like lobes</td>
<td>from a single basal stem</td>
<td>4.5-6 × 3.5-4.5µm broadly ellipsoidal, smooth,</td>
<td>on dead and sometimes well-rotted conifer stumps</td>
</tr>
<tr>
<td>Tulostoma melanocyclum Bres.</td>
<td>Basidiomycota</td>
<td></td>
<td>8-10 mm, globose, with a short, tubular, straight cut off peristoma, 3-5 cm long, 3-4 mm in diameter, grooved, more or less protruding small scales</td>
<td>5.4-7.2 (8.4) µm, globose, spiny,</td>
<td>on soil, grassland</td>
<td>Kaya 2015</td>
</tr>
</tbody>
</table>
4. CONCLUSIONS

Approximately 2500 macrofungi diversity has been determined in our country with the systematic studies conducted from past to present. In addition, a number of rare and interesting species were recorded. With the current studies, new taxa are added to these numbers every day. Some of these rare and interesting species identified as candidates will be used to prepare a list of Red Mushrooms from Turkey.

Many types of macrofungi are usually grown in habitats or substrates that are threatened for various reasons. Rare species in such habitats are considered to be automatically threatened species. In addition, some species, which are still quite common, but are strongly reduced in the species population, can also be included in the list. Species with a very narrow ecological range are considered to be more vulnerable than species with a wider range.

It is thought to be a pioneering work with this study, on the creation of Turkey macrofungi red list. For the detection of fungal species that are under threat protection in Turkey, the government and legislators must take urgent measures in this regard. With the meetings to be held with the relevant ministries, a practical road map should be drawn in line with the opinions of the experts.

Compared with other European countries, Turkey has yet to offer a Red List of related fungi. However, Arnolds (1995) provides a list of species by country in the Red List. Therefore, Germany has 1,400 species, Poland 1,013, Netherlands 944 species, Denmark 898, Norway 649, Sweden 515, Great Britain 445, 211 in Austria, Czech Republic 123 and Finland 161. Ivancevic (1995) 97 is the species for the Front Red List of Yugoslavia, while Tkalcec, Z., Matocce, N., Mesic, A. and Tortic, M. (1997) proposes 130 species for Croatia.

As a result, in this study, a total of 30 taxa were introduced, 6 of which were in Ascomycota and 24 in Basidiomycota.

REFERENCES

THE ENVIRONMENTAL IMPACT OF THE OLIVE PROCESSING INDUSTRY IN LUSHNJA DISTRICTS

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Abstract:

Olive cultivation in our country is one of the earliest and most important agricultural activities. Albania is the country with the most optimal climate in the Mediterranean basin, where olive cultivation is sustainable alternatives. Development of olive production is considered as one of the priority branches of agriculture. This study analyzes the environmental impact of the activity of olive oil processing lines, producing solid waste as secondary products and liquid. According to estimates, Albania's olive is about 40 thousand hectares with a fund of approximately 6 million olive trees, with annual production capacity of 55500 tonnes of olive or 7770 tonnes of olive oil. In the 1990s -95s, the number of trees decreased considerably due to abandonment of non-productive surfaces, but currently has a national plan for increasing the area planted. The amount of discharges (liquid and solid) from olive factories estimated 35 million liters a year. According to forecasts to increase the amount of olive will increase the level of emissions in the near future. For this reason it should be noted the fate of the application processing technologies with minimum impact on the environment. The analysis of these residues is of interest because they are deposited on agricultural land, reducing productivity and thus affecting the economy of the country. For this study was selected a processing factory in LUSHNJA, Albania. The factory uses 3-phase processing technology (3P). Samples were taken in the period of intensive processing in December 2018. Initially samples were prepared for analysis, then it was determined: the amount of solid materials, % of ash, carbon, acidity (pH) and conductivity. Heavy metals were determined at different wavelengths using the Spectrophotometers UV-VIS. This study analyzes the impact on the environment of solid and liquid waste of the olive processing industry in LUSHNJA district. The elements analyzed by the collected samples are: K, Na, Mg, Cd, Pb, Zn, Fe, Cu. From the graphic, the sample is characterized by increasing order: Pb < Cu < Mg < Fe < Zn < Cd < Na < K. Elements K, Na, Fe refer to natural earth origin, Mg, Zn, Cd of gas origin, atmospheric depositions affect the change of cations content in these plantations. Elements Cu and Pb has origin from tire burning. The olive processing industry in Albania after the '90s passed from state ownership to private ownership forms. As a result, the processing lines have been widely spread and unstudied way, causing improper management of solid and liquid olive residues. In this context we recommend the reuse of liquid and solid wastes. Liquid waste can be used for irrigation in a permissible value of 800 m³ / ha, solid waste can be included in the reprocessing scheme. Solid waste produced can be used as animal feed, to obtain active coal from the fruit nucleus or in other cases may be used for combustion by various private subjects.

Keywords: Olive processing industry, Environmental impact, UV-VIS, Heavy metals, Liquid and solid waste, Acidity

General area of research: Chemistry

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1. INTRODUCTION

Olives consist of autochthonous cultivars where: Kalinjoti occupies over 40%, Grain Great Berat (KMB) 18% and Frantoio about 10% of the area. Currently it is administered by 60,000 family farms. Currently, 184 factories of different types have been installed in the territory of the country, and capacity over 850 Kv / hour. Biological potentials of our country's olive grove are over 15 thousand tons of oil / year. At global level, Albania is ranked 19th in this culture. Factors that make it necessary to develop olive production are:

- Meeting the needs of the country with olive oil and table olives, minimizing import and increasing the export of high quality olive oil.
- Reduce the vacant emptiness of rural areas through increasing the level of employment, both inside and outside the farm, increasing the financial incomes and reducing the level of poverty.
- Improve the socio-cultural life of people, and to make it prosperous and cheerful.

1.1 Olive Tree

Olive, (Olea europaea) is a subtropical plant from the "Oleaceae" family. Olive tree is a multiyear plant. Its origin is in the Eastern Mediterranean and today is known and spread across the globe. Olive is rich in calories, protein, fiber, vitamin A, vitamin B6, vitamin B, vitamin C, magnesium, linolenic acid, oleic acid, calories, calcium, etc. The olive fruit is rich in oil, which is used as food, and has healing properties. Mostly, olive fruit is used more for olive oil and less for table olives. Maximum efficiency in the production of olive oil has been reached to the south of the country, including Saranda, Delvina, Vlora, Mallakastra and in the center including Fieri, Lushnja, Berat and Tirana, including about 85% of the planted fruit fund. Currently, a strategic plan targets a total of 25 million trees by 2020.

1.1.1. Olive fruits

The fruit is composed of 3 parts: epicarpi (outer skin), mesocarpi (pulpi) and endocarpi (core).

Table 1: Chemical composition of olive fruit (%)

<table>
<thead>
<tr>
<th>Components</th>
<th>Pulpi (%)</th>
<th>Core (%)</th>
<th>Essence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>60</td>
<td>9.2</td>
<td>30</td>
</tr>
<tr>
<td>Oil</td>
<td>30</td>
<td>0.8</td>
<td>27</td>
</tr>
<tr>
<td>N-compounds</td>
<td>3</td>
<td>3.3</td>
<td>10</td>
</tr>
<tr>
<td>Sugar</td>
<td>7.5</td>
<td>40</td>
<td>26</td>
</tr>
<tr>
<td>Celullose</td>
<td>6</td>
<td>38</td>
<td>1.8</td>
</tr>
<tr>
<td>Minerals</td>
<td>2</td>
<td>4</td>
<td>1.5</td>
</tr>
<tr>
<td>Polyphenols</td>
<td>3</td>
<td>0.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Others compounds</td>
<td>-</td>
<td>4.3</td>
<td>4.2</td>
</tr>
</tbody>
</table>
1.2 The Environmental Impact Of Olive Processing Waste

- Olive cultivation and its processing industry produce large amounts of waste. According to official statistics, the cultivated area in Albania is approximately 40 thousand hectares. According to preliminary calculations only from the pruning stage, 27 kg each year is produced per olive tree. It is also estimated that 6% of the amount of fruit for processing is made up of leaves. From the fruit processing process produced "desired product" olive oil at 25%, semi-liquid residue in 35% and aqueous phase in 40%.

- Olive oil production is characterized by considerable amounts of solid and liquid waste. Their deposition is a critical problem because according to various studies the discharge of liquid wastes into surface waters affects the reduction of their biodiversity.

The impact on the environment caused by the waste produced during the processing process has not been the focus. They are not reprocessed to add economic value and minimize negative impact on the environment. Vegetation waters are directly discharged into surface waters. They contain high levels of organic substances. Recently private entities are aware of the economic interest in processing this amount by building tanks for storing water that is produced before it is discharged and olive groves can be used as animal feed to obtain active coal of fruit etc.

There is an opportunity to build an olive grove collection network to be extracted. But since it requires a certain investment, this is missing as a procedure. Currently, in Albania, it is difficult to apply minimal negative environmental impact schemes to deposit the residues because there are no practices of using olive oil for other purposes of obtaining the products but in most cases are used as animal feed or for burning. In our country the olive processing technology is dominated by that 3-phase and this technology is an important contributor to water discharges.

2. METHOD

For this study was selected a processing factory in LUSHNJA districts. The factory uses 3-phase processing technology. The samples were taken in December 2017. Samples are placed in the oven at 500 ± 15°C for 3 hours and dried in the thermostat at 100±5 °C temperature. Is calculated the total % of solids, ash content in%, carbon content, conductivity and pH.

3. EXPERIMENTAL RESULTS

The elements analyzed by the collected samples are: K, Na, Mg, Cd, Pb, Zn, Fe, Cu. The method used is SAA. Were measured absorbances of PB (white test), standards and samples and were calculated the concentration of each metal (knowing that we took 2 g of dried sample and diluted it in 100 ml balloon).
Table 2: The results of the elements in ppm.

<table>
<thead>
<tr>
<th>Elements</th>
<th>Names</th>
<th>Value</th>
<th>Samples</th>
<th>Subtraction of Absorbance</th>
<th>Concentration (ppm)</th>
<th>Concentration (µg/g)ose (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>PB (white test)</td>
<td>0.089</td>
<td>0.741</td>
<td>0.167</td>
<td>3.904</td>
<td>390.4</td>
</tr>
<tr>
<td></td>
<td>St (Standard)</td>
<td>0.256</td>
<td></td>
<td>0.652</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na</td>
<td>PB (white test)</td>
<td>0.091</td>
<td>0.569</td>
<td>0.169</td>
<td>2.828</td>
<td>282.8</td>
</tr>
<tr>
<td></td>
<td>St (Standard)</td>
<td>0.260</td>
<td></td>
<td>0.478</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mg</td>
<td>PB (white test)</td>
<td>0.088</td>
<td>0.212</td>
<td>0.110</td>
<td>1.127</td>
<td>112.7</td>
</tr>
<tr>
<td></td>
<td>St (Standard)</td>
<td>0.198</td>
<td></td>
<td>0.124</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cd</td>
<td>PB (white test)</td>
<td>0.008</td>
<td>0.516</td>
<td>0.205</td>
<td>2.478</td>
<td>247.8</td>
</tr>
<tr>
<td></td>
<td>St (Standard)</td>
<td>0.213</td>
<td></td>
<td>0.508</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pb</td>
<td>PB (white test)</td>
<td>0.017</td>
<td>0.047</td>
<td>0.293</td>
<td>0.102</td>
<td>10.2</td>
</tr>
<tr>
<td></td>
<td>St (Standard)</td>
<td>0.310</td>
<td></td>
<td>0.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zn</td>
<td>PB (white test)</td>
<td>0.093</td>
<td>0.310</td>
<td>0.138</td>
<td>1.572</td>
<td>157.2</td>
</tr>
<tr>
<td></td>
<td>St (Standard)</td>
<td>0.231</td>
<td></td>
<td>0.217</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fe</td>
<td>PB (white test)</td>
<td>0.002</td>
<td>0.215</td>
<td>0.175</td>
<td>1.217</td>
<td>121.7</td>
</tr>
<tr>
<td></td>
<td>St (Standard)</td>
<td>0.177</td>
<td></td>
<td>0.213</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cu</td>
<td>PB (white test)</td>
<td>0.004</td>
<td>0.017</td>
<td>0.019</td>
<td>0.894</td>
<td>89.4</td>
</tr>
<tr>
<td></td>
<td>St (Standard)</td>
<td>0.023</td>
<td></td>
<td>0.017</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The data received is presented graphically

![The content of elements in the sample (mg/kg)](image)

**Figure 1: Graphic presentation of sample concentrations expressed in mg / kg**

From the graphic presentation the sample is characterized by increasing order: Pb < Cu < Mg < Fe < Zn < Cd < Na < K. Lead resulted in lower content than the detection limit (KD) of the method (0.047 ppm), ie less than 0.6 mg / kg.

From the graphic presentation the sample is characterized by increasing order: Pb < Cu < Mg < Fe < Zn < Cd < Na < K. The lead resulted in a content lower than the dictation limit (KD) of the method (0.047 ppm), ie less than 0.6 mg / kg. The elements potassium (K), sodium (Na), iron (Fe), refered to natural origin from soils, Mg, Zn, Cd with gas origin. The Cu and Pb elements originate from tire burning, so the impact is small. The liquid samples were analyzed at the point of discharge of the point taken in the study. The device used was a universal pH-meter, the pH value was 5.16 and the dissolved O2 (mg / l) resulted 1.54. The temperature at which the measurement was carried out was 15°C. If the pH values of liquid discharges are compared with several categories of natural water such as: groundwater and surface waters (6.5 to 8.5), rainwater (5.5 to 6.0), sea water approximately 8.0, it results that these discharges are of the acidic category.

**4. CONCLUSION**

The olive processing industry in Albania after the '90s passed from state ownership to private ownership. As a result, the processing lines have been widely spread and unproven, causing inadequate management of solid and liquid olive residues. This study deals with an actual problem related to the negative effects on the environment from the activity of this industry making this issue more present. In this context, we recommend:

- Reuse of liquid and solid wastes.
Liquid waste can be used for irrigation at a permissible value 800 m$^3$/ha with origine from three-phase lineage by building tanks for storing water produced before it is discharged. In the case of solid waste, can be built a collection network built for the re-acquisition of residual oil quantities by introducing them into processing schemes to increase the economic value of this industry and to minimize the negative impact on the environment. Olive herbs produced can be used as animal feed, to obtain active coal from the fruit nucleus or in other cases may be used for combustion by various private entities.

Suvencion for farmers
Giving a producer payment would be a success because they would increase their interest in high production and they would be obliged to meet the requirements for environmental practices.

REFERENCES

DEVELOPMENT OF A SOFTWARE PLATFORM FOR SURGERY SIMULATORS

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Abstract:

In recent years, computer-aided simulation software in medicine has been used frequently as a secondary tool in physicians’ decision-making processes. Most of these simulation software is used to simulate surgeries on organs. This study focuses on the development of a variety of software components needed for the surgical simulators. A collision detection routine based on the line-triangle intersection, representing medical tool-organ interaction, is developed. Mass spring systems are implemented for the simulation of soft tissue deformations. The developed software also allows surface and volume model loading and user manipulation such as rotation and transition. The developed software platform has a simulation loop, allowing real time user interactions, deformation simulations and visualization. The platform is tested for a number of applications including deformation simulation of human kidney. Convincing results are achieved in real time visually. Thus, the developed software platform can be used for different surgical simulation applications with the same changes.

Keywords: Surgical simulator, Soft tissue deformation, Simulation

General area of research: Computer Graphics

ICFAS2019-ID: 1070

1. INTRODUCTION

Surgical simulators have become very popular as technological development in computer graphics and virtual reality [1,2,3,4,5]. These simulators are mainly used for teaching anatomical structures and surgical procedures in medical education. They are also used to plan the real surgical operations using real data from patients. A surgical simulator consists of hardware and software parts. Haptic force feedback device is the hardware part of the simulator and responsible for user interaction [6,7]. User can use medical tools attached to the haptic device to touch, to move, to rotate or to cut the soft tissues. Haptic device is also responsible for generating force feedback and delivering to the user. This force feedback generates actual touch feelings.

The software used in a surgical simulator requires knowledge from different research areas. Collision detection is a very important part of such software platform. Collision detection is
responsible for tracing the medical tool, in a virtual scene, and finding any collision with virtual objects, tissues, organs or bones. There are different methods for finding collision detection [8,9].

Simulating the deformation of soft tissues/organs caused by medical tools is the essential part of the any surgical simulators. There are many algorithms developed for such purposes [10,11,12,13,14]. These algorithms can be classified based on their mathematical/physical background (physically based/procedural) or on their real time performance.

In this work we used axis-aligned bounding boxes (AABB) method for finding any collision between the tip of the medical tool and organs/tissues. We implemented mass spring systems for deformation simulation. This method uses physically based algorithm and works in real time. The software platform developed is suitable to include other methods as well. The software platform is implemented using C++ programming language. In order to load, manipulate and visualize 3D organ/tissue models, we use OpenGL [15], which is thought of as an Application Programming Interface.

2. METHOD

Any surgical simulator can be fundamentally represented by the Figure 1, where basic requirements are given. Modules such as material properties, textures and procedures are application depended based on the purpose of the simulator. For example, such modules are different in kidney simulation and in tooth simulation.

![Diagram](image)

Fig.1. Core of a surgical simulator
2.1. Mass Spring Systems

Mass spring theory represents the deformable object by a 3D mesh consisting of \( n \) nodes and \( m \) links. Each node is considered as a mass point and the links between mass points are considered as springs. The internal force generated by this structure has two components. One is caused by the spring stiffness,

\[
 f_{ij}^K = K \left( |X_i - X_j| - r_0 \right) \frac{(X_i - X_j)}{|X_i - X_j|}
\]

where \(|X_i - X_j|\) is the current, while, \(r_0\) is the rest length of the spring. \(X\) represents the positions of the mass points and \(K\) is given as spring stiffness parameter. The multiplication term at the end of the equation gives the direction of the forces. The second component is generated by the velocity change across the spring

\[
 f_{ij}^D = D(V_i - V_j) \frac{V_i - V_j}{|V_i - V_j|}
\]

where \(V\) gives the velocity of the mass point. The total force acting on each mass point is then calculated by summing the forces generated due to spring stiffness, to the spring velocity change and external forces. Once the total force is known, there are many numerical integration methods such as implicit/explicit Euler or Runge-Kutta to calculate the new positions and velocities of simulation. In this study, Euler implicit and explicit methods are implemented. The developed software is suitable to integrate other methods.

2.2. Collision Detection and Response

Collision in this work occurs when the tip of the medical tools hits the organ/tissue. The goal is then to find which triangle and vertex is hit with the tip of the tool. Collision detection, in this work, is performed in two steps. In the first phase, axis-aligned bounding boxes (AABB) is utilized to divide the whole geometry into the 3D boxes. At the leaf of the each box, there is only one triangle. This method determines which triangle is hit, a collision occurs.

This work, then implements a ray triangle intersection algorithm [16] to find where in the triangle is hit. Using this location, we calculate closest mass point to this location. This mass point is then marked as collision point. Figure 2 shows collision and its locations using a simple model. The small square point is the collision points generated from the tip of the tool.
Fig.2. Collision detection, finding intersected triangle and vertex.

2.3. Visualization

The visualization module takes care of the model loading, any user defined manipulation and updating scene in real time in the case of deformation. The developed software also allows springs and points representation of 3D models. Figure 3 shows an example of such visualization and Figure 4 shows a different model, a spleen, in the same scene.

Fig.3. Line, spring, representation of a 3D model.
This module also responsible for texture mapping, material properties and color of the tissue/organ in consideration. These properties are application dependent. The simulation loop here also ensures the 40 fps in real time.

3. EXPERIMENTAL RESULTS

The developed software platform is tested with a variety of models. One is simple deformable model consists of 66 triangles and 35 vertices. The model interacts with a virtual tool. Deformation caused by the pulling the model from its one vertex is simulated as shown in Figure 6.
The second simulation is performed on a slightly more complicated model. A kidney model with 3996 triangles and 2000 vertices is undergoing deformation due to pulling and pushing from its one vertex with a virtual tool. A realistic deformations for both cases are also simulated in real time as shown in Figure 7.

![Deformation simulation of kidney model, pulling and pushing.](image)

4. CONCLUSIONS

This paper represents a complete simulation software designed for surgery simulations. The software capable of loading models, user manipulations, material properties and texture mappings, real time visualizations and realistic deformations. The simulation loop ensures real time performance even for models with large number of elements, triangles and vertices. The developed software is tested with several different models and with several different scenarios. These scenarios have different manipulations and a variety of deformations. The software platform produces virtually convincing results and works in real time. The developed software, therefore, can be used as a template for developing surgical simulators for different tasks.

REFERENCES

15. https://www.opengl.org/
Abstract:

In recent years, due to the increasing number of animals, farmers are under too much logistical and administrative workload. For this reason, they cannot spend as much time as before to monitor the health and well-being status of animals, thus bringing with its serious illness and health problems. In this regard, farmers need a new livestock management system. By using different modelling techniques that are able to follow the effects of animal husbandry, production, health and well-being on the environment continuously (7/24) with fully automated monitoring and control systems which are developed by using the latest technology in animal husbandry and working in real time. A livestock management system can predict the important events such as birth and disease before it happens and take necessary precautions. As an example of this system, it is possible to show the sound technology to provide early diagnosis and to reduce the use of antibiotics in cows. As reported in previous studies, cough is defined as a natural indicator of animal welfare. For example, in studies carried out on pigs in recent years, an automatic classification algorithm has been developed by examining the characteristics of the sounds of animals, and in addition to the classification of the cough sound of the animals, the position of the animal in the shelter has been determined automatically. The aim of this study is to show how the sound technology is utilized in Europe in order to continuously monitor the health of the pigs that are being produced extensively. This technology, which is not yet used in the Balkan countries, is brought to the attention of our scientists and farmers who are interested in the sensitive farming methods in animal husbandry and animal husbandry, and it is to be discussed whether this technology can be used in bovine and ovine livestock facilities, which are heavily produced in Balkan countries.

Keywords: Sound analysis, position detection, cough, animal welfare
General area of research: Agriculture
ICFAS2019-ID: 1078

1. INTRODUCTION

In recent years, many applications have been reported in the framework of sensitive livestock for animal production. For example; Van hirtum et al. (2001) described cough as a natural acoustic indicator of animal welfare. Other approaches examined the relationship between sound (Van hirtum and Berckmans 2004) water drinking behavior (Madsen and Kristensen, 2005) or
temperature (Geers et al. 1997) and animal welfare. The sounds of pigs were classified by Marx et al. (2003) and were directly related to pain.

Fig.1. Cough sound detection software (Exadaktylos ve ark. 2008).

Further research was focused on audio analysis in commercial pig farms (Ferrari et al., 2008), automatic classifiers (Fig. 1) (Exadaktylos et al., 2008; Silva et al., 2008), studies also calculating the differences between the time to reach the microphones of the cough sound (Fig. 2), localization of pig sounds (Silva et al., 2008) and localization and classification algorithms were combined (Exadaktylos et al., 2008).

Fig.2. Cough sounds on seven different microphone (Silva ve ark. 2008)
The aim of this study is to show how the sound technology is utilized in Europe in order to continuously monitor the health of the pigs, which are produced extensively, and to bring this technology, which is not yet used in balkan countries, to the attention of our scientists who are interested in animal husbandry and precision agriculture.
2. RESULTS AND DISCUSSION

In the first study conducted under laboratory conditions, algorithms were developed to detect cough sounds among all other voices. Sixty healthy animals received 5334 individual sounds, including 2034 coughing sounds, including animal sounds and background noise. As a result of the analysis, cough sounds were determined with a success rate of 92% (Van Hirtum et al. 2001). In another study, cough sounds were classified with a rate of 85.5% and other sounds with a accuracy of 86.6% (Guarino et al. 2008). In the second stage, current cough identification methods have been extended and a new method in real time has been proposed to identify cough sounds of sick pigs (Exadaktylos et al. 2008). A total of 11 experiments were performed using three Belgian males and three males, Landrace pigs, between 9-12 weeks and 20-40 kg. The data set consisted of 231 chemical coughs, 291 disease coughs and 149 other sounds. Preliminary results for the evaluation of the algorithm are based on the individual voices of healthy and sick animals obtained in the laboratory. Exadaktylos et al. (2008), cough sounds with 85% accuracy and 82% (Table 1) of disease-related cough sounds (Figure 5).

![Fig.5. Classification of cough sounds (Exadaktylos ve ark. 2008).](image)

<table>
<thead>
<tr>
<th>Mic.</th>
<th>Sick Cough Sound (Algorithm)</th>
<th>Sick Cough Sound (Manual Labeling)</th>
<th>Accuracy (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>88</td>
<td>64</td>
<td>73%</td>
</tr>
<tr>
<td>2</td>
<td>101</td>
<td>76</td>
<td>75%</td>
</tr>
<tr>
<td>3</td>
<td>41</td>
<td>33</td>
<td>80%</td>
</tr>
<tr>
<td>4</td>
<td>40</td>
<td>37</td>
<td>93%</td>
</tr>
<tr>
<td>5</td>
<td>35</td>
<td>29</td>
<td>83%</td>
</tr>
<tr>
<td>6</td>
<td>47</td>
<td>38</td>
<td>81%</td>
</tr>
<tr>
<td>7</td>
<td>37</td>
<td>31</td>
<td>84%</td>
</tr>
</tbody>
</table>
In the final stage, Silva et al. (2008) applied localization algorithm. As can be seen from Figure 6, localization of cough attacks of pigs was possible using this method. In a period of three hours, a total of 179 coughs were recorded in 19 cough attacks using seven microphones. After the mapping of the locations within the farm, it was seen that some danger zones could be detected. Although ingestion may indicate the position of cough or coughing seizures, this does not mean that cough comes from different animals. Different coughs recorded in this shelter can come from a single pig. All configurations showed a good position estimation with a mean error of 0-1.5 m and a standard deviation of 0.4 m (Silva et al. 2008).

![Fig.6. Location of cough sounds (Silva et al. 2008)](image)

3. CONCLUSIONS

Increasing the importance of animal welfare with the detection of cough sounds and their location indicates that such methods can be used in later times. With these developed systems, not only veterinarians will have information about animals but will also be aware of the status of their animals (7/24). This method can be used to visualize respiratory tract diseases and to reduce the use of antibiotics by selective and early treatment of animals in the determined areas of the whole farm.

REFERENCES


STUDY REGARDING THE SIGNS AND SYMPTOMS IN ORO-MAXILLO-FACIAL DISEASES THROUGH TWO-STEP CLUSTERING

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Abstract:

There are diagnoses in the oro-maxillo-facial area which can be established only through clinical examination, i.e. extra-oral exam, intra-oral exam and radiological exam. We used the Two-Step clustering procedure to analyze the symptoms tracks by the dental physician during these exams, in order to find the hierarchy between them and to evaluate the accuracy of this clustering method in identifying the diagnoses of cutaneous abscess and mandible fracture. The study sample was made from 653 patients registered in the “Sf. Spiridon” Hospital from Iasi, Romania – the Oro-Maxillo-Facial Clinic, and the number of clusters was determined automatically, using the Schwarz’s Bayesian Criterion (BIC) and a maximal limit of 15 clusters. The clustering procedure performed fairly for all the three types of examinations investigated, and the most relevant predictors among symptoms were identified.

Keywords: Oro-maxillo-facial disease, Two-Step clustering, Symptoms, Automated detection

General area of research: Biostatistics

ICFAS2019-ID: 1093

1. INTRODUCTION

Many diagnoses in the oro-maxillo-facial area are established through clinical examination, other in-deep investigations being often not necessary. The standard clinical examination consists from three distinct procedures: the extra-oral exam, the intra-oral exam and the radiological exam. During these controls, the dental physician usually tracks the presence / absence for a finite list of key signs and symptoms, with maximal relevance in finding the final diagnosis. In the current paper we performed a statistical study on a sample of 653 patients registered in the “Sf. Spiridon” Hospital from Iasi, Romania – the Oro-Maxillo-Facial Clinic, in order to find a hierarchy between these signs and symptoms using the two-step clustering procedure.
2. METHOD

The analysis was performed in SPSS 20.0, and we used the two-step clustering procedure because we had to deal only with categorical variables. The number of clusters was determined automatically, using the Schwarz’s Bayesian Criterion (BIC) and a maximal limit of 15 clusters. In output, we used for evaluation 2 particular oro-maxillo-facial diagnoses, the cutaneous abscess and the mandible fracture, which were the most frequent in the studied sample (54.9% and respectively 34.7% cases).

3. EXPERIMENTAL RESULTS


The analysis detected the presence of 3 clusters (fig. 1), with a fair quality (fig. 2), and the most important predictors among those 23 are: the presence of painful bone points, congested teguments, warm teguments and relaxed teguments. The 1st and 3rd clusters cover 93.4% cases with cutaneous abscess (and 27.8% fake positive (FP) cases), and the 2nd cluster covers 88.4% cases with mandible fracture (and 3.4% FP cases).

The intra-oral exam is characterized by 11 signs and symptoms: 1. bone mobility, 2. teeth mobility, 3. purulent secretion, 4. fistula, 5. hypoesthesia, 6. swollen mucosa, 7. congested mucosa, 8. edematiated mucosa, 9. erythematous mucosa, 10. painful at palpation mucosa, 11. fluctuant mucosa. The analysis detected the presence of 2 clusters (fig. 3), also with a fair quality (fig. 4); the most important predictors are: swollen mucosa, congested mucosa, painful on
palpation mucosa, bone mobility and fluctuant mucosa. The 1st cluster covers 69.6% cases with cutaneous abscess (11.5% FP cases), and the 2nd cluster covers 94.6% cases with mandible fracture (36.4% FP cases).

The radiological exam is characterized by watching 9 signs and symptoms: 1. bone lysis, 2. calculus in the salivary gland, 3. radio transparence, 4. radio opaque formation, 5. cyst, 6. coronary destruction, 7. solution of bone continuity, 8. bone substance loss, 9. fracture tract. The analysis detected again the presence of 2 clusters (fig. 5), with a fair quality (fig. 6); the most important predictors are radio transparence and coronary destruction. The 1st cluster covers 84.1% cases with mandible fracture (38.2% FP cases), and the 2nd cluster covers 68.0% cases with cutaneous abscess (19.0% FP cases).
4. CONCLUSIONS

The Two-Step Cluster Analysis detects accurately the natural groupings of cases and helps the dental physician in establishing the diagnosis by pointing out the most relevant predictors (signs and symptoms) to be tracked during the patient’s clinical exam. There is a certain overlapping between the identified clusters and specific diagnoses, applicable in automated decision systems.

REFERENCES


MODELING AND FORECASTING THE DIFFUSION OF MOBILE TELEPHONY IN ALBANIA AND TURKEY

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Abstract:

Mobile telephony has become one of the main factors driving the social and economic development of a country. This study examines the diffusion process of mobile telephony in Albania and Turkey. The main objective of this research is to model and to forecast the diffusion rate of mobile telephony using Logistic and Gompertz models, and World Bank data. The results of Logistic model, the best model for prediction of the mobile telephony diffusion rate in Albania, indicate that the maximum level of mobile diffusion of 132% is predicted to be achieved in year 2025. The results of Gompertz model indicate that the maximum diffusion rate of 97.98% is predicted to be achieved after year 2025. These findings are useful to customers, telecommunication operators, and policy makers.

Keywords: Mobile subscriber, Technology diffusion, Logistic model, Gompertz model, STATA.

General area of research: Applied Mathematics

ICFAS2019-ID: 1094

1. INTRODUCTION

Diffusion of new technology, such as mobile phones, is an important driver of economic growth. Mobile telephony has exhibited substantial growth and this growth is expected to continue with the introduction of technically advanced mobile cellular networks. Mobile phones have changed the way of communication, and play a substantial role in people lives, from the simple basic tasks of calling to work related duties such as sharing documents and/or sending emails quickly. Mobile telephony is the leading means for accessing communications because deploying mobile network is cost-efficient and mobile provides greater flexibility and convenience to its subscribers than wireline telephone (Singh, 2008).

Mobile telephony industry has exhibited an impressive growth throughout the world. In 2017, the number of people connected to mobile services surpassed 5 billion globally (with 3.7 billion in developing markets), that is two out of three people in the world had a mobile subscription. Mobile technologies and services generated 4.5% of GDP globally, a contribution that amounted to $3.6 trillion of economic value added (GMSA, The Mobile Economy 2018 Report). By the end of 2017, 85% of the population in Europe – 465 million people – subscribed to mobile services. The total addressable market for the region’s mobile operators is approaching saturation point. In 2017,
mobile technologies and services generated 3.3% of GDP, a contribution that amounted to €550 billion of economic value added (GSMA, The Mobile Economy Europe 2018 Report).

In Albania, there is a significant increase in the use of broadband access services both in the number of users of these services and in the volume of data during the period 2013-2017. The number of active users (use in the last 3 months of the year) of mobile telephony in 2017 amounted to about 3.2 million, representing a decrease of 5.9% compared to 2016. Mobile population penetration by broadband from 3G/4G networks at the end of 2017 reached 72% compared to 60% at the end of 2016, and 46% at the end of 2015. The number of active broadband mobile users has increased by only 65% in 2013-2017. Significant growth has also occurred in 2017 compared to 2016, where the number of 3G/4G users has increased by 20%. (Albanian Electronic and Postal Communications Authority, Annual report 2017)

In attempts to model and forecast the diffusion of innovations, a common step is the selection of an S-shaped trend model. Majority of the studies typically examine the penetration of a technological diffusion by means of the estimation of S-shaped growth curves, such as the Logistic and the Gompertz curves, and present estimates of the speed of diffusion and saturation level (or maximum size) of the market. The Logistic and Gompertz model each have their specific characteristics, making them useful models in empirical studies of diffusion. There are several studies about the growth pattern of mobile telephony markets using the diffusion theory. Some studies examined the diffusion of mobile telephony at country-level and some other empirical studies examined the mobile diffusion in several countries.

Traditionally, diffusion models have been used in telecommunications for forecasting the demand of a new product, to measure the product lifecycle dynamics, and as a decision tool to make strategic marketing choices (Meade and Islam, 2006). Rouvinen (2006), and Wu and Chu (2010) suggest that applying an S-shaped diffusion model is the first step to analyze diffusion of telecommunication services. Meade and Islam (2001) compare 17 growth models based on time series and find that models that use fewer variables such as Logistic, Gompertz and Bass models provide better estimates and more forecast accuracy. Gruber and Verboven (2001) used the logistic curve to analyze diffusion of mobile telephony in European Union and find that technological progress dominates market structure between 1984 and 1997.

Botelho and Pinto (2004) find that the Logistic model adequately describes the path of mobile phone diffusion in Portugal between 1989 and 200, and that the expected saturation level is 95%. In their study, Frank (2004) finds that network coverage is the most influential factor in the diffusion of mobile phones in Finland, based on logistic diffusion function estimation between 1981 and 1998, and the final penetration rate was estimated at 91.7% in 2009. Pereira and Pernias-Cerrillo (2005) found that the Logistic curve is a valid representation of the diffusion process in Portugal using quarterly data from 1994 to 2003, but only as a long-term trend. Moreover, they identified significant effects of increased competition on the diffusion process. They also observed that there were seasonal fluctuations that accounted for much of the variation in the early stages of diffusion. Rouvinen (2006) studied the factors determining the diffusion of digital mobile telephony across 200 developed and developing countries in the 1990s with the aid of a Gompertz model. The market size and network effects were found to play more important roles in the developing countries. Lee and Cho (2007) show that the Logistic model fitted better to the cellular mobile subscribers data covering 1984 to 2002 in Korea compared to the ARMA model. Results
indicated that the speed of diffusion increases with per capita GDP, but it decreases with the number of main telephone lines in operation. The final penetration rate was estimated to be 71.3% of the population. They also find that income growth was the most significant factor.

Michalakelis et al. (2008) studied the diffusion rate of mobile telephony subscriptions in Greece. Bass model, Fisher–Pry model, the Gompertz models and some representatives of the logistic variants were used. They find a saturation level between 111–126% for Greece and considers the Gompertz model as the most appropriate model for forecasting and Logistic model fits the actual data better. Singh (2008) found that the Gompertz model adequately described the path of mobile phone diffusion from 1995-1996 to 2005-2006 in India and the number of mobile phones will exceed the number of people by 2022-2023. Gamboa and Otero (2009) examined the diffusion pattern of mobile telephony in Colombia. The findings indicate that the diffusion pattern of mobile telephony in Colombia can be best characterised as following a Logistic specification. The estimated saturation level of 103.7 was expected to be reached in five years time.

Chu et al. (2009) found the most appropriate diffusion model was the Logistic model and the market competition was identified as a primary driver of the diffusion rate of mobile telephony in Taiwan. Dergiades and Dasilas (2010) found that the Logistic model describes better the diffusion process of mobile telecommunication services into the Greek market for the period 1993 to 2005 and also the Logistic model was best for forecasting. Wu & Chu (2010) found that the Gompertz model outperforms the other models before diffusion take-off, and the Logistic model is superior after inflection and over the aggregate range of the diffusion process in Taiwan during 1988–2007. The saturation levels vary from 104.8 to 105.5.

Gupta & Jain (2012) found that Gompertz model best describes the mobile diffusion process in India. Xielin et al (2012) found that Gompertz model outperforms the Logistic and Bass models in forecasting the diffusion of mobile telephony in China, and the Gompertz model forecasts higher market potential than the other two models. Karacuka and Catik (2012) found that the Gompertz model has better explanatory power for the diffusion process of mobile subscriber data in Turkey for 1986-2006. The future forecasted values predict that the mobile diffusion trend will be increasing. Yamakawa et al. (2013) indicate that the Gompertz model is the most appropriate model the diffusion of mobile telephone subscriptions in Peru. The Gompertz model's 5-year forecast of subscriptions predicts a further 11.72 million subscribers. Market concentration, population, regulated interconnection tariffs and GDP per capita were determinants of diffusion. Honoré (2019) shows that the Logistic model best describes the diffusion of mobile phone technology in Cameroon, and income, openness to competition and SMS usage are key forces driving this diffusion.

Understanding the diffusion process of new technologies is crucial to strategic planning of economic and social infrastructure. An effective management of mobile services requires an understanding of the factors that underlie the evolution of the market. Factors such as market timing, market potential and adoption speed are of great importance for telecommunications operators for capacity planning. Understanding the evolution of mobile telephony market and its possible future trend is equally important for policy makers (Singh, 2008).

The main objective of this research is to model and predict the diffusion of mobile telephony in Albania and Turkey using the World Bank data in order to help operators and policy makers to
implement the most suitable strategies. After it was confirmed that the mobile telephony diffusion follows the S-shaped curve, the Logistic and Gompertz models were estimated using STATA software.

2. METHOD

2.1. Diffusion Models

The literature on the diffusion of emerging technology generally uses S-curves to predict the diffusion process. Because the new technology typically at first grows slowly, then exhibits a growth rate greater than 1, followed by a period of slower growth (growth rate less than 1) and finally the growth rate slows down and converges to some saturation level. The empirical S-curve literature, in the technology-diffusion context has tended to focus on logistic model and Gompertz model (Franses, 1994; Bengisu and Nekhili, 2006).

The logistic model is represented by the differential equation:

\[ \dot{y} = ay(c - y) \]  

where where \( y(t) \) represent the total diffusion at time \( t \), \( c \) the maximum expected level of the Internet technology and \( a \) is the coefficient of diffusion which describes the diffusion speed. The diffusion speed is proportionate to the population that has already adopted the service \( y \) and the remaining market potential \( c - y \).

The solution of the logistic model (1) is given by:

\[ y(t) = \frac{c}{1 + e^{-at(t-t_0)}} \]  

where \( y(t) \) is the estimated diffusion level at time \( t \), \( c \) is the maximum level of diffusion; \( a \) is the speed of diffusion; \( t_0 \) is the moment of time when technology diffusion achieved half of its maximum level.

The Gompertz model is represented by the differential equation:

\[ \dot{y} = a y(\ln c - \ln y) \]  

The solution of the Gompertz model (3) is given by:

\[ y(t) = ce^{-a(t-t_0)} \]  

where \( c \) is the maximum diffusion rate; \( a \) is the speed of diffusion; \( t_0 \) is the moment of time when technology diffusion achieved the share \( 1/e \approx 36.8\% \) of its maximum level.

Both the Gompertz and Logistic curves involve the estimation of three parameters, and range between a lower asymptote of 0 and an upper asymptote of \( c \). The important feature of the Gompertz path is that the diffusion goes faster at the beginning but becomes slower over time. This leads to a relatively short period of rapid expansion and to a relatively long period of gradual growth up to the maximal level. The logistic curve is more symmetric, the growth rate is initially not as high as in the Gompertz curve and it declines more gradually (Jarne et al. 2007).

2.2. Data

The annual data used for this analysis are taken from the World Bank database. The dataset contains information about mobile cellular subscriptions per 100 people for Albania (1996-2017) and...
Turkey (1986-2017). To estimate the parameters of the Logistic and Gompertz models the nonlinear least squares method and STATA software were used. For forecasting, a model that fits best to the in-sample data does not necessarily provide more accurate forecasts. Therefore, the performance of out-of-sample forecasts is used to help for the selection of a diffusion model. The out-of-sample data cover the period 2015-2017.

The choice of functional form for a certain technology helps to characterize the dynamics of the trend. Some specific technologies are described best by one functional form and other technologies by another. Some model selection criteria used here are: Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC). The best model is the model which has the smaller value of AIC and BIC. To evaluate the performance of the best fitted or forecasted model was used the Root Mean Square Error (RMSE): \[ RMSE = \sqrt{\frac{1}{n} \sum_{i=1}^{n} (y_i - \hat{y}_i)^2}. \]

3. RESULTS

The mobile diffusion rates for Albania and Turkey during the study period, shown in figure 1, each following a S-curve pattern.

In Albania, the diffusion rate of mobile telephony is increased from 0.94% in 2000, to 49.7% in 2015 and to 126.3% in 2013 which is the highest rate in the period 1996-2017. The figure 1 indicates that the diffusion rate is increased during the period from 1996 to 2007 and then in year 2008 is decreased at 62.16% and the other decrease was in 2014 (115%). At the end of 2017, the diffusion rate was 119.38%, about 3.7% higher compared with the diffusion rate of 2016. The mobile diffusion rate in Albania has exceeded 100% in 2011 with 106%.

In Turkey, the diffusion rate of mobile telephony is increased from 13% in 1999, to 93.5% in 2008 and to 96.3% in 2017 which is the highest rate in the period 1986-2017. The figure 1 indicates that the diffusion rate is increased during the period from 1986 to 2007 and then in year 2008 is decreased at 88%. At the end of 2017, the diffusion rate was about 2% higher compared with the diffusion rate of 2016. The mobile diffusion rate in Turkey has exceeded 100% in 2011 with 106.3%.
The diffusion rate of mobile telephony was higher for Turkey until year 2009, and after 2009 the diffusion rate was higher for Albania.

The models obtained for all countries in the study are statistically significant and the parameters of the models are statistically significant at 1% level (tab. 1).

The results of Logistic model for the diffusion rate of mobile telephony in Albania indicate a maximum level of 131.9% and the speed of convergence to the saturation (maximum) level is 0.338. Mobile technology diffusion has achieved half of its maximum level in 2006. The results of Gompertz model indicate a maximum diffusion rate of 155.25%, the speed of diffusion is 0.178 and half of its maximum level is achieved in 2005.

The fit of each model is measured by the values of AIC, BIC, and RMSE. The results of both models show that Gompertz model has the best performance in describing the mobile technology diffusion, whereas the Logistic model is the best to predict the diffusion rate of mobile technology in Albania.

The Gompertz model is found appropriate to describe the diffusion process of mobile telephony in India (Singh, 2008; Gupta and Jain, 2012), Taiwan (Wu and Chu, 2012), China (Xielin et al, 2012) and Peru (Yamakawa et al., 2013).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Albania (n = 22)</th>
<th>Turkey (n = 32)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Logistic</td>
<td>Gompertz</td>
</tr>
<tr>
<td>( c )</td>
<td>131.89*</td>
<td>155.25*</td>
</tr>
<tr>
<td>( a )</td>
<td>0.338*</td>
<td>0.178*</td>
</tr>
<tr>
<td>( t_0 )</td>
<td>2006.84*</td>
<td>2005.83*</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.9886</td>
<td>0.9912</td>
</tr>
<tr>
<td>( R^2 ) adj</td>
<td>0.9864</td>
<td>0.9896</td>
</tr>
<tr>
<td>AIC</td>
<td>135.74</td>
<td>130.70</td>
</tr>
<tr>
<td>BIC</td>
<td>138.58</td>
<td>133.54</td>
</tr>
<tr>
<td>RMSE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In-sample</td>
<td>7.355</td>
<td>6.441</td>
</tr>
<tr>
<td>Out-of-sample</td>
<td>8.087</td>
<td>13.479</td>
</tr>
</tbody>
</table>

Note: Significance level: *, p < 1%.

The results of Logistic model for the diffusion rate of mobile telephony in Turkey indicate a maximum level of 93.56% and the speed of convergence to the saturation (maximum) level is 0.472. Mobile technology diffusion has achieved half of its maximum level in 2003. The results of Gompertz model indicate a maximum diffusion rate of 97.98%, the speed of diffusion is 0.286 and half of its maximum level is achieved in 2001. Values of AIC, BIC, and RMSE indicate that Logistic model has the best performance in describing the mobile technology diffusion in Turkey, whereas the Gompertz model is the best to predict the diffusion rate of mobile technology.

Logistic model is found appropriate to describe the process of mobile diffusion in Portugal (Botelho and Pinto, 2004; Pereira and Pernias-Cerrillo, 2004), in Korea (Lee and Cho., 2007), Taiwan (Chu et al., 2009), Colombia (Gamboa, and Otero, 2009) and Cameroon (Honoré, 2019). The Gompertz
model is found to fit best to the data and to give accurate forecasts for the mobile diffusion process in Turkey in the study of Karacuka and Catik (2012).

Comparing the estimated parameters of the best fitted models, results indicate that Albania has the highest estimated speed of diffusion of 0.338 and the highest maximum diffusion rate (155.25%). In the figure 2 are shown the actual and predicted data for mobile diffusion rates for two countries in the study.

Fig. 2. Actual and predicted number of mobile subscribers using Logistic and Gompertz models

The saturation rate of mobile telephony diffusion in Albania (131.9%), generated by logistic model, is predicted to be achieved after year 2025. The saturation rate of mobile telephony diffusion in Turkey (97.98%), generated by Gompertz model, is predicted to be achieved after year 2025.

4. CONCLUSIONS

Growth models are appropriate to model the mobile telephony diffusion. Developing models that explain the growth process is critical for policy formulation, capacity planning and introduction of new products and technologies. Mobile diffusion (growth) projection informs providers of these services/products about the potential consumer base.

In this study, the diffusion of mobile telephony is analysed using S-Shaped growth curve models such as Logistic and Gompertz models. This study examines the mobile telephony diffusion in Albania and Turkey using the World Bank data for mobile cellular subscriptions per 100 people. Results of descriptive analysis indicated that the data for each country follow a S-shaped curve. The diffusion rate of mobile telephony was higher for Turkey until year 2009, and after 2009 the diffusion rate was higher for Albania. In Albania, the highest rate of mobile diffusion was 126.3% in 2013, whereas in Turkey was 96.35% in 2017.

The results of estimated models indicated that: Gompertz model fits best to the actual data and Logistic model is the best model to predict the diffusion rate of mobile telephony in Albania; Logistic model fits best to the actual data and Gompertz model is the best model to predict the diffusion rate of mobile telephony in Turkey.
Comparing the estimated parameters of the best fitted models, results indicate that Albania has the highest estimated speed of diffusion of 0.338 and the highest maximum diffusion rate (155.25%). The results of Logistic model, the best model for prediction of the mobile telephony diffusion rate in Albania, indicate that the maximum level of mobile diffusion of 132% is predicted to be achieved around the year 2025. The results of Gompertz model, the best model for prediction of the mobile telephony diffusion rate in Turkey, indicate that the maximum diffusion rate of 97.98% is predicted to be achieved after year 2025.

Once identified, the accurate forecasting model, Logistic or Gompertz, can be useful for modeling aspects, such as the saturation level, of the future path of a new technology. Business managers can utilise such models to develop strategies that increase the potential adopters’ population, hence maximising profits. Estimates of the true market size and diffusion coefficients can help the telecommunication operators to assess their options for the introduction of future technologies (5G).

In the future research, the factors influencing the diffusion process of mobile telephony such as GDP per capita, inflation, unemployment rate, mobile telephony market competition, etc., can be studied using panel data modeling. Also, the usage of smartphones applications can be studied in the future research.

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TIME SERIES ANALYSIS OF TUBERCULOSIS IN MEDEA PROVINCE IN ALGERIA

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Abstract:

Tuberculosis (TB) is an infectious disease caused by the Mycobacterium tuberculosis. The disease is prevalent in almost every region of the world. In 2017, TB caused an estimated 1.3 million deaths and an estimated 10.4 million people developed TB disease. Tuberculosis remains a major health problem in Algeria. In 2017, the incidence rate of TB was 54.6 per 100,000 population with a total of 23,224 cases notified.

Predicting the incidence of any disease plays an important role in planning health control strategies for the future, developing intervention programs and allocating resources. This study aimed to analyse and interpret the available data for TB in Medea province, which records the highest number of TB cases in Algeria, and to develop a forecasting model. Retrospective time series analysis was used to study the monthly TB notification data collected from 2008 to 2016 from the surveillance system of Tuberculosis control program of Algeria. Data were examined for normality, variance equality and stationary conditions. Different models, using Box-Jenkins approach, were performed and the best model was selected on the basis of the smallest Schwarz criterion, Akaike information criterion, standard error regression, the highest adjusted $R^2$, the stationary and invertibility condition, and the white noise condition for residuals. The time series analysis showed that a $(2,6) \times (1,1)$ autoregressive integrated moving average model offered the best fit to recorded data of TB in Medea province. This model was used to predict TB cases for the year 2017, and the fitted data showed considerable agreement with the actual data.

Keywords: Algeria, Epidemiology, Time series analysis, Tuberculosis

General area of research: Mathematics

ICFAS2019-ID: 1016
THE LOCAL AND GLOBAL DYNAMICS MODEL OF A CANCER TUMOR GROWTH

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Abstract:

In this talk, we tried to analyse a possible mathematical model of inhibition of a cancer growth phase-space kinetic processes under immune reaction supported by chemotherapeutic agents. Mathematical modelling of this process is viewed as a potentially powerful tool in the development of improved treatment regimens. Mathematical analysis of the model equations with multipoint initial condition, regarding to dissipativity, boundedness of solutions, invariance of non-negativity, nature of equilibria, local and global stability have been investigated. We studied some features of the behavior of one of three-dimensional tumor growth models dynamics described in terms of densities of three cells populations: tumor cells, healthy host cells and effector immune cells. We found sufficient conditions, under which the trajectories from the positive domain of feasible multipoint initial conditions tend to one of the equilibrium points. The addition of a drug term to the system can move the solution trajectory into a desirable basin of attraction. We show that the solutions of the model with a time-varying drug term approach can be evaluated more fruitful way and down to earth style from the point of practical importance than the solutions of the system without drug treatment, in the condition of stimulated immune processes, only.

Keywords: Mathematical modeling of tumor dynamics, Immune system, Stability of dynamical systems, Drug treatment, Multiphase attractors

General area of research: Health

ICFAS2019-ID: 1022
A CLASS OF MARKOV OPERATORS AND THEIR APPROXIMATION PROPERTIES

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Abstract:

The starting point of this talk is a positive approximation process acting on functions defined on $\mathbb{R}_+$. This class uses an equidistant network of the form $(k\lambda_n)_{n\geq1}$, where $(\lambda_n)_{n\geq1}$ is a strictly decreasing sequence of real numbers such that $\lim_{n\to\infty} \lambda_n = 0$. The operators are designed as follows

$$(L_n f)(x) = \sum_{k=0}^{\infty} a_k(\lambda_n;x) f(k\lambda_n), \quad n \in \mathbb{N}, \quad x \in \mathbb{R}_+,$$

where $a_k(\lambda_n;x): \mathbb{R}_+ \to \mathbb{R}_+$ is continuous function for each $(n,k) \in \mathbb{N} \times \mathbb{N}_0$. Setting by $e_j$ the monomial of $j$-th degree, we assume that $L_n$ are Markov-type operators and

$$L_n e_j \in \Pi^*_j, \quad j \in \mathbb{N},$$

where $\Pi^*_j$ represents the set of all algebraic polynomials of $j$-th degree. We propose to study the following integral variant of $L_n$ defined by the formula

$$(D_n f)(x) = a_0(\lambda_n;x) f(0) + \sum_{k=1}^{\infty} a_k(\lambda_n;x) \int_0^{\infty} f(n\lambda_n t) \frac{t^{k-1} dt}{B(n+1,k)}.$$

where $B$ stands for Beta function. Some properties of this class are investigated in unweighted and weighted spaces of functions. Our goal is to show how the approximation properties are transferred from $L_n$ to $D_n$, $n \in \mathbb{N}$, operators.

Also, in our construction particular cases are outlined.

Keywords: Korovkin theorem, Modulus of smoothness, Rate of convergence, Weighted space

General area of research: Mathematics

ICFAS2019-ID: 1023
NONLOCAL CAUCHY PROBLEM FOR SCHRÖDINGER TYPE EQUATIONS WITH GENERAL ELLIPTIC PART

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Abstract:

The existence, uniqueness, regularity properties and Strichartz type estimates for the solution of multipoint Cauchy problem for linear and nonlinear Schrödinger equations with general elliptic leading part are obtained. Consider the multipoint Cauchy problem for nonlinear Schrödinger equations (NLS)

\[ i\partial_t u + Lu + F(u) = 0, \quad x \in \mathbb{R}^n, \quad t \in [0,T], \]

\[ u(0,x) = \phi(x) + \sum_{k=1}^{m} \alpha_k u(t_k,x) \]

where \( L \) is an elliptic operator defined by

\[ Lu = \sum_{|\alpha| \leq 2l} a_{\alpha} D^\alpha u \]

for \( \beta=(\beta_1,\beta_2,...,\beta_n) \), \( a_\beta \in \mathbb{C} \), \( m \) is an integer, \( t_k \in (0, T] \), \( \alpha_k \) are complex numbers, \( F \) is a nonlinear operator and \( u = u(t,x) \) is an unknown function. If \( F(u) = \lambda |u|^p \) in (1.1) we get the multipoint Cauchy problem for the nonlinear equation

\[ i\partial_t u + Lu + \lambda |u|^p u = 0, \quad x \in \mathbb{R}^n, \quad t \in [0,T], \]

\[ u(0,x) = \phi(x) + \sum_{k=1}^{m} \alpha_k u(t_k,x) \]

for a.e. \( x \in \mathbb{R}^n \), where \( p \in (1,\infty) \), \( \lambda \) is a real number.

Keywords: Schrödinger equations, Elliptic operators, Local solutions, Strichartz type inequalities, regularity properties of PDE

General area of research: Mathematics

ICFAS2019-ID: 1026
COMMUTATIVE IDEAL THEORY AND DEDEKIND DOMAINS

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Abstract:

Unique factorization first appeared as a property of natural numbers by the Fundamental Theorem of Arithmetic. In the 19th century, it was noticed that this theorem can also be applied to integers. For this reason, it began the attempts to generalize the Fundamental Theorem of Arithmetic beyond the natural numbers. This situation led to the concept of irreducible elements. In classical arithmetic any irreducible element is a prime element and vice versa but in more general domains a prime element may not be irreducible. Furthermore, the uniqueness of factorization into irreducibles (when it exists) does not hold in some rings of integers. The efforts in investigating a generalized interpretation of the Fundamental Theorem of Arithmetic implied important outputs in the Commutative Ideal Theory. Of central importance have been prime and maximal ideals. In particular, there are considered certain classes of domains such as Principal Ideal domains, Unique Factorization domains, Integrally closed domains, Noetherian domains, Dedekind domains and the relations between them. Dedekind domains are still not well-behaved, in the sense that their elements cannot be expressed uniquely as product of prime elements. However, a fundamental characteristic inhabits Dedekind domains. This theorem states that every proper (integral) ideal of a Dedekind domain can be written in one and only one way as a product of prime ideals. Moreover, this factorization property into prime ideals characterizes Dedekind domains. The development of Dedekind domains provided an interesting way of establishing a Unique Factorization Theorem for ideals which enlarged the Fundamental Theorem of Arithmetic.

Keywords: Fundamental Theorem of Arithmetic, Commutative Ideal Theory, Prime ideal, Maximal ideal, Dedekind domains

General area of research: Mathematics

ICFAS2019-ID: 1028
A COMPREHENSIVE OVERVIEW AND LATEST STUDIES ON THE MATHEMATICAL MODELS ABOUT TB DISEASE IN TURKEY

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Abstract:

This study is a comprehensive review of the mathematical models made in Turkey on tuberculosis (TB) that humanity has been struggling for years. In Turkey, the incidence of tuberculosis which is 172.9 per 100,000 in 1965, it has fallen quickly to a level like 52.2 per 100,000 in 1975. From 1975 to 2000, the incidence of tuberculosis which is 21.8 per 100,000, there has been a not so fast decline trend compared to previous years. In the last two decades, the incidence rates have been almost the same. These findings suggest that strong tuberculosis control programs are needed. All mathematical models which have been developed for the course of this disease have been introduced, studies conducted in Turkey have been examined in detail. These results of studies analyzed separately by using data obtained, the conclusions of these studies results in Turkey were evaluated in general. Information is given about where the deficiencies in the studies are due. It is aimed to create a road map by evaluating the results of all data.

Keywords: Mathematical Modelling, Epidemics, Epidemic Model, Tuberculosis in Turkey

General area of research: Mathematics

ICFAS2019-ID: 1029
ON THE RECONSTRUCTION OF MULTIDIMENSIONAL BANDLIMITED SIGNALS FROM DISCRETE DATA

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Abstract:

Bandlimited signals are abundant in nature. Most audio and video signals are bandlimited. The reconstruction of these signals from discrete data, such as samples of the signals or samples of their derivatives is a very important mathematical and engineering problem. While the reconstruction of one-dimensional bandlimited signals has been extensively studied, the reconstruction of higher dimensional signals from discrete data has not been completely solved. The difficulty arises from the fact that the construction depends on the geometry of the region on which the signal is confined. Numerical results are available but closed form solutions are elusive. In this talk we discuss the reconstruction of a class of multidimensional signals that are bandlimited in the sense of the fractional Fourier transform and the linear canonical transform.

Keywords: Multidimensional transforms, Sampling theorems; Bandlimited signals
General area of research: Mathematics
ICFAS2019-ID: 1030
STATISTICAL RELATIONAL LEARNING: A STATE-OF-THE-ART REVIEW

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Abstract:

The objective of this paper is to review the state-of-the-art of statistical relational learning models developed to deal with machine learning and data mining in relational domains in presence of missing, partially observed, and/or noisy data. It starts by giving a general overview of conventional graphical models, first-order logic and inductive logic programming approaches as needed for background. The historical development of each SRLs key model is critically reviewed. Finally, the last part of the paper focuses on the practical application of statistical relational learning techniques to a broad variety of areas. We conclude with a brief discussion on limitations of current SRLs methods.

Keywords: Statistical Relational Learning, Probabilistic Graphical Models, Inductive Logic Programming, Probabilistic Inductive Logic Programming
General area of research: Computer Sciences
ICFAS2019-ID: 1031
THE STABILITY OF MARANGONI CONVECTION IN A HORIZONTAL LAYER OF NANOFLUID

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Abstract:

A linear stability analysis is undertaken for the onset of Marangoni convection in a horizontal layer of a nanofluid heated from below. The model employed for the nanofluid incorporates the effects of Brownian motion and thermophoresis. The lower boundary of the layer is assumed to be a rigid surface at fixed temperature while the top boundary is assumed to be a non-deformable free surface cooled by convection to an exterior region at a fixed temperature. The lower boundary of the layer is assumed to be impenetrable to nanoparticles with their distribution being determined from a conservation condition. Material properties of the nanofluid are modelled by the non-constant constitutive expressions developed by Kanafer and Vafai (2011) based on experimental evidence. The work of this investigation will focus on Marangoni convection for layers of distilled water/alumina and distilled water/cupric oxide nanofluids. Calculations will adopt the models of Kanafer and Vafai (2011) for the effective dynamic viscosity and effective thermal conductivity of these nanofluids. Simultaneously, models for the surface tension of these nanofluids will be proposed based on the experimental findings of Jeong et al. (2008) for the distilled water/alumina nanofluid and Pantzali et al. (2009) for the distilled water/cupric oxide nanofluid.

Keywords: Marangoni, Linear stability, Nanofluid, Brownian motion, Thermophoresis
General area of research: Mathematics
ICFAS2019-ID: 1034
AN IMPLEMENTATION IN PARALLEL OF AN OPTIMIZATION TECHNIQUE IN ENERGETIC FIELD IN ALBANIA

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Abstract:

The energetic field is one of the most fundamental sector in the development the economy of a country. This is the reason why in many studies a mathematical model of an electro energetic problem is present. This optimization problem are solved in different ways and one of this methods is particle swarm optimization (PSO), which is considered one of the most efficient techniques for finding the optimal solution.
In this paper we present a modification of PSO technique and the study of the convergence through differential equations. We give a parallelization algorithm of the modified method. As a real problem we take in consideration the energy production in hydro power plants in Albania.

Keywords: PSO, optimization, Parallel implementation, Differential equation
General area of research: Mathematics
ICFAS2019-ID: 1035
ALLEVIATION OF NaCl TOXICITY IN BEAN (*Phaseolus vulgaris* L.)
LEAVES BY THE EXOGENOUS APPLICATION OF NARINGENIN

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Abstract:

Objective / Purpose: Naringenin (4,5,7-trihydroxy-flavonone, NGN), a bioflavonoid widely found in citrus fruit, tomatoes and cocoa, exerts a powerful radical scavenger activity. It has been shown to possess antioxidant, antiproliferative, antitussive, and interesting hepatoprotective properties. The effect of 100 mM NaCl on growth, relative growth rate (RGR), relative water content (RWC), osmotic potential (Ψ⊥), the maximal efficiency of PSII photochemistry (Fv/Fm), proline (Pro) content and thiobarbituric acid reactive substances (TBARS) evaluated in bean (*Phaseolus vulgaris* L.) growing in media with and without an amendment of naringenin application for 7 days.

Results: After exposure to 100 mM NaCl, the significant reduction in Pro content began after the first day of stress in wheat leaves. RWC, RGR, Ψ⊥ and Fv/Fm decreased after salinity during the experimental period. Stress caused an increase in TBARS as from the first day of stress. On the other hand, the application of naringenin to hydrophonic system could change the mobility of Na and Cl, and so the uptake to bean of Na and Cl was reduced.

Conclusion: Under naringenin application, the oxidative stress induced by salinity treatment was reduced, providing the decrease in TBARS content and increase in RGR, RWC, Fv/Fm, Pro and Ψ⊥. It is concluded that application of naringenin had significant positive effects on oxidative damage, water status and photosynthetic activity in bean leaves exposed to NaCl stresses.

Keywords: Naringenin, Osmotic adjustment, *Phaseolus vulgaris* L., Salt stress

General area of research: Biology

ICFAS2019-ID: 1039
TESTING USING HASH OR HMAC IN WEB SERVICES

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Abstract:

HMAC is the special case where the message authentication code has hash functions. All work that can be done with HMAC can be done with also hash functions. In this study, two structures will be compared with different criteria on web services. Some of the situations to be tested are: text with variable length, transmission in encrypted or unencrypted media, use of various encrypting algorithms etc.

Keywords: TripleDES, Message level security, SHA512.

General area of research: Computer Science

ICFAS2019-ID: 1040
EVALUATION OF THE ANTIVIRAL ACTIVITY OF BALLOTA GLANDULOSISSIMA EXTRACTS AGAINST RESPIRATORY SYNCYTIAL VIRUS (RSV)

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Abstract:

In order to find new and effective antiviral agents from natural sources, the antiviral properties of methanol and aqueous extracts obtained from Ballota glandulosissima Hub.-Mor. Et Patzak were evaluated by Colorimetric XTT test against Respiratory syncytial virus (RSV). The concentration required to provide 50% protection against cytopathic effects caused by virus is defined as EC50, the selectivity index (SI) was determined from the ratio of CC50 (50 % Cytotoxic Concentration) to EC50.

At the end of the study, it was found that both the methanol (EC50 = 12.45 µg/mL; SI = 24.84) and aqueous (EC50 = 19.12 µg/mL; SI = 24.59) extracts of Ballota glandulosissima had almost the same strong anti-RSV activity as well as ribavirin (EC50 = 3.25 µg/mL, SI = 34.89), which is used as a positive control against RSV.

In conclusion, we can say that B. glandulosissima extracts are worthy of further studies in order to develop RSV as an alternative to the drugs used in clinical practice. This is the first report on the anti-RSV activity of B. glandulosissima.

Key Words: Ballota glandulosissima, Methanolic and aqueous extracts, Antiviral activity, Respiratory syncytial virus

General area of research: Biology
ICFAS2019-ID: 1043
ON THE CONTROL OF DAMPED BOUSSINESQ EQUATION

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Abstract:

In this paper, the optimal distributed control problem of an Damped Boussinesq equation is studied. DubovitskiiMilyutin functional analytical approach is formulated for obtaining the necessary optimality condition in the form of Maximum principle for the system under consideration. Necessary optimality condition is presented in fixed final horizon case.

Keywords: Boussinesq equation, Maximum principle, Deflection, Performance index
General area of research: Mathematics
ICFAS2019-ID: 1048
Abstract:

To provide an accurate prediction of different properties of the molecular systems, from conformation changes to thermodynamic properties (such as free energy of hydration), and besides, consistency among all other molecules already optimized, remains still challenging, computationally time-consuming and perhaps tricky to automate. For example, it is already difficult to fit the electrostatic potential energy surface for even small molecules from a few molecular surface points.

Recently, automated optimization methods have shown to be very useful by combining quantum mechanics methods using the density functional theory (DFT) calculations as the reference to calibrate classical force field parameters. In this case, the electronic-structure properties are used as the chemical sample space. Other automated methods have also been introduced using the atomic resolution of the molecules as chemical sample space. A disadvantage of these approaches is that a large number of compounds are necessary to be screened to ensure an accurate parameterization of a new molecule, which is computationally very demanding.

Very recently, machine learning approaches are introduced to automate classical force field parameters using the reference energies from electronic-structure calculations to predict intra-molecular interactions without needing to use potential harmonic approximations of the classical force field types. Although these methods are very accurate to interpolate among the training dataset, they suffer for not being able to extrapolate outside the training dataset. Therefore, in practice, the increase of diversity among the molecules included in the training dataset is required to guarantee good predictions.

This study aims to discuss the importance of the choice of the chemical space of the training dataset, so that gained experience by the training to incorporate all the laws of physics adequately.

Keywords: Force field parameterization, Automation, Machine Learning

General area of research: Physics

ICFAS2019-ID: 1049
TOWARD THE COMPLETE SET OF DIFFERENTIAL EQUATIONS THAT DESCRIBE REGULATORY NETWORKS

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Abstract:

The focus of this work is modelling and simulation of regulatory systems. We consider a simple model of a regulatory network, and apply both discrete and hybrid modelling techniques. The numerical simulations of both models yield consistent results: they predict that the system reaches its stability in a condition where concentrations of some components are above a threshold, and some others below it, biologically representing a healthy physiological condition.

As a first approach toward estimation of kinetic parameters of interactions between the components, we introduce a novel methodology of exploiting the genetic algorithm on semi-random matrices, which represent Jacobians of transformation of dynamic equations of our system, in the mean field approximation. Finding the matrix which best describes the system dynamics can serve as a first approximation to a fully continuous deterministic model of a regulatory system. The numerical simulations show that this method can be successfully applied on our toy system, giving a good description of its long-term behaviour.

Keywords: Regulatory system, Boolean model, Hybrid model, Genetic algorithm, Fixed point
General area of research: Mathematics
ICFAS2019-ID: 1052
LATIN SQUARES, AFFINE PLANS AND STEINER TERNARY SYSTEMS

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Abstract:

In this paper, we will present a description of the latin squares, affine planes and Steiner triple system, which will give some illustrative examples. We will present an algebraic description of the latin squares. Also, they will be given, proofs, links to Latin squares and finite affine plane of order $Sn$. We will bring some interesting examples. In this paper we provide necessary and sufficient conditions for the existence of a Steiner triple system.

Keywords: Latin squares, Affine planes, Steiner triple system, Desing
General area of research: Mathematics
ICFAS2019-ID: 1053
DIOPHANTINE APPROXIMATION AND EXPANSIONS IN NON-INTEGER BASES

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Abstract:

We are interested to beta – expansions of an algebraic numbers in an algebraic base beta with a point of Diophantine approximation. It is not an easy task to get beta –expansions for cases that this expansions is not finite or periodic. Since there is no evidence for a particular structure for case when this expansion is not finite or periodic, some authors are try to give an way to get the expansions. Diophantine exponent have an important role to get Diophantine properties of numbers with given sequences related to beta expansions. A complexity function gets the measure for infinite word over a finite alphabet and count the distinct blocks of a letter in a given word. Blanchard have given a classification of beta shifts in five classis, C_1 beta shift of fine type d_β (1) is finite , C_2 d_β (1) periodic when beta shifts is suffix, C_3, d_β (1) is not eventually periodic, C_4, d_β (1) contain arbitrary large strings of zeros and C_5 classes d_β (1) contains all admissible words. [1] Controlling the gaps of strings of zeros in d_β (1) give a new classification of algebraic numbers more than 1 with classes Q_i^j compare to Blanchard classification C_1,C_2, C_3, C_4,C_5 . Schmeling and Later proved that the three last classes C_3, C_4,C_5 have Hausdorff dimension one so mostly contain transcendental numbers [2].

Keywords: Beta-integer, Diophantine approximation, Pisot numbers, Perron number, Mahler measure

General area of research: Mathematics
ICFAS2019-ID: 1054

References


SOME HERMITE-HADAMARD TYPE INEQUALITIES FOR n-TIME DIFFERENTIABLE FUNCTIONS WHICH ARE GENERALIZED (s, m, φ)-PREINVEX

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Abstract:

In the present paper, the notion of generalized (s, m, φ)-preinvex function is applied in order to establish some new integral inequalities of Hermite-Hadamard type for n-time differentiable functions. At the end, some applications to special means are given.

Keywords: Hermite-Hadamard inequality, Hölder inequality, Power mean inequality, Convex functions
General area of research: Mathematics
ICFAS2019-ID: 1058
TWO CHARACTERIZATIONS OF STRICT CONVEXITY IN LINEAR 2–NORMED SPACES

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Abstract:

In this paper two equivalent characterizations of strict convexity in linear 2–normed spaces in terms of duality mappings of type $B'$ as related to linear 2–normed spaces, are given.

Keywords: Linear 2–normed space, Strict convexity, Linear 2–functional, Duality mapping

General area of research: Mathematics

ICFAS2019-ID: 1059
SOME RESULTS ON MULTI-VALUED FRACTALS IN EXTENDED B-METRIC SPACES

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Abstract:

Fractals and multi-valued fractals have several applications in many fields such as in biology, computer graphics, dynamical systems, geophysics etc. Fractal sets can be generated by using several techniques. One method for constructing fractals is by using Iterated Function Systems, which is a finite set of “contraction mappings” on a complete metric spaces. So, the most common setting for the study of fractals is the case of operators in complete metric spaces. Lately researchers have found several results for fractal set or multi-valued fractal other by generalizing the space or by generalizing the contraction mappings. The aim of this paper is to extend the study of multi-valued –fractals by using multi-valued operators in extended b-metric spaces.

Keywords: Fractals, Fractal operator, Iterated function system, Extended b-metric space

General area of research: Mathematics

ICFAS2019-ID: 1064
INVESTIGATION OF SOME PHYSICAL BEHAVIORS OF DISPERSIVE SHALLOW WATER WAVES

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Abstract:

In this work, dispersive shallow water wave dynamics are considered by Rosenau-Kawahara-RLW equation. Finite element method is applied to the equation and stability of the method is analyzed by using von Neumann theory. The accuracy of the proposed method is checked via error norms and conserved quantities. Then, we study on three test problems including motion of solitary wave, interaction of two solitary waves and evolution of solitons to investigate some physical behaviors of dispersive shallow water waves. Last of all, we can say that the presented method is easy to apply and it gives precise solutions with little computational effort.

Keywords: Rosenau-Kawahara-RLW equation, Finite element method, Dispersive shallow water waves

General area of research: Mathematics

ICFAS2019-ID: 1068
ANALYSIS OF THE EFFECT OF INHABITANT BEHAVIOR ON THE ENERGY CONSUMPTION IN THE RESIDENTIAL SECTOR

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Abstract:

The sector of building is one of the main targets of the improvement of energy efficiency, since it represents today more than one third of the worldwide consumption of energy and an equivalent amount of its associated emissions. In Algeria, this sector has the highest energy consumption. Its consumption represents more than 42% of the total final consumption. This study aims to investigate the energy consumption trend of inhabitants and to study their behavior in order to rationalize this consumption. In this work a statistical survey was conducted covering 100 homes in the town of Constantine located in north east of Algeria, in order to estimate the electricity and gas consumption by the inhabitants and analyzing their behaviors related to this consumption. Particularly, by examining their manner of using heating and air conditioning (such as the adjusted temperature and the frequencies of this use). Moreover this survey inspects the type of lighting and the types of the domestic appliances used and the frequencies of this use, as well as the occupancy rate of different rooms of the building by the inhabitants. In the second part of this work a numerical simulation of several types of building was carried out using TRNSYS software in order to evaluate the thermal performance of these buildings. TRNSYS software allows us to estimate the energy need of heating and air conditioning. A particular simulation is carried out for a special type of building for which the data were collected by the survey with the aim of determining its theoretical energy consumption and comparing it with real data obtained by the survey. This comparison allows us to study the potential of energy saving by improving the building characteristics (particularly by improving its envelope) on one hand and on the other hand by raising awareness of the inhabitants in order to adjust their practices toward a more rational behavior as regards energy consumption. The statistical survey conducted covering 100 homes in the city of Constantine has enabled us to draw the following conclusions:

• Approximately 33% of constructions are made of materials with poor thermal characteristics such as concrete blocks. One can notice the low use of thermal insulation in these buildings, with a maximum of 5% of buildings thermally insulated.
• The numerical simulation has shown that the improvement of the envelope allows an energy saving of more than 40%.
• About ¼ households use energy-consuming lamps (incandescent lamps) while the use of low-consumption LED lamps is very low.
• A small number of inhabitants does not necessarily imply a reduction in energy consumption, this is due to the irrational attitude of the inhabitants.
• The actual consumption resulting from the questionnaire is higher than that obtained by the simulation by 17%, this is due to the irrational behavior of the users.

Keywords: Thermal engineering, Thermal confort, Numerical simulation, TRNSYS software
General area of research: Mathematics
ICFAS2019-ID: 1073
STUDY OF THE THERMAL BEHAVIOR OF THE OPTIMIZATION OF A RURAL HOUSE LOCATED IN SOUTH MEDITERRANEAN

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Abstract:

The objective of our work is to study the thermal behavior of the optimization of a rural house located in Algeria. Improvements are made to the exterior envelope, adjacent walls, glazed surfaces, orientation, ventilation and solar gain management; We are going to compare three cases, with the same area of 80 m², located in several climatic zones in Algeria, inhabited by a family of four, these variants are defined as:
* Basic case "un-optimized"
* Conventional building "optimized using conventional techniques"
* Natural building "optimized using bioclimatic techniques"
The thermal behavior of the three variants will be simulated using the dynamic thermal simulation software TRNSYS 17, whose building modeling will be done by SketchUp 2016, over a meteorological year (meteorological data will be imported from METEONORME software).

Keywords: TRNSYS 17, Thermal behavior, Rural house, South Mediterranean Rim
General area of research: Thermal engineering
ICFAS2019-ID: 1074
EVIDENCES OF DISTRIBUTION SPECIFICS FOR DAILY EURO-ALBANIAN CURRENCY EXCHANGE RATES

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Abstract:

In this work we considered the dynamics of Euro/ALL exchange rates. By analyzing the distribution of the relative change in the daily exchange rate series for the period [2000, 2019] we obtained that the distribution of the return is unstable. Hence the consideration of the whole interval for statistical analysis has been disqualified. But in all we observed that the exchange rate return of Euro to national currency has been more stable than the corresponding of USD/All and the return of the price of precious metals. This behavior supported the idea that a constant pressure on the exchange misbalance has produced the effect but which one of exchange rate factors has been dominant has not been identified herein. For shorter intervals less non-stationary distributions have been observed and usually they fall in the interval [2008, 2019]. Using empirical mode decomposition we localized the time interval where a trend on the volatility is clearly identified by the last mode behavior. We observed that the trend of the return has decreased smoothly from 2012 and reached the bottom of negative values near 2017 and is expected to grow up decreasing its magnitude in the near future for c.p conditions. Therefore the corresponding exchange rate would be less volatile in statistical view. By checking respective series of exchange rate for the presence of self-organization it resulted that isolated quasi self-organization processes arise and disappear without reaching the crash point. Therefore no strong movement in the exchange rate is much likely to occur in the near future if general condition remains apparently unchanged.

Keywords: Exchange rate, Log-periodic, Stationary states, Unstable distribution
General area of research: Mathematics
ICFAS2019-ID: 1075
EVALUATION OF LIGHTNING CONDITIONS IN COMMERCIAL DAIRY FARMS

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Abstract:

In this study, it is aimed to compare the measurement values of the lighting systems used in dairy farms with international standards. The studies were carried out in the more primitive dairy farm, which is a connected stop system with 20 animals and a modern dairy farm which has a freestanding system, milking house, delivery house and infirmary with 3000 animals. PCE-EM 888 anemometer was used to measure existing lighting levels of commercial farms. Five different points of each dairy farms were chosen to perform these measurements. As a result of this study, the presence of lighting levels in existing systems was investigated and it was aimed to determine the level of artificial illumination especially in times of natural illumination. The results are compared with the standards and aimed to reach the correct lighting level. Average lighting was found as 1151.2 lüx in modern dairy farm while the ASAE standard was 500 lüx. Altough, the ASAE standard was 200 lüx for primary dairy farms, the average lighting was found as 4.6 lüx. It was aimed to raise awareness of farmers about the missing lighting areas and what should be done as a result of these determinations. The results show that the average lighting in primary commercial dairy farms was definitely insufficient. Therefore, the farmers were informed and advised to upgrade their lighting armatures in their farms. Conversely, the average lighting of modern dairy farm was found very high as more than double of standards. Thus, the owner of modern farm was advices to decrease lighting levels of the farm for energy efficiency.

Acknowledgement: This research was supported by Çanakkale Onsekiz Mart University. The Scientific Research Coordination Unit, Project number: FBA-2018-2771

Keywords: Dairy farming, Milking, Lighting, Animal welfare, Animal health
General area of research: Agriculture
ICFAS2019-ID: 1077
THE EXISTENCE AND UNIQUENESS OF THE SOLUTION FOR FREDHOLM INTEGRO-DIFFERENTIAL EQUATION USING HDG METHOD

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Abstract:
The main purpose of this study is to find the solution of Fredholm integro differential equations by HDG method. In this context, first of all, the existence and uniqueness of the solution will be proved. In particular, the selection of the stability parameter and the theoretical process on the system of equations must be careful. Then, a few numerical examples will be given to show that the method yields effective and convergent results.

Keywords: HDG method, Stability parameter, Fredholm integro differential equation
General area of research: Mathematics
ICFAS2019-ID: 1079
ON GENERALIZED SOLUTIONS OF NONLINEAR SYSTEMS

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Abstract:

In this study, theoretical statements on weak solvability of nonlinear coupled systems are presented in a Hilbert space $H$. The well known solution method, Faedo Galerkin method, which is widely used for proving existence and uniqueness of solutions for systems of differential equatios, is given. Some auxiliary theorems as Riesz representation theorem, Lax Milgram theorem and the basic properties of Sobolev spaces are presented.

Keywords: Faedo Galerkin method, Bilinear forms, Coupled systems, Gelfand triple
General area of research: Mathematics
ICFAS2019-ID: 1080
SOME DNA CODES OVER $F_2$

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Abstract:

The study of algorithms to investigate optimal codes is an important topic in the area of pattern recognition for real DNA sequences. In this study, a new algorithm which converts real genes to vectors over $F_2$ is proposed to obtain optimal codes. As a result, some self-dual codes and optimal codes (according to Grismer bound) are found.

Acknowledgements: Computing resources used in this work were provided by the National Center for High Performance Computing of Turkey (UHeM) under grant number 1006492019.
This work was supported by Research Fund of Yildiz Technical University. Project Number: 2016-07-03-DOP05

Keywords: Algebraic DNA codes, Self-dual codes, Pattern recognition

General area of research: Mathematics

ICFAS2019-ID: 1082
Abstract:

The starch consists of amylose and amylopectin linked together by 1,4 and 1,6 glycosidic bonds. There are abundant in nature. But, starch is a biopolymer with a weak barrier due to its hydrophilic nature. It is preferred to improve the barrier and physical properties of cross-linking starch in various applications. In this study, water vapor permeability, solubility and optical properties of pure and cross-linked starch films were investigated. For the solubility test of the films, dry weights were taken and as a result, the solubility value for starch film was 27.08 ± 1.08%, whereas this value was 6.48 ± 1.13% in cross-linked films. Absorbance of 600 nm wavelength in the opacity test of the films was carry out. The absorbance value for the starch film was 0.184 ± 0.001 and 0.242 ± 0.019 for the crosslinked films. Water vapor permeability test was performed according to ASTM E 9680 standard. As a result, it is 31.69 ± 0.43x10⁻⁷ g s⁻¹ m⁻¹ Pa⁻¹ for starch film, whereas in the cross-linked film it is 27.8 ± 2.68x10⁻⁷ g s⁻¹ m⁻¹ Pa⁻¹.

Keywords: Water vapor permeability; opacity; starch; film.

General area of research: Chemistry

ICFAS2019-ID: 1084
ANALYSIS OF NONLINEAR FRACTIONAL-ORDER VOLterra
INTEGRO-DIFFERENTIAL EQUATION

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Abstract:

This study is focused on studying the existence and the uniqueness of nonlinear Volterra's integro-differential equation solutions, which contains a NFDt. It is a new definition of fractional time derivative of Caputo. Firstly, we consider some conditions on the kernel K and its partial derivative ∂K/∂x to assure the existence and uniqueness of its solution. Then we study the approximation of the solution for its equation. Finally, we use Matlab and C++ to get the approximate solution of three examples of this equation, and we compare the exact solution with the approximate solution of these examples.

Keywords: Integro-differential Volterra equation, New definition of fractional time derivative
General area of research: Mathematics
ICFAS2019-ID: 1085
BIOLOGICAL ACTIVITY STUDIES OF NEW SYNTHESIS BORON COMPOUNDS

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Abstract:

The importance of boron compounds have been increasing because of its several applications, the synthetic efforts to provide new molecules and due to their biological properties. Against this background, the numbers of articles in scientific journals on biological effects of boron have increased steadily since 1990, and important contributions were published in this journal. Important clusters of contemporary research can be identified in the essential role of boron in plants and animals and associated mechanisms of action, perspectives for boron compounds in pharmacy/pharmacology, and human safety aspects [Hermann M. Bolt, Yalçın Duydu, Nurşen Başaran, Klaus Golka, Arch Toxicol (2017) 91:2719–2722.]. New boron compounds have been synthesized and characterized with melting points of the substances, 1H, 13C NMR, LC-MS / MS, UV-Vis. and FTIR analyzes. The antioxidant activities of obtained boron compound were determined by CUPRAC, DPPH free radical and ABTS cation radical removal methods. Their cytotoxicity was also examined.

Keywords: Boron compounds, Antioxidant activities, Cytotoxicity
General area of research: Chemistry
ICFAS2019-ID: 1016
HYPERGRAPHS : FOOD NETWORKS

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Abstract:

A hypergraph is a generalization of a graph since, in a graph an edge relates only a pair of points, but the edges of a hypergraph known as hyperedges can relate groups of more than two points. The representation of complex systems as graphs is appropriate for the study of certain problems. We give several examples of social, biological, ecological and technological systems where the use of graphs gives very limited information about the structure of the system. We propose to use hypergraphs to represent

Keywords: Hypergraphs, Food networks

General area of research: Mathematics

ICFAS2019-ID: 1088
A THERMAL COMFORT EVALUATION USING A STATISTICAL ANALYSIS OF INTERIOR TEMPERATURE FOR A BUILDING LOCATED IN CONSTANTINE, ALGERIA

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Abstract:

The objective of this study is to analyze the thermal behavior of a residential building with an aim of estimating thermal comfort in this building for a case of a passive air conditioning. Passive air conditioning can play a major role in promoting energy efficiency in the building sector. Considering that this sector is one of the main targets of the improvement of energy efficiency, since it represents today more than one third of the worldwide consumption of energy and an equivalent amount of its associated emissions. In Algeria, this sector has the highest energy consumption. Its consumption represents more than 42\% of the total final consumption. In this work a numerical simulation using TRNSYS software was carried out, in order to determine the annual distribution of temperatures inside this building. This thermal simulation allows us to estimate the hourly value of the temperature inside each room for a chosen location. To carry out this simulation a detailed description of the building used is given with precision, such as the details concerning the building envelope (type of wall, type of window, orientation, solar protection etc.). Furthermore a schedule (scenario) of occupation of different rooms is provided with the level of activity of each occupant. In addition, a schedule describing the use of lighting and that of the various appliances, which contribute to the internal heat gains, is elaborated. The site of the selected building is the town of Constantine located east of Algeria and having the geographical and weather characteristics as follow:

- Latitude 36.17\textdegree\ north
- Longitude 6.37\textdegree\ east
- Altitude is of 694 m
- Located in climatic zone B

The weather data of this site are ensured by a weather file provided by the software. In order to carry out a statistical analysis of the results obtained by the TRNSYS software, a computer program has been developed in order to process these results. This processing made possible the calculation of the statistical distribution of temperatures throughout the year, based on the annual distribution of the building's internal temperatures.

In this study two statistical distributions were determined namely the probability density as well as the cumulative probability of the interior temperature of the building. The distribution of the cumulative probability of interior temperatures calculated for the two extreme seasons, namely winter and summer, made possible the analysis and the estimation of the duration of thermal comfort for passive air conditioning.

Keywords: Thermal engineering, Thermal comfort, Numerical simulation, TRNSYS software

General area of research: Thermal engineering

ICFAS2019-ID: 1089
IMPLEMENTATION OF A DATA COMPARATIVE MODEL TO ENSURE PRODUCT QUALITY FOR ANALYTICAL SOLUTIONS

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Abstract:

This research aims to demonstrate and implement a comparative model of data in the development of analytical solutions using agile methodology. The model is based on the end-to-end data test in which the actual result achieved after executing a test case compares with the result in which the test case should functionally produce according to the requirements. By comparing the current result with the expected result, initially, a row hash is generated for the fields that will be included in the comparison, which is compared to the row hash of the expected results by a key column, and where also the case of the key column scope is oriented, could be a compound key. In the comparison mechanism, the dataset with different row hash are oriented according to the xml format in different nodes in order to accelerate and increase the efficiency of the data comparison process. The comparison process of the expected results with the generated results will be executed in parallel for more than one comparison at the same time, through the parallel execution mechanism which will be monitored by the a database level agent, where, regardless of the cases or the functionalities that are being developed, we need to ensure that the final results of all test cases are as expected.

Through this research, we provide an instrument that enhances the efficiency and quality of analytical solutions when dealing with agile methodology for new functionality developments. The implementation of a comparative model of data from multiple sources will be the focus of this study.

Keywords: Agile, Data comparison, Row hash, Xml, Parallel
General area of research: Computer Science
ICFAS2019-ID: 1090
RISK ASSESSMENT OF SPECULATION IN SECTORS OF ALBANIA’S ECONOMY: 2005 –2018

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Abstract:

The main purpose of this study is to develop a risk assessment of speculation in several sectors of Albanian economy for democratic state during the specified period. The study aims to evaluate the speculation rate of main Albanian industries, such as manufacturing, post and communication, agriculture, construction etc. We use the probabilistic definition of risk, developed by “Steklov” Mathematical Institute in Moscow (2012) and Gelfand’s classification. The results are obtained for Albanian economy for a time frame from 2005 to 2018, using secondary data. Some of the industries in Albania contain a huge amount of speculation, dominated by post and communication and also construction. In overall, industrial sector in Albania contains a considerable amount of speculation. These findings are of great importance to Albanian policy makers, researchers, and especially to Albania citizens. Brutality of unfair game in Albanian economy, in combination with corruption, generates excessive speculation.

Keywords: Speculation, Risk, Quarterly GDP growth rate, Fair game, Albania
General area of research: Mathematics
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A MATHEMATICAL MODEL OF THE TUMOR GROWTH WITH REAL NOISE

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Abstract:

A stochastic model is developed to describe the growth of a heterogeneous tumor for dispersed cells regime.
The mathematical model is a stochastic partial differential equation of parabolic type in three dimensional space and time, with a multiplicative real noise term.
The main feature of the model is that it takes into account behavior of tumor cells as well as random interactions between tumor cells, immune system cells and anticancer drugs.
The main results are: The existence of stochastically weak solutions, path-wise uniqueness and a convergence result for approximate solutions. Some biomedical applications are suggested.

Keywords: Tumor growth, Dispersed, Cells, Real noise, Path-wise uniqueness, Convergence of approximated solutions

General area of research: Mathematics

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