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## International Journal of Mathematical Models and Methods in Applied Sciences

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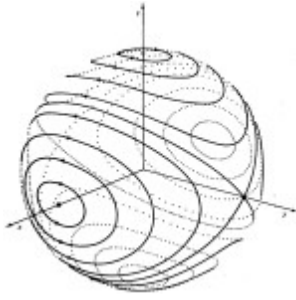
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## **• Bulletin Board**



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o **January 7th 2015:**

[The International Journal of Biology and Biomedical Engineering](#) is now Indexed in Scopus

o **June 4th 2014:**

New Special Issue on International Journal of Mechanics: [Special Issue dedicated to the 100th Anniversary of Russian Academician Yury N. Rabotnov](#) by Professors Yury A. Rossikhin and Marina V. Shitikova

o **October 28th 2013:**

New upcoming NAUN journals in 2014:  
International Journal of Materials  
International Journal of Computational Intelligence

o **October 25th 2013:**

The Editorial Boards of our journals are under constant update. New Associate Editors are being invited to assist with the review process.

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## International Journal of Mathematical Models and Methods in Applied Sciences

ISSN: 1998-0140  
Volume 9, 2015

Notice: As of 2014 and for the forthcoming years, the publication frequency/periodicity of NAUN Journals is adapted to the 'continuously updated' model. What this means is that instead of being separated into issues, new papers will be added on a continuous basis, allowing a more regular flow and shorter publication times. The papers will appear in reverse order, therefore the most recent one will be on top.

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**Volume 9, 2015**

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Title of the Paper: **On the Stochastic/Deterministic Numerical Solution of Composite Deterministic Elliptic PDE Problems**

Authors: **George Sarailidis, Manolis Vavalis**

Pages: **740-747**

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**Abstract:** We consider stochastic numerical solvers for deterministic elliptic Partial Differential Equation (PDE) problems. We concentrate on those that are characterized by their multidomain or/and multi-physics nature. In particular we consider either plain random walk on spheres methods or synergies of conventional deterministic PDE solving methods and traditional probabilistic Monte Carlo approaches. Our main objectives are two. One is to clearly define the context and the practical approach concerning the use of deterministic components that lead to effective numerical solvers for linear deterministic PDEs. The other is the design and implementation of a proof-of-concept computational framework that allows experimentation in order to elucidate the capabilities and identify the emerging computational characteristics of the proposed approaches. A class of model problems in two and three space dimensions are first considered and experimental results are presented and discussed.

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**Title of the Paper: Schwarz Splitting for the Steady State Problem of Saltwater Intrusion in Coastal Aquifers**

**Authors: E. Maroudas, N. Vilanakis, Ch. Antonopoulos, E. Mathioudakis, Y. Saridakis, M. Vavalis**

**Pages: 733-739**

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**Abstract:** In this study we investigate the effectiveness of a meta-computing method on the modeling and the implementation of a truly multi-domain, multi-physics numerical scheme for an important practical problem in the area of environmental engineering. A case study of the steady state of saltwater intrusion in coastal aquifers is considered and a meta-computing scheme is developed and implemented on the basis of modern highly efficient software tools and practices. Numerical experiments exhibit the several desired characteristics of the proposed methodology and the associated implementation. They also justify the necessity for further research and development for an emerging new numerical computing paradigm that although known has not yet prove its practical value in particular for realistic engineering problems.

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**Title of the Paper: Combining Stochastic Optimization and Numerical Methods-Software for the Pumping Management of Coastal Aquifers: Case Study of a Rectangular Homogeneous Aquifer**

**Authors: I. E. Athanasakis, Z. A. Dokou, E. N. Mathioudakis, P. N. Stratis, N. D. Vilanakis**

**Pages: 727-732**

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**Abstract:** The advantages of using the Algorithm of Pattern Extraction (ALOPEX) stochastic optimization technique in combination with both analytical models as well as 3D numerical simulators have been recently studied in detail in [23]–[25]. In this work, we present some preliminary results from the coupling of the Collocation method and the FEniCS open source modules to the ALOPEX algorithm as an effective pumping management process of 2D aquifer approximation models. The results refer to a test case of a homogeneous rectangular aquifer that approximates the freshwater coastal aquifer at Vathi area in the Greek island of Kalymnos. The objective is, on the one hand, to provide an optimal pumping management plan for the aquifer that would maximize the total freshwater volume pumped from the aquifer and, on the other, to keep all pumping active locations safe from saltwater intrusion. For this we adapt and use the ALOPEX parameter

configuration and the efficient penalty system introduced in [25] with guard points around the pumping locations. Our numerical simulations indicate that our pumping management results using the Collocation and FEniCS methods strongly compete the results obtained by using the analytical representation of the flow potential, known for this type of aquifers. Therefore, both Collocation and FEniCS methods can be effectively used to investigate the problem of optimal pumping management in heterogeneous aquifers with complex geometry boundaries and in general, aquifers where the analytical representation of the flow potential is unavailable.

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Title of the Paper: **Acceleration of Multiple Solution of Linear Systems for Analyses of Microstrip Structures**

Authors: **T. R. Gazizov, S. P. Kuksenko, R. R. Akhunov**

Pages: **721-726**



Abstract: Complexity of algorithms of LU-decomposition, BiCGStab and CGS methods, using arithmetic complexity and Onotation, has been estimated. Algorithms for multiple solution of linear systems by an iterative method with preconditioner recomputation have been developed; these algorithms are based on the analysis of complexity and arithmetic mean time of linear systems solutions. It has been revealed that the order of solution and the choice of matrixes for computing a preconditioner, significantly affect the resulting acceleration. A number of experiments on computation of 100 capacitive matrixes of two strip structures have been carried out.

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Title of the Paper: **Methods for the Electricity Supplier Selection – Case Study of the Czech Republic**

Authors: **Martina Kuncova**

Pages: **714-720**



Abstract: Electricity belongs to the commodities that are more and more important for our lives. The industrialized countries are characterized among other things by the developed technological infrastructure and energetic system. In such a country people do not care much about the electricity distribution system but they think about the costs connected with the electricity consumption. This article describes the situation in the Czech Republic which is divided into three distribution regions and households can choose among many electricity suppliers. The main aim of this contribution is to show the mathematical tools to find the cheapest supplier. As a lot of different tariffs are given according to the electricity consumption and circuit breakers the tariff D25d for the households was chosen for the case study.

---

Title of the Paper: **Multidimensional Set-Indexed Partial Sums Method for Checking the Appropriateness of a Multivariate Spatial Regression**

Authors: **W. Somayasa, Gusti N. A. Wibawa, Yulius B. Pasolon**

**Abstract:** In this paper we propose an asymptotic procedure for diagnosing the appropriateness of a multivariate spatial regression with correlated responses based on the so-called multidimensional set-indexed least squares residual partial sums processes of the observations. The limit process which is a projection of the higher dimensional set-indexed Brownian sheet is derived by applying the vectorial analogue of Prohorov's theorem. The adequacy of the assumed model is tested by using the Kolmogorov-Smirnov and Cramér-von Mises functional of the processes. Simulation based investigation are conducted in studying the finite sample size performance of the tests by comparing with that of the classical likelihood ratio test. Finally we attempt to apply the proposed method to a mining data supplied by a mining industry in Southeast Sulawesi.

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**Title of the Paper: Deducing Exact Ground States for Many-Body Non-Integrable Systems**

**Authors: Zsolt Gulácsi**

**Pages: 691-699**

**Abstract:** I describe in details the method which uses positive semidefinite operator properties in deducing non-approximated results for quantum mechanical many-body non-integrable systems. The steps of the procedure, namely i) the transcription of the Hamiltonian in a positive semidefinite form  $H=O+C$ , where  $O$  is a positive semidefinite operator while  $C$  is a scalar, ii) the deduction of the total particle number dependent ground state by constructing the most general solution of the equation  $O|\Psi\rangle = 0$ , iii) the demonstration of the uniqueness by concentrating on the kernel of the operator  $O$ , and iv) the study of the physical properties of the deduced phase by calculating elevated ground state expectation values and the analysis of the low lying part of the excitation spectrum, are described in extreme details.

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**Title of the Paper: On Left Integro-Differential Splines and Cauchy Problem**

**Authors: Burova I. G.**

**Pages: 683-690**

**Abstract:** In the case of integro-differential splines we use the values of integrals over net intervals. Integro-differential polynomial splines were first used in the works of Kireev V.I. Integrodifferential nonpolynomial splines were used by the author of the paper. The error of approximation and results of approximation by the left integro-differential splines are represented in the paper. We construct implicit numerical methods for solving Cauchy problems by using polynomial and nonpolynomial left integro-differential splines. Here we compare the quality of approximation of different methods used for solving differential equations.

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**Title of the Paper: Definition and Validation of a Methodology to Identify the Road Surface Anomalies on the Streets by Measuring the Noise and Vibration**



Authors: **Vincenzo Barone, Domenico Walter Edvige Mongelli, Antonio Tassitani**

Pages: **677-682**



Abstract: This work was developed in order to introduce an automatic methodology for detecting anomalies on the road pavement, using informations provided by a noise dosimeter and a vibration dosimeter also synchronized with a smartphone equipped with geo-locator (GPS). There are already studies relating to this topic, especially developed to identify objects located in the subsoil or to recognize the stratigraphy of bituminous conglomerates composing the asphalt road paving, but no one has studied in deep in an appropriate way the possibility of identifying road surface anomalies through the analysis of sound pressure levels or acceleration levels that can be registered on board of a vehicle that runs along a stretch of road. In this regard, this survey methodology, once tested and validated, allows to identify road anomalies in a specific route, making a single survey and through the combined use of measuring instruments.

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Title of the Paper: **Control of Time-Delay Systems by Means of Modified Smith Predictors: A Simple Matlab Toolbox**

Authors: **Radek Matušů, Roman Prokop**

Pages: **668-676**



Abstract: This paper is focused on description of a simple Matlab toolbox for control of time-delay systems by means of modified Smith predictors. More specifically, the program contains three methods, namely modified Smith predictor for unstable and integrating processes with time delay, modified PI-PD Smith predictor for processes with long dead time, and modified Smith predictor design by Coefficient Diagram Method (CDM). The software offers Graphical User Interface (GUI) for convenient controller design with subsequent direct applicability in prepared Simulink schemes. Its capabilities are demonstrated on several simulation examples. The described product is downloadable on the Internet and can be freely used for research and educational purposes.

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Title of the Paper: **A Real-Coded Genetic Algorithm for Multiobjective Time-Cost Optimization**

Authors: **Jorge Magalhães-Mendes**

Pages: **659-667**



Abstract: This paper presents a new multiobjective optimization technique based on genetic algorithm for the time-cost construction problem. The chromosome representation of the problem is based on random keys. The schedules are constructed using a priority rule in which the priorities are defined by the genetic algorithm. Schedules are constructed using a procedure that generates parameterized active schedules. In construction projects, time and cost are the most important factors to be considered. In this paper, a new hybrid genetic

algorithm is developed for the optimization of the two objectives time and cost. The results indicate that this approach could assist decision-makers to obtain good solutions for project duration and total cost.

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Title of the Paper: **Temporary Change Detection on ARMA(1,1) Data**

Authors: **Raden Mohamad Atok, Azami Zaharim, Dzuraidah Abd. Wahab, M. Mukhlisin, Shahrum Abdullah, Nuraini Khatimin**

Pages: **651-658**



Abstract: The aim of this research is to carry out appropriate method to detect Temporary Change on Autoregressive Moving Average (ARMA) (1,1) data. Estimation of model parameters and outlier effects are used to iteratively for joint estimation procedure. Simulation data were generated from ARMA (1,1) model. The ARMA consists of 4 models which were produced by parameters combination of Autoregressive (AR) and Moving Average (MA). Residuals were estimated by Conditional Least Square (CLS) and Median Absolute Deviation (MAD). Removing outliers' effect used two ways: replacing data which containing outlier and omitting. The observation contains outlier replaces by other value, namely replacement procedure and omitting the observation contains the outlier, namely omit one procedure. The result shows omit one procedure detect outliers better than replacement procedure for all cases. Moreover, MAD and Omit one combination is slightly better than CLS and Omit one combination. This method was implemented to Surabaya's Air Pollutant (Sulfur Trioxide) data and produced similar result. Joint Estimation method using combination MAD and omit one procedure obtain more accurate to detect Temporary Change than three others procedures.

---

Title of the Paper: **A Heuristic Method to Obtain the Optimal Distribution of Drinking Water in Jazan Region**

Authors: **Abdullah Y. Al-Hossain, Said Bourazza**

Pages: **646-650**



Abstract: In this paper, minimizing the cost of electric power used by the pumps distribution system for drinking water is the main goal. First, we present the mathematical formulation of the real model that we try to optimize. This model uses the optimal operating parameters of the pump. We collected data from the General Agency of Drinking Water at Jazan city and we got three problems involving three districts: Swiss, Mahliya and Chatea. We adapted the heuristic method of simulated annealing to solve these problems, and we compare the results with those obtained by the Min function of Mathematica software. The solutions obtained by our method gives exact results, which is an advantage for the practical application for real system as shown in the case of Jazan city.

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Title of the Paper: **An Evaluation Model of Internal and External Contributions in Hierarchical Organizations**

Authors: **Satoshi Ikeda, Tsutomu Ito, Makoto Sakamoto, Takao Ito**



Abstract: Two typical but different types of organization exist: one is traditional organization with a pyramid shaped hierarchical structure, while the other is a network organization with a nonhierarchical structure. In the organization sciences and its allied field including business administration, economics, public administration, sociology, and psychology, the behavioral patterns and values required in a specific organization have been discussed from the standpoint of being successful relative to other competing firms. From the examination of the literature, it is readily discernible that organizational studies on authority and layering have primarily been qualitative in nature. Organization theory suggests that to streamline the management of a large organization begins by dividing it into several sections. We propose a new mathematical model which defines internal and external contributions for the organizations in this paper. Consequently, the evaluation function in the new model is adapted by the sum of the contribution to the external of all members in a given organization. This paper offers two or more evaluation measures that are required for an organization to be specialized.

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Title of the Paper: **The  $\gamma$ -Transform Approach: a New Method for the Study of a Discrete and Finite Random Variable**

Authors: **Fabio Grandi**

Pages: **624-635**



Abstract: In this paper, we present a new method for the study of a discrete random variable whose probability distribution has a finite support. The approach is based on the introduction of a transform of the probability density function, named  $\gamma$ -transform, which better suits the finite nature of the random variable than the traditional probability generating function. In particular, in addition to the transformation/anti-transformation pair, a simple formula is presented for computing the factorial moments of a random variable directly from the  $\gamma$ -transform of its probability density function. Moreover, it is shown how the  $\gamma$ -transform can be determined from the nature of the combinatorial problem under study thanks to its physical meaning. Examples and applications to estimation problems relevant for computer science are provided, in which the simple construction of a  $\gamma$ -transform gives immediate access to the complete characterization of the underlying probability distribution (density function and moments)

---

Title of the Paper: **Modeling of Absorption and Steady State Fluorescence Spectra of Full LH2 Complex (B850 - B800 Ring)**

Authors: **Pavel Heřman, David Zapletal**

Pages: **614-623**



Abstract: Computer simulated absorption and steady state fluorescence spectra for the model of peripheral cyclic antenna unit LH2 from purple bacteria are presented. Comparison of the results for more complex system (B850 and B800 ring) with our previous results calculated only for B850 ring is done. Dynamic

disorder, interaction with phonon bath, in Markovian approximation simultaneously with uncorrelated static disorder in local excitation energies are taken into account in our simulations. The cumulant-expansion method of Mukamel et al. is used for the calculation of spectral responses of the system with exciton-phonon coupling. Also localization of exciton states is investigated.

---

Title of the Paper: **On the Nonlinear Behavior of R.C. Buildings in Near-Field Areas**

Authors: **Mariella Diaferio, Dora Foti**

Pages: **607-613**



Abstract: The paper shows the results of a nonlinear dynamic analysis performed on a fixed base reinforced concrete 2D frame subject to near-field earthquakes, i.e. seismic motions close to the epicentral area of the fault rupture. In these areas both the acceleration and velocity signals are impulsive-type and, consequently, the response of the structures requires a specific study. The r.c. frame here considered has six levels and two equal spans; it has been designed according to the instructions provided in Eurocode 2 exclusively under gravity loads, the same design as for lots of existing buildings. The nonlinearity of the frame has been assumed with a diffuse plasticity and a fiber modeling has been considered for the structural elements.

---

Title of the Paper: **Mathematical Modeling and Optimization of the Tactical Entity Defensive Engagement**

Authors: **Jan Mazal, Petr Stodola, Dušan Hrabec, Libor Kutěj, Milan Podhorec, Dana Kříšťálová**

Pages: **600-606**



Abstract: Mathematical modeling and optimization is commonly used in many application areas. Computational support of not only military processes is not exceptional in this decade, however its scope still lies outside the direct decision support of commanders in various operations. The latest trends of technology development require further operational and technological development of decision making process support. This paper deals with mathematical modeling of the defensive behavior of the tactical entity. We implement the built model into our tactical information system. The system is designed for an effective and precise prediction of possible scenarios of a situation at hand, but solution of the particular operational task is based on individual approaches and could not be generalized yet. The solution of individual operational problem usually addresses the multi-criteria integration of operational analysis and models linked to the proper quantification and criteria setting. Finally, we provide some original insights into the optimal defensive behavior problem and illustrate the obtained solutions of selected computational examples involving various criteria.

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Title of the Paper: **A Methodology for Verification of a New Model for Evaluating the Usability of an M-banking Application**

Authors: **Hamisu Ibrahim Abubakar, Nor Iaily Hashim, Azham Hussain**

**Abstract:** Many models for evaluating the usability of mobile application exists, but they are static, crumbled and have not undergone a verification process by usability experts to examine their capability of collecting data for the intended applications. Therefore, the proposed model is established and verified in response to the need identified in the literature because it is important for m-banking applications to provide customers with the anticipated and likely sense of interaction, to be easy to use and encourage the customers to accept the technology. This paper describes the verification procedure for a newly proposed model for evaluating the usability of m-banking applications. The purpose of this verification procedure is to identify the main practices for model verification methods for evaluating the usability of an m-banking application. The verification was conducted through the use of usability experts in mobile application development and academia to examine the model and its components. The verification form and questionnaire that measured the model in terms of consistency, understandable, easy to use, tailorable, verifiable and overall impressions have been completed by the usability experts, and the proposed model has been improved based on the feedback received from the experts. The finding from the experts' questionnaire shows that the proposed model is complete, original and acceptable for the intended application. Therefore, this paper will provide additional knowledge in both theory and practice on model verification methods, especially for usability evaluations of commercial applications.

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**Title of the Paper: Evaluation of a Prediction Model Based on Ridge Regression for Asthma Persistence in Preschool Children**

**Authors: Ioannis I. Spyroglou, Eleni A. Chatzimichail, E. N. Spanou, E. N. Paraskakis, Alexandros G. Rigas**

**Pages: 581-591**

**Abstract:** The accurate prediction of asthma persistence in childhood is one of the most significant issues about this chronic disease. Asthmatic children usually develop their first symptoms before the fifth year of age. The early detection of the preschoolers whose asthma persists after the age of five could lead into better treatment opportunities and disease long-term outcome. 148 patients with mean age ( $\pm$ SD)  $9.9\pm 2.7$  years who received a diagnosis of asthma at the age under the five were used for the asthma prediction system. All children have performed spirometry pre and post bronchodilation and a detailed case history was obtained. In this work, since there is strong multicollinearity among the factors affecting the asthma persistence, a Logistic Ridge Regression model is proposed for its prediction. The estimated parameters of the proposed model are obtained by using a penalized likelihood function. Moreover, a test is developed for checking the validity of the fitted model based on the randomized quantile residuals. The 5% rejection regions of the randomized quantile residuals are constructed by using a proper bootstrap method and they are added in the QQ-plot. The prediction accuracy of asthma persistence was tested by a second group of 33 children aged 3.5-5 years who were reevaluated at the mean age ( $\pm$ SD) of  $9.2\pm 2.7$  years. The proposed prediction system for asthma persistence evaluated in real life setting has shown an accuracy of 93.18%, while the positive predictive value of and negative predictive value 96.15% and 88.89% respectively. The experimental results of our study show that the proposed system can be a valuable tool in medical-decision making and clinical research.

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**Title of the Paper: Modeling Approach for the Air Convective Drying of Leafy Materials**

Authors: **A. Orphanides, A. Fantousi, V. Goulas, V. C. Gekas**

Pages: **576-580**



Abstract: Mathematical modeling in applied sciences could include predictive approaches in various unit operations of Chemical Engineering and/or Food Engineering. In air convective drying two key factors influence quantitatively and qualitatively the process and the processed material; temperature and air velocity. Although during the drying unit operation a severe shrinkage of leafy material occurs, no explicit account of this fact is taken in herb plant drying modeling. Even more rare, not to say un-existent, are applications of the true driving force, that is the thermodynamic driving force, according to the opinion of the authors. In this work both aspects have been considered and explicitly applied in the modeling of drying of a common herb plant, *Mentha viridis*, used as a model aromatic herb plant material. Furthermore, the study of synergistic or inhibitory effects between the influencing factors is presented. Application of the three before-mentioned aspects leads to interesting findings which are thoroughly discussed in the present paper.

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Title of the Paper: **Total Cost Reduction Using a Genetic Algorithm for Multi-Vendor and Single Manufacturer**

Authors: **Mohd Nizam Ab. Rahman, Raden Achmad Chairdino Leuveano, Fairul Azni Bin Jafar, Chairul Saleh, Baba Md. Deros**

Pages: **566-575**



Abstract: The model configuration of the supply chain integration, which consists of multi-vendors and a single manufacturer under a shared transportation, is considered in this study. In finding the solution, the complexity increases as the number of actors in the supply chain increases. To address this complexity, several researchers typically use complex mathematical approaches (e.g., linear programming, non-linear programming, mixed integer programming, and derivatives) with model assumptions to simplify the model problem. However, under this assumption, most supply chain models cannot be implemented in practice. This paper proposes a heuristic approach based on Genetic Algorithm (GA) to solve the complex modeling. The objective is to minimize the total cost of the system by finding the optimal inventory replenishment decisions, which includes delivery quantities, batch production, and the number of shipments from multi-vendors to a single manufacturer. Moreover, numerical examples and experimentation are presented to illustrate the application of GA in finding the optimal or near optimal solution. Comparative analysis is conducted to compare the performance of GA with that of other approaches to determine the characteristics that are valuable in practical problems.

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Title of the Paper: **Wiener-Hopf Analysis of Sound Waves by a Rigid Cylindrical Pipe with External Impedance Surface**

Authors: **Burhan Tiryakioglu, Ahmet Demir**

Pages: **558-565**



**Abstract:** In the present work, diffraction of sound waves emanating from a ring source by a rigid cylindrical pipe with external impedance surface, is analyzed. This boundary-value problem is investigated using Wiener-Hopf technique. To obtain a couple of simultaneous Wiener-Hopf equations, Fourier transform is applied. The solution which involves two sets of infinitely many constants satisfying two infinite systems of linear algebraic equations, is found analytically by the application of saddle point technique.

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**Title of the Paper: Analysis of Mixed Convection Boundary Layer Flow of a Nanofluid Past a Vertical Plate Embedded in a Porous Medium**

**Authors: A. A. Abdullah, F. S. Ibrahim**

**Pages: 545-557**



**Abstract:** The unsteady mixed convection flow near the stagnation point region of a heated vertical plate in a porous medium saturated with a nanofluid is studied analytically and numerically using Buongiorno's model. The model used for the nanofluid incorporates the effects of Brownian motion and thermophoresis. An appropriate similarity transforms are used and the resultant equations are solved using the fourth-fifth order Runge-Kutta method with shooting technique for different values of the parameters governing the problem. The effects of the governing parameters on fluid velocity, temperature, nanoparticle volume fraction, skin friction, Nusselt number and Sherwood number are discussed.

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**Title of the Paper: On the Mathematical Properties of the Solutions in the Models of Fluid Dynamics of the Ocean which Involve Heat and Salinity Transfer**

**Authors: A. Giniatouline**

**Pages: 537-544**



**Abstract:** We investigate the properties of the solutions of PDE systems which describe fluid dynamics of the Ocean with heat and salinity transfer. We prove the existence and uniqueness theorem for a layer. We study the spectrum for the problems modelling the small inner oscillations of viscous rotating compressible three-dimensional fluid which consider the involvement of the heat and salinity transfer for different boundary value problems which include either kinematic viscosity or the combined kinematic and volume (bulk) viscosity. We prove that the essential spectrum for both operators consists of one real point which depends on the parameters of compressibility and viscosity. We also find the sector of the complex plane to which all the eigenvalues belong. We compare the obtained results with our previous study of the spectral properties for incompressible and inviscid rotating fluid. The results of this paper may find their application in the study, either theoretical or computational, of the Ocean and the Atmosphere of the Earth.

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**Title of the Paper: Three-Axis Dynamic Modeling of Induction Motor**

**Authors: Ya. Dorjsuren, L. Tumenbayar, J. Tsevegmid**



Abstract: This paper presents a new modeling and simulation method for the three phase asynchronous motor. This model called three-axis dynamic model of induction motor. The dynamic model is examined by Matlab/Simulink as a rated power of 55 kW asynchronous motor. New three-axis dynamic model is compared with conventional d and q-axis dynamic model. Comparative results are shown as the functions of stator and rotor current, angular speed, and torque of the three phase induction motor. The new model is shown as better results than the d-q model.

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Title of the Paper: **Personal Full Electric Vehicle PICA V: Non Linear Dynamic Model and Simulation**

Authors: **F. Cepolina, E. M. Cepolina, R. M. Molfino**

Pages: **518-526**



Abstract: Request of sustainable personalized transport is growing in different areas of service robotics, for aid to mobility of elderly and motion disabled people, for freight delivery in urban environment, for passengers transport in restricted zones as airports and greens because of the small dimensions, tiny footprint, on-board intelligence, friendly human car interface and zero environmental impact. The paper studies the feasibility of an electric vehicle with four non steering wheels considering as driving principle the skid steering that has been mainly used for tracked vehicles. The vehicle is a complex nonlinear multi body system with numerous mobilities either in stiff and in elastic motion. For evaluating the vehicle performances, the maneuverability and stability behavior it is needed the availability of a model able to describe all the significant motion modes in different operative conditions. The paper presents the PICA V model and some results of the simulation campaign that demonstrated its soundness and reliability.

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Title of the Paper: **The Evaluation of the linear Complexity and the Autocorrelation of Generalized Cyclotomic Binary Sequences of Length  $2^{np^m}$**

Authors: **Vladimir Edemskiy, Olga Antonova**

Pages: **512-517**



Abstract: In this article, we discuss a computation method for the linear complexity of generalized cyclotomic binary sequences of length  $2np^m$ . This method allows to assess the linear complexity of above-mentioned sequences and to design the sequences with high linear complexity. Also we generalize known results about binary sequences of length  $2pm$ . In conclusion we evaluate the autocorrelation of generalized cyclotomic binary sequences of length  $2np^m$ . In most cases these sequences have high linear complexity and poor autocorrelation performance.

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Title of the Paper: **Efficient and Accurate Scheme for Hyperbolic Conservation Laws**



Authors: **Mukkarum Hussain, Ihtam UI Haq, Noor Fatima**

Pages: **504-511**



**Abstract:** The progress of numerical techniques for scalar and one dimensional Euler equation has been a great interest of researchers in the field of computational fluid dynamics for decades. In 1983, Harten worked on non-oscillatory first order accurate scheme and modified its flux function to obtain a second order accurate total variation diminishing (TVD) explicit difference schemes for scalar and one dimensional Euler equation. Although, TVD schemes are low dissipative and high resolution schemes, but for explicit formulation they are bounded by stability criterion  $CFL < 1$ . Stability criteria for explicit formulation limits time stepping and thus increase computational cost. Research in the field of efficient low dissipative high resolution scheme is an active ground. In 1986, Harten enhanced his TVD scheme and presented  $(2K+3)$  point explicit second order accurate schemes for scalar and one dimensional Euler equation which are TVD under CFL restriction  $K$ . Numerical experiments were made to demonstrate the performance of the schemes for several choices of  $K$ . His results depict that for increasing values of CFL total number of time steps are decreased which eventually decrease computational time. Computation of scalar problems depicts that Harten's large time step (LTS) scheme is a high resolution and efficient scheme. However, computations of hyperbolic conservation laws show some spurious oscillations in the vicinities of discontinuities for larger values of CFL. Zhan Sen Qian noticed that these spurious oscillations are due to the numerical formulation of the characteristic transformation used by Harten for extending the method for hyperbolic conservation laws. He suggested performing the inverse characteristic transformations by using the local right eigenvector matrix at each cell interface location to overcome these spurious oscillations. Large time step schemes developed by Harten and Qian have been tested with minmod limiter which is very dissipative. In present work, Qian MLTS TVD scheme is tested with more compressive limiters, namely, centralized MC and superbee. Shock tube problem for SOD boundary conditions is solved to understand the performance of MLTS TVD scheme with compressive limiters in the regions of discontinuities and strong shock waves.

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Title of the Paper: **Application of Bayesian Multivariate Method to Time Dependent Data**

Authors: **Steward H. Huang**

Pages: **499-503**



**Abstract:** Time dependent data have widespread scientific applications. A very interesting area of its applications is growth curve models. Researchers have considered these models under different real-world scenarios, including complicated variance-covariance structures with autocorrelations. In this paper, the goal is to incorporate these types of structures into the models for multivariate random variables under Bayesian formality. Due to the complexity of the models many other models in literature have to make compromising assumptions. However, this paper will make Bayesian estimates of parameters for these highly complicated models with greater similarity to real world situations. Through judicious choices of priors, we obtain highly informative posteriors in the estimation procedures. The models presented in this paper are useful and competitive alternatives to frequentist's approach.

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Title of the Paper: **Effect of Demand Rate on Evaluation of Spurious Trip Rate of a SIS**

Authors: **Thao Dang, Michael Schwarz, Josef Börcsök**

Pages: **487-498**



Abstract: A spurious trip is one cause of an unexpected plant shutdown initiated by a safety-instrumented system (SIS). Therefore, spurious activation normally leads to lost production or low availability of the EUC. Some of the spurious activations can lead to a hazardous state and so the plant cost can be extremely increased. On these foundations the modeling of spurious activations in safetyinstruments systems (SIS) has been studied for over ten years and in different industry branches, for example: nuclear industry, offshore-onshore industry, process industry, etc..... In line with the important standard IEC 61508, SISs are generally classified into two types: low-demand systems and high-demand systems. This article focuses on the estimation of "spurious trip rate" (STR) and "mean time to failure spurious" (MTTF<sub>Spurious</sub>) for these two different system modes. The research is based on block diagrams and the Markov model and is exemplified by two system configurations: 1oo1 and 1oo2.

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Title of the Paper: **Some New Findings on the Mathematical Structure of the Cell Method**

Authors: **Elena Ferretti**

Pages: **473-486**



Abstract: In the classification diagram of the Cell Method (CM), which is the truly algebraic numerical method, the global variables are stored in two columns: the column of the configuration variables, with their topological equations, and the column of the source variables, with their topological equations. The structure of the classification diagram is the same for both the global and the field variables of every physical theory of the macrocosm. The importance of this diagram stands just in its ability of providing a concise description of physical variables, without distinguishing between the physical theories. Recently, we have shown that we can provide the classification diagram of the CM with a mathematical meaning, in addition to a physical meaning. Actually, we can recognize in the classification diagram of the CM a structure of bialgebra. In this paper, we give a further insight into the mathematical foundations of the CM by comparing the structure of the algebraic formulation with the structure of the differential formulation. Particular attention is devoted to the computation of limits, by highlighting how the numerical techniques used for performing limits may imply a loss of information on the length scales associated with the solution. Since the algebraic formulation does not make use of the limit process, this means that the algebraic formulation preserves the information on the length scales associated with the solution. Conversely, the differential formulation is forced to introduce a proper enrichment of the equations and/or the space of reals for taking into account the length scales associated with the solution.

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Title of the Paper: **Inter-Firm Transactional Relationships in Yokokai: An Empirical Investigation Using the IDE Spatial Model**

Authors: **Takao Ito, Rajiv Mehta, Tsutomu Ito, Makoto Sakamoto, Satoshi Ikeda, Seigo Matsuno, Katsuhiko Takahashi**

Pages: **463-472**

**Abstract:** This paper discusses recent fundamental changes in the Japanese alliance networks known as keiretsu, and reports the findings of an empirical investigation on the relationship between these changes and corporate performance. More specially, the performance of Japanese auto manufacturers, such as Toyota, Mazda and Nissan, among others, has significantly improved due to sophisticated production system technologies, highly productive workers, and recurring transaction relationship with other partners in their network organization. One possible determinant of their success could be due to their unique organization forms – the keiretsu– which provides a strong platform to forge their strategic alliance ties with their parts suppliers as well as collaboration into research and development activities with other automobile manufacturers. After the Lehman Brothers bankruptcy in 2008, the strong ties between automobile makers and their supplier partners underwent significant modifications manifested by a “loosening of network ties due to “external influences”. Consequently, this begs the following questions: What is the status quo of automotive keiretsus? Are transactional relationships in keiretsu still associated with improved corporate performance? To answer these questions, this paper reports the results of a study that collected data on transaction to shed light on the relationship between inter-firm transactional relationship and corporate performance. The findings of this empirical investigation reveal that: (1) Keiretsu is a flexible, highly adaptive organizational form; its scale is prone to modifications in response to changes in economic conditions; (2) Transactional relationship is still a significant determinant of increasing profits for keiretsu partners even in the aftermath of the 2008 financial crisis.

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**Title of the Paper: Multiple-Criteria BIM-Based Evaluation of Architectural Submittals**

**Authors: Ibrahim Albukhari, Tarek Hegazy**

**Pages: 453-462**

**Abstract:** Submittal evaluation is a formal process to measure the compliance of contractor-proposed materials, equipment, and processes before they can be used in a project. For monumental projects that involve unique architectural components, contractors often submit alternatives that may involve minor deviations from designer’s requirements. Thorough evaluation is therefore necessary to save project time and quantify the best-value acceptance conditions considering short-term and long-term implications, without compromising design rationale or performance. Thus, this paper develops a structured decision-support framework to help evaluate key architectural submittals during construction in an efficient and speedy manner. First, sample submittal logs were analyzed and architectural windows are defined as key architectural submittals. The research then proposed a mechanism to use Building Information Models (BIM) to store design rationale and specification data within its 3D model of a building. The proposed framework then utilized the multi-attribute utility theory (MAUT) to evaluate the compliance of window submittals with design rationale and performance-related criteria, in addition to computing the overall utility of a submittal and its related life cycle cost. The proposed framework uses this data and applies the multi-attribute utility theory (MAUT) and the analytical hierarchy process (AHP) to evaluate the degree of submittal compliance with design rationale and performance criteria. Accordingly, it suggests correct acceptance conditions, based on analysis of the cost and time implications at the short-term and the long-term during operation. Applying the framework to a case study shows its ability to determine the bestvalue decisions. The integration of BIM with decision analysis enabled efficient automation of the submittal evaluation process, thus saving time and reducing subjectivity. In addition, storing the design rationale and performance-related criteria in the BIM enabled dynamic updating of specifications with the data of approved submittals, thereby facilitating better operation of buildings.

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**Title of the Paper: A Recurrence Equation-Based Solution for the Cubic Spline Interpolation Problem**

Authors: **Peter Z. Revesz**

Pages: **446-452**



Abstract: This paper presents a simple and fast recurrence equation-based method for solving the cubic spline interpolation problem. The computational complexity of the method is  $O(n)$ , where  $n$  is the number of measurements. The recurrence equation-based method is illustrated by an example that estimates the movement of a moving object. The paper also describes a MATLAB implementation of the new method and the use of cubic spline interpolation within the MLPQ database system.

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Title of the Paper: **A Forecasting Model Based on Time Series Analysis Applied to Electrical Energy Consumption**

Authors: **Carmine Tepedino, Claudio Guarnaccia, Svetoslav Iliev, Silviya Popova, Joseph Quartieri**

Pages: **432-445**



Abstract: One of the main objectives of the European Union (EU) is the reduction of energy consumption and the elimination of energy wastage. These two issues are extremely important, especially in large energy demanding areas, such as transportation, manufacturing, etc.. Electricity consumption prediction is a basic tool for energy management system. Precise prediction of transportation companies helps the energy providers to make right decision for proper distribution of electricity. In this paper, the authors present a Time Series Analysis Model and its application to the electricity consumption of public transportation in Sofia (Bulgaria) in 2011, 2012 and 2013. This technique is based on the dataset analysis and is able to arise the trend slope, the periodic pattern and the random component as a function of time. The innovation of the presented model is in the multiple seasonality and in its ability in following the monthly oscillations. The dataset analysed will show a strongly periodic pattern that will be reconstructed with three different seasonal coefficients. The adoption of statistical tests for linearity and stationarity will show that the series under study is nonlinear and stationary. Comparison between models with two and three seasonalities will be performed in terms of error analysis. A validation on the January 2013 dataset for the triple seasonality model will show interesting results in terms of very low mean error and standard deviation. In addition, a proper interpretation of the model coefficients will open the way to the implementation of improved energy management strategies.

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Title of the Paper: **The Intelligent Identification Technique with Associative Search**

Authors: **Nataliya N. Bakhtadze, Ekaterina A. Sakrutina**

Pages: **418-431**



Abstract: In modern control systems, identification is an integral part of adaptive control where process models are adjusted using real-time operation data and control actions optimal with respect to some

performance criterion are developed. The methods for developing predictive models in control systems and decision-making support for nonlinear non-stationary objects are proposed. The methods are based on the application of associative search procedure to virtual model identification as well as on wavelet analysis techniques. The paper presents novel associative search techniques enabling the development of a new dynamic object's model on each time step rather than plant approximation pertaining to time. The model is build using the data samples from process history (associations) developed at the learning phase. The new techniques employs the models of human individual's (process operator's, stock analyst's or trader's) behavior based on professional knowledge formalization. Application examples from oil refining and chemical industries, power engineering, and banking are adduced.

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Title of the Paper: **Modelling Based Approach for Attracted Transport Readiness Trips Estimation to the Site**

Authors: **N. Zenina, A. Romanovs, Y. Merkurjev**

Pages: **410-417**



Abstract: Accessibility can be evaluated as a measure of demand, supply and readiness. This research is focused on third measure, readiness. Readiness is expressed as a number of incoming traffic flow to the commercial site taking into account transport access alternative design, number of generated trips with correction for local conditions, delay per vehicle and level of service. To select appropriate transport access alternative isolated intersections (unsignalized, signalized, signalized with allowed left turn from shoulder; roundabout) and system of two intersections (two signalized, two roundabouts and mixed with one signalized and one roundabout) were analyzed. Number of generated trip was calculated based on rate methods taking into account sustainable parameters such as mixed use, public transport, employment and others. Based on transport access design analysis and number of generated trips five variants of the signalized intersections with left turns from shoulder were selected for further analysis and modeling. Transport simulation model was built for each considered transport access alternative according to the four stages of transport planning model with additional restriction – level of service for each model cannot exceed D/E level. Each transport access simulation model was verified and validated. Minimum volume ellipsoid and minimum covariance determinant estimator were used to detect outliers in simulation output results.

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Title of the Paper: **Appraisal of the Extraordinary Contribution in General Regulatory Plan of Rome**

Authors: **O. Campo**

Pages: **404-409**



Abstract: With the new General Regulatory Plan for Rome, adopted with D.C.C. No. 33/2003 and approved with D.C.C. No. 18/2008, in the part concerning the criteria for equalization, they introduce/insert the so-called "Extraordinary Contribution" to urbanization, one of the most important innovations, introduced by the new Plan, which fixes an amount in addition to the cost of primary urbanization and those related to building permit, borne by the promoter of urban transformation development project. However, at a distance of eleven years after the adoption of the new General Regulatory Plan for Rome and more than six after its final approval, the regulation for the calculation of the Extraordinary Contribution was finally approved by the Rome City Council. One of the reasons for this delay is identified in the legal basis of the additional

financial obligation of the project developer, and an appeal brought before the Regional Administrative Court of Law [T.A.R.] was put to rest with the Legislative Decree No. 78/2010 converted into Law No 122/2010 where Article 14(16) permits the introduction of Extraordinary Contribution with the exact wording of the technical conditions of the new GRP for Rome and with the decision of the Council of State, Section IV No 4545 of 13/07/2010. Several attempts have been made to regulate this additional cost, the last of which was the approval by the Board of Councillors in February 2014 definitively ratified by City Council Resolution No. 128/2014 of a regulation stating, in summary, that the real estate value to which the extraordinary contribution for urbanisation must be applied, i.e. at the rate of 66.6% as described in Article 20(3) of the Rule for Implementation (NTA), is equal to the difference between two distinct transformation values (below VT) of the property transformed: VT1-VT, i.e. the difference between the Value of the Transformation of the property, calculated taking into account the additional construction foreseen by the proposed intervention (VT1), subtracted from the Value of Transformation of the same property under normal urban regulations without further negotiations, so setting the parameters and the method of calculation.

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Title of the Paper: **Industrial Web Application Customization Mechanism to Improve Software Quality and Productivity**

Authors: **Azham Hussain, Mohammad Nuruzzaman, Hatim Mohamad Tahir**

Pages: **396-403**



Abstract: Competition in the software market for industrial use is very challenging. Quality and productivity of software is very important to the software industry to remain competitive. Most of the commercial and industrial web applications are complex, hard to implement, risky to maintain and customization requires deep understanding of the requirements. Research showed that customization and reusability may increase the productivity and quality of the software and also decrease the development time. Unfortunately, implementing systematic reuse and customize existing system has proven to be a difficult process. While software engineers continue to struggle with cost and time, reuse has emerged as a good engineering principles and practice in various fields. However, technology to completely integrate user interface, reuse design, customization and implementation is still immature. The aim of this study is to provide a novel visual object sharing technique for designing, customizing, reusing and visualizing web elements to provide a breakthrough solution for the given problems. This technique support and provide rapid development of web-based business application where all of these underlying data and application codes are defined by meta-data, tag library and XSLT schema. This study contributes mainly in the field of reusability and customization for the web application. This study also demonstrated empirical data from two commercial projects and the results indicated that proposed object-oriented application framework (OOAF) is consistently better than traditional methods. By using OOAF, software industries are able to reduce development time, increase the quality and productivity of web application.

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Title of the Paper: **Methods for Study the Reliability of Vehicles Used in Ornamental Rock Quarries**

Authors: **Dascar Secara Camelia Monia, Nan Silviu Marin, Dascar Emil**

Pages: **389-395**



**Abstract:** The productivity of an open pit mine relies on a very effective and reliable transportation system. For a marble quarry, it is critical that haul trucks are maintained efficiently to have a high availability. Many authors have studied records and associated statistics in regards to failure data. Normal distribution has been used to describe the failures of the individual machine components of a complex system, but different variables and machine particularities, wear or other constrains, determine a real life data following a dynamic large distribution. The objective of this paper is to present two techniques of estimation based on record statistics for the two-parameter Weibull distribution theory and its parameters (shape  $\beta$  and scale  $\alpha$ ) and the Exponential Method with the survival time parameters. Finally, a real dataset of the failure data for haul trucks in operation at a marble quarry is used to illustrate by fitting the Weibull and Exponential distributions to the data, calculate the relevant parameters and obtain the fatigue life equation by regression under different failure probabilities. The distribution analysis in terms of reliability and durability shows a trend of increasing failure rate, opening the opportunity for setting a decision plan on reliability centered maintenance planning activities, possible improvements, respect the optimal load/speed, and the need to revise the maintenance data collection process.

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**Title of the Paper: Finite Element Analysis and Modeling of Details Timber Structure**

**Authors: O. Sucharda, D. Mikolasek, J. Brozovsky**

**Pages: 380-388**



**Abstract:** The paper analyses a timber hall. A beam model is globally analysed and focus is placed on structural details. 3D computational models are used for the analysis of the structural models. Nonlinearities are taken into account. A particular attention is paid to the analysis of the top steel joint with pins. The objective of the paper is to evaluate stiffness of some details for a glue timber lam structure. For that purpose, the nonlinear models of materials, geometric nonlinearities and contact elements are utilised. The software used for modelling is based on the Finite Element Method.

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**Title of the Paper: The Mathematical Foundations of the Cell Method**

**Authors: Elena Ferretti**

**Pages: 362-379**



**Abstract:** try. We will show in this paper that we may obtain the same associations on the basis of mathematical considerations, thus deepening the mathematical foundations of the CM. This will allow us to recognize in the classification diagram of the Cell Method a structure of bialgebra, where the operators are generated by the outer product of the geometric algebra and the exterior product of the dual algebra of the enclosed exterior algebra. In doing so, the classification itself of the physical variables will take on a deeper meaning, by allowing us to associate the configuration variables with the geometric interpretation for the elements of a vector space and the source variables with the geometric interpretation for the elements of the dual vector space in the bialgebra. We will also discuss a new four-dimensional space/time cell-complex for studying time dependent phenomena with the CM.

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**Title of the Paper: A Multiagents System for a Parallel and Distributed Paradigm**

Authors: **Alberto Arteta, Juan Castellanos, C. Nuria Gomez, L. F. Mingo**

Pages: **352-361**



Abstract: Cell computing works on computational models based on cell's behavior to process the information in a faster way than usual. Recently, numerous biological models have been developed and implemented. In particular cell membrane systems are structures that simulate the behavior and the evolution of membrane systems found in Nature. This paper proposes an application capable to supervise a cells membrane model through a multiagents system (MAS). By using multiagent systems the membrane models functionality improves. This creates the possibility of having scenarios where biological systems and multiagent systems work together to enhance the performance in bio-inspired models.

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Title of the Paper: **Gravity Forces as a Tool for the Experimental Verification of the Universe Simulators Based on the Measurement Standards Variability**

Authors: **Vitaly O. Groppen**

Pages: **345-351**



Abstract: The main objectives of this paper are in experimental verification of the universe simulators based on the measurement standards variability by the gravity forces control technology and in optimization of parameters of deployed capacitors used in these experiments as sensors. Substrate material and capacity of these capacitors as well as applied voltage are the tools of this optimization. Used simulators result in mathematical model which is based on the idea of substitution of energy distributed in the neighborhood above the upper surface of the horizontally disposed deployed capacitor by the material point with equivalent mass: force of the gravitational interaction of capacitor with this point has opposite direction to the force of its' gravitational interaction with the Earth thus reducing this force. Results of experiments with different sensors and scales allow us to select effective equipment and combination of materials, construction, capacity and voltage, which should have a deployed capacitor in the further investigations.

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Title of the Paper: **Structural Analysis of Historical Masonry Arches: State-of-the-Art and Recent Developments**

Authors: **Lucio Nobile, Veronica Bartolomeo**

Pages: **338-344**



Abstract: The aim of this paper is to give an overview of the main analytical and numerical methods for the assessment of masonry arches , highlighting strengths and weaknesses. The methods are mainly three: i) the Thrust Line Analysis Method; ii) the Mechanism Method; iii) the Finite Element Method. The Thrust Line Analysis Method and the Mechanism Method are analytical methods and are based on two of the fundamental



theorems of the Plastic Analysis, while the Finite Element Method is a numerical method that uses different strategies of discretization to analyze these structures.

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Title of the Paper: **Tactical Models Based on a Multi-Depot Vehicle Routing Problem Using the Ant Colony Optimization Algorithm**

Authors: **P. Stodola, J. Mazal**

Pages: **330-337**



Abstract: This article deals with the metaheuristic solution to the Multi-Depot Vehicle Routing Problem (MDVRP) using the Ant Colony Optimization (ACO) algorithm. The first part of this article presents the original algorithm of the authors. It introduces pivotal principles of the algorithm, along with conducted experiments and acquired results on benchmark instances in comparison with rival state of the art methods. The primary part of the article deals with two tactical models based on our problem solution: (a) optimal supply distribution on the battlefield and (b) optimal UAVs reconnaissance. Both models have become a part of our tactical information system which serves as a tool for commanders to support them in their decision making process. The models are introduced in terms of problem formulation, implementation, and application in practical situations in the domain of the military.

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Title of the Paper: **Optimisation of a Complex Manufacturing Process Using Discrete Event Simulation and a Novel Heuristic Algorithm**

Authors: **Blaž Rodič, Tadej Kanduč**

Pages: **320-329**



Abstract: In this paper we present the methods and results obtained in a manufacturing process optimisation project. The client company is a major regional manufacturer of specialized furniture with 30.000 items in its catalogue. Their main goals are a reduction of manufacturing costs and order fulfilment lead time. We have used discrete event simulation (DES) to build a model that reflects the current manufacturing processes and allows us to test optimisation methods. Due to the large number of products and their manufacturing processes we have developed an automated model construction method that uses customer order data and manufacturing process database to build an ad-hoc simulation model. The model and method were tested in the first optimisation task: reduction of product travel distance through modifications of factory layout. We have developed a novel heuristic optimisation method based on force-directed graph drawing. The method outperformed other more general heuristic methods for QAP (Quadratic Assignment Problem) and produced significantly improved factory layouts.

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Title of the Paper: **A Geometric Model for the Analysis of Citation Distributions**

Authors: **Lucio Bertoli-Barsotti, Tommaso Lando**

**Abstract:** In this paper, we present an empirical study for modeling the citation distribution of papers of individual authors. We analyzed the citation records of applicants to the so called “Abilitazione Scientifica Nazionale” (ASN), a new procedure, based on scientific qualification criteria, for the recruitment of academic staff in Italy. We analyzed citation records of 131 physicists who were applicants in the ASN for a full professorship in the specific area of Condensed Matter Physics, using different mathematical models, namely: zeta, geometric, logarithmic and Pareto (of the first kind). Each model was “estimated”, on the basis of the observed citation pattern, via minimum Kullback-Leibler distance method. The geometric distribution was also considered by using a trimmed version of the estimator. As a measure of the effectiveness of the model, we computed the Kolmogorov-Smirnov distance. The most remarkable result is that the geometric distribution can provide an adequate tool for the modelization of the citation distribution of an author. Model fit may be further improved by adopting the trimming method.

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**Title of the Paper:** **Symmetric Association Schemes and Generalized Krein Parameters**

**Authors:** **Vasco Moço Mano, Luís Almeida Vieira**

**Pages:** **310-314**

**Abstract:** This paper presents a generalization of the Krein parameters of a symmetric association scheme and via this generalization some bounds on the classical Krein parameters are deduced.

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**Title of the Paper:** **A Multi-Agent Based Framework for Real-Time Monitoring and Scheduling to Handle Dynamic Changes**

**Authors:** **Kwan Hee Han, Yongsun Choi, Sung Moon Bae**

**Pages:** **303-309**

**Abstract:** Manufacturing industries are under great pressure caused by the rising costs of energy, materials, labor, capital, and intensifying worldwide competition. In particular, frequent change of customer requirements is a tough challenge to manufacturing company. To deal with this problem adequately, real-time monitoring and scheduling is an essential task to be competitive. Conventional static scheduling system cannot deal with this problem effectively. The new requirements to overcome the limitations of conventional scheduling method are as follows: First, a new approach can monitor and reflect the real situation of shop floor in real-time. Second, it can model the various parameters and performance objectives of shop floor in a scheduling system with accuracy. Agent technology is particularly appealing to model and solve the monitoring and scheduling problems in manufacturing industries. Proposed in this paper is real-time monitoring and scheduling framework based on autonomous multi-agents. And to show the usefulness of proposed framework, a prototype system is developed and implemented. The main advantage of proposed framework is to generate a realistic and easy-to-understand schedule by imitating real-world decision-making process.

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Title of the Paper: **Mathematical Modeling and Analysis of Learning Techniques for the Game of Go**

Authors: **Arturo Yee, Matías Alvarado**

Pages: **293-302**



Abstract: In this paper the mathematical modeling for Go game is by using Finite State Machine. The purpose in Go gaming is territorial control, and it is a hard challenge for computer sciences, since it conceals a huge combinatorial complexity that impacts the options for learning automation. In this paper, we show how the use of pattern recognition by neural networks (NNs) is quite efficient during the first and middle stage in a Go match, while Monte Carlo Tree Search (MCTS) during the match ending stage. The experimental results on the use of NNs and MCTS illustrate our claim, and precede the analytical comparison of major approaches based on NNs for Go automation.

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Title of the Paper: **A Novel Approach for Integrated CBOK with Software Engineering Body of Knowledge Using Formal Mapping Technique**

Authors: **A. Kenza Meridji**

Pages: **277-292**



Abstract: To date in software engineering discipline literature mapping is done in a non formal way. Although software engineering is a new emerging engineering discipline but still lacks formal mapping methods. The most known body of knowledge is the SWEBOK that is considered as a body of knowledge for software engineering discipline that supports program curriculums and certifications. The GSwE2009 curriculum includes the core body of knowledge CBOK which provides guidelines for the education of students for a professional master's degree in software engineering. This paper suggests a novel approach to mapping using set theory operations. This mapping method will make formal mapping between two defined entities or sets. This research uses the software engineering body of knowledge (SWEBOK) and a core body of knowledge (CBOK) as object of study; and therefore the formal mapping is applied for both bodies of knowledge at all levels of structural decomposition; and consequently, the differences and similarities between both bodies of knowledge are depicted.

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Title of the Paper: **A Taxonomy for the Virtual Machine Allocation Problem**

Authors: **Zoltán Ádám Mann**

Pages: **269-276**



Abstract: Recently, the virtual machine allocation problem, in which virtual machines must be allocated to physical machines in cloud data centers, has received a lot of attention. This is a very complex optimization

problem with many possible formulations. In order to foster the clear definition of problem variants and the comparability of algorithms to solve those problem formulations, this paper introduces a generic model of the problem and derives the typically investigated problem variants as special cases. Meaningful problem variants are structured in the form of a taxonomy of problem models.

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Title of the Paper: **Scorpion Envenomations and Climate Conditions : The Case of Naama Province in Algeria**

Authors: **Schehrazad Selmane**

Pages: **261-268**



Abstract: Scorpion envenomations represent an actual public health problem in Algeria, at various levels, in three-fourths of the country provinces. A total of 903; 461 scorpion sting cases and 1996 induced deaths were reported in the country between 1991 and 2012. As the scorpion envenomation surveillance is based on passive system, the present study aims to analyse and to interpret the reported scorpion sting cases and to develop a forecasting model in order to perceive changes in the incidence early enough in Naama province, one of the endemic zone for scorpion envenomations. In addition to the epidemiological profile of scorpion stings, we performed time series analysis and regression analysis to estimate the relationship between scorpion sting cases and climate conditions. We also have explored the predictive power of alternative model incorporating seasonality. The epidemiological survey revealed that scorpion envenomations are observed through the year, round the clock, reaching peaks in July-August, and the more prone human body parts are upper and lower limbs. The time series analysis and regression analysis have shown that the scorpion activity in Naama province is climate dependent phenomenon; the temperature and precipitation are the main factors; they were used to derive the best predictive model for scorpion sting cases. Regression models produce reliable models to predict the number of scorpion stings provided that involved climate variables are on hand, and could therefore assist public health services as to be in state of preparedness by providing in advance the health facilities by the appropriate number of antivenom vials necessary.

---

Title of the Paper: **Numerical Analysis and Modelling of Recirculating Flows**

Authors: **Christina G. Georgantopoulou, George A. Georgantopoulos, Nikolaos S. Vasilikos**

Pages: **247-260**



Abstract: One of the most important issues in control engineering of flows is the accurate specification of recirculating zones, especially at various fluid and thermal industrial applications, where the working fluid's pressure and temperature values are important enough. In the present paper we develop a complete numerical approach for the simulation, modeling and estimation of recirculating flows, mainly inside short pipes. We use Cartesian grids, uniform as well as structured – nested ones with refinement, in order to succeed the appropriate choice of the number of sub-grids and the refinement factor providing accurate results for the fluid flow. The mathematical modeling of the governing Navier – Stokes equations consist of upwind schemes with up to third order of accuracy. We present the incompressible, steady and laminar flow inside a square lid-driven cavity, a channel with step and a backward facing step channel, trying to predict the recirculation lengths and define the position of detachment and reattachment points. The utility of the methodology is tested by comparing our results to those of the standard single algorithm as well as of the

literature. We conclude that our numerical algorithms and technique provide accurate results for the prediction of the recirculating incompressible flows and it can be applied in extended pipeline flow networks.

---

Title of the Paper: **Inertial Navigation by Interpolating the Flight Path of Moving Objects Based on Acceleration or Velocity Measurements**

Authors: **Peter Z. Revesz**

Pages: **241-246**



Abstract: This paper presents solutions to two cases of the inertial navigation problem, which is the problem of estimating the flight path of a moving object based on partial information. In the first case considered, only acceleration data and in the second case considered only velocity data is assumed to be available. In both cases simple and fast recurrence equationbased algorithms are provided that can estimate the flight path in  $O(n)$  computational time complexity where  $n$  is the number of measurements.

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Title of the Paper: **Mathematical Modeling of Disturbances on the Axes of the Telescope in the Conditions of Ship Motions**

Authors: **S. A. Tushev, V. N. Drozdov**

Pages: **235-240**



Abstract: The current circum terrestrial space is the subject of space activities of many countries, especially of the Russian Federation. System of space monitoring of the Russian Federation combines various radio and optical-electronic equipment. In order to improve the monitoring of space objects, these plants are placed not only on the fixed and mobile land stations, but also on the ships, to be able to observe for the space objects in various parts of the world ocean. The existing solutions in the field of trajectory measurement telescopes installed on a deck of the ship require a gyro-stabilized platform. However, gyro-stabilized platform has low dynamic characteristics, which influence on the precision of measurements. Therefore, it is necessary to develop a control system without a stabilizing device in which the ship motions are compensated by a precision electric drive. Among others, this purpose includes the problem of investigation of disturbances applied to axis of telescope's mount. The mathematical model of telescope electric drive reference is built with six kinds of ship motions. It is used to simulate dynamic disturbances. The authors have studied parameters of disturbances applied to telescope axis for the target motion path family in a wide range of angular coordinates. The paper shows the features of the mathematical modeling of disturbances caused by the marine pitching. The proposed mathematical model allows assessing parameters of dynamic disturbances caused by ship motions. It could be used for mounts of telescopes with different configuration. The article is helpful for students, specialists and developers of precision electric drives, especially of sea-based telescopes.

---

Title of the Paper: **An Improved Monolithic Multigrid Fluid-Structure Interaction Solver with a New Moving Mesh Technique**

Authors: **D. Cerroni , S. Manservisi, F. Menghini**

Pages: **227-234**



Abstract: Fluid-Structure Interaction simulations have gained popularity in the research community because of their applications in several industrial and biological fields. In such problems mesh movement is necessary in order to clearly evaluate the deformed solid state and the stresses. In many cases, especially when large displacement occurs, the movement of the mesh nodes can reduce accuracy and convergence properties of the solver. In this paper we present an improved fluid structure interaction solver with a new moving mesh algorithm based on a multilevel Arbitrary Lagrangian Eulerian method to be used in the computation of the arbitrary fluid displacement field. This algorithm is used together with a multigrid, monolithic, fluid structure interaction solver for large displacement problem in which the mesh overlapping is more likely to happen. Numerical simulations in two and three-dimension for both hexahedral and tetrahedral meshes are reported in order to better investigate the capabilities of this solver.

---

Title of the Paper: **Actuarial Models for Valuation of Critical Illness Insurance Products**

Authors: **P. Jindrová, V. Pacáková**

Pages: **218-226**



Abstract: Critical illness insurance (CII) or critical illness cover is an insurance product, where the insurer is contracted to typically make a lump sum cash payment if the policyholder is diagnosed with one of the critical illnesses listed in the insurance policy. The schedule of insured illnesses varies between insurance companies. The basis for the valuation of each insurance product, not excluding CII products, is the knowledge of probability of insurance event specified in the policy. This article aims to explain and apply methods of classical and Bayesian statistical inference how to estimate the probability of critical event diagnoses in the Slovak insurance companies, specifically for the men and women and for various age groups. The estimated event probabilities are subsequently used for setting risk premiums in the homogeneous groups by sex and age. The individual risk model has been used for calculation of premiums. Data submitted by the Decree No. 20/2008 to the National Bank of Slovakia from Slovak insurance companies giving exposure to the critical illness risk have been used for all calculations in the article.

---

Title of the Paper: **Cross-Country Robotized Vehicles Control: Fuel Saving Technique**

Authors: **V. Kh. Pshikhopov, D. B. Pogosov**

Pages: **211-217**



Abstract: This paper is about original fuel saving technique and nonlinear multilinked control for tracked robots, equipped with AC electric transmissions. Adequate mathematical model of the cross-country tracked robot, its AC electric transmission and diesel engine are presented. The position-trajectory control method with constant power of the engine together with induction motor optimization technique are introduced. These

solutions able to control non-hyperbolic traction drives. Together with fuel saving we provide selectable traction motor optimization. The robot drives with the engine optimal mode and no braking in allowable range of speeds.

---

Title of the Paper: **Small Noise Asymptotic Expansion for a Infinite Dimensional Stochastic Reaction-Diffusion Forced Van Der Pol Equation**

Authors: **F. Cordoni, L. Di Persio**

Pages: **202-210**

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Abstract: Starting from the classical Van der Pol equation, after suitable changes of variables, we derive a reaction-diffusion type forced Van der Pol equation with values in a suitable infinite dimensional Hilbert space. In particular we will perturb previous equation with a small additive Brownian noise. After some preliminary results concerning the non trivial existence and uniqueness of a solution, due to the presence of a non-Lipschitz non-linearity, we provide a rigorous asymptotic expansions in term of the small parameter  $\epsilon$  of the related solution up to order 3. We will then explicitly write the first three order of the rigorous expansion and provide as well an upper bound for the remainder.

---

Title of the Paper: **Some Approaches for the Parallelization of the QR Decomposition of a Matrix**

Authors: **Halil Snopce, Azir Aliu**

Pages: **193-201**

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Abstract: In this paper are investigated some methods for parallel computation of the QR decomposition method of matrices. A mathematical approach is based on the method of given's rotation and the method of householder reflection. The mathematical background is followed by the corresponding array which uses systolic approach. In both cases the systolic array is triangular array. On the case of the systolic array based on given's rotation, parallelization continues step by step as it is shown at figures 5 and 6. The output values of figure 5 become the input for figure 6 and vice versa, the output values of figure 6 become the input for figure 5. This kind of iteration is repeated until achieving the convergence.

---

Title of the Paper: **Modelling the Filtration Processes of Liquids from Multicomponent Contamination in the Conditions of Authentication of Mass Transfer Coefficient**

Authors: **Andrii Safonyk**

Pages: **189-192**

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Abstract: A mathematical model of the process of purification of liquids from multicomponent pollution by n-layers magnetic filter is built, which takes into account the inverse effect of the determining factors (concentration of fluid contamination and sediment) on the medium characteristics (porosity factor), and includes the ability to identify an unknown mass transfer coefficient. We propose an algorithm for solving the corresponding nonlinear inverse singular perturbed problem of the "convection-mass transfer."

---

Title of the Paper: **Mathematical Justification of the Stability of Axially Symmetric Singlet Large Bipolaron**

Authors: **V. K. Mukhomorov**

Pages: **176-188**



Abstract: Using the variational method we investigated spatial symmetry of a large bipolaron in singlet state. It is shown strictly mathematically that the formation stable state of bound two polarons in the singlet state corresponds to an axially symmetric spatial formation. It was found that the inclusion step-by-step of electron correlations lead to an increase in the binding energy of the bipolaron, but does not change spatial symmetry of bipolaron. At the same time spherically symmetric two polarons formation is not stable, even after accounting for electronic correlations. There are numerous arguments that point out the fallacy of spherically symmetric model of singlet bipolaron. It is shown that the variational principle should apply subject to certain restrictions that are imposed on the wave function. We performed a comparison of experimental data with the theoretical results. Theoretical results have been obtained in the framework of an axially symmetric bipolaron. At the same time for electronic-excited triplet states we have shown that a large bipolaron is one-center formation. We give explanations of changing the spatial symmetry of a large bipolaron when changing its spin state.

---

Title of the Paper: **The Binary Operations Calculus in  $E(a,b,c)$**

Authors: **Abdelhamid Tadmori, Abdelhakim Chillali, M'hammed Ziane**

Pages: **171-175**



Abstract: In this work, we study the elliptic curve over the ring  $F(2^d)[\varepsilon; \varepsilon^2=0]$ ; where  $d$  is a positive integer. More precisely in cryptography applications, we will give many various explicit formulas describing the binary operations calculus in  $E(a,b,c)$ . The motivation for this work came from the observation that several practical discrete logarithm-based cryptosystems, such as ElGamal, the Elliptic Curve Cryptosystems.

---

Title of the Paper: **To the Theory of Nonlinear Dynamic Equations for the Long Elastic Rod in Viscous Media**

Authors: **S. O. Gladkov**

Pages: **166-170**



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Abstract: The classical action for the long elastic rod was constructed and the resistance force accounted due to the formula for  $f(fr)$ . The both of the nonlinear dynamic equation and the transversal condition for free end of the elastic rod has been found. In accordance by Navier - Stokes equation the force of resistance  $f(fr)$  of cylindrical body as a function of its radius  $r$  was calculated. In this case of the distance range  $\delta r$  measured from the surface are  $n^{(-1/3)} \ll \delta r \ll v/u$ , where  $n$ - molecular concentration,  $v$ - kinematic viscosity and  $u$ - is the velocity of the flow.

---

Title of the Paper: **On the investigation of component-based reliability model in computer networks**

Authors: **Edvinas Greicius, Saulius Minkevicius**

Pages: **154-158**

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Abstract: The main object of this research is performance in terms of reliability of multi-server computer networks. Probability limit theorems on the queue length and virtual waiting time in an open multi-server queueing network in heavy traffic are derived and proved for important probabilistic characteristics of the queueing system. A reliability model is investigated and applied for a multi-server computer network, where the time of failure is related to the parameters of the system.

---

Title of the Paper: **Modeling of Processes of Near-Electrode Polarization in Polymer Films**

Authors: **Margarita E. Borisova**

Pages: **148-153**

[Download](#)

Abstract: In this article the results of measurements of ramp and reverse voltage I-V characteristics in thin polymer films and in polymer blends at high temperature are presented. The experimental data were analyzed on the basis near-electrode polarization models by using of mathematical modeling. The analytic equations for calculation of the charge carrier mobility were received. It is established the ionic nature of charge carriers in polymer films at high temperature. The distributions of electrical field and potential were calculated.

---

Title of the Paper: **Mathematical Prediction of Binary Mixtures Flash-Points**

Authors: **M. Skrinska, J. Skrinsky, P. Dolnicek, P. Lukesova, J. Marek**

Pages: **128-132**

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Abstract: The flash points of three organic binary mixtures containing alcohols were measured in the present work. The experimental data was obtained using the Pensky-Martens closed cup tester. The experimental data were compared with the values calculated by the approximation model. Activity coefficients were calculated by the Wilson equation. The accuracy of predicted flash point values is dependent on the thermodynamic model used for activity coefficient.

---

Title of the Paper: **Open Job Shop Scheduling via Enumerative Combinatorics**

Authors: **Daniela I. Borissova, Ivan C. Mustakerov**

Pages: **120-127**



Abstract: The paper presents using of enumerative combinatorics for open job shop scheduling problems. Two approaches are described – one approach aims to determine a schedule that minimizes the total makespan by solution of a single optimization task and other that is based on solving in parallel of a number of optimization tasks. For the goal, a combinatorial optimization modeling is described and corresponding algorithm is proposed. The described approach of enumerative combinatorics for optimal job shop scheduling is numerically tested for real job shop scheduling problem.

---

Title of the Paper: **Variational Principle in the Hydrodynamic Lubrication Theory**

Authors: **L. Savin, A. Kornaev, E. Kornaeva**

Pages: **114-119**



Abstract: Most of the laws of physics are brought to a statement that some value in the process under study has to reach its minimum or maximum. In such form these laws are called variational principles and their role in physics is hard to over-estimate. In the present paper a variational principle of the modeling of the stationary flows of viscous incompressible media of complex rheology is shown and its equivalency to the classic approach of the continuum mechanics is shown. An asymptotic case, namely a problem of a Newtonian fluid flow in an infinitely long bearing, is studied to verificate this, and the results match the results of other authors.

---

Title of the Paper: **Comparison of Two Iteration Methods for Solving Nonlinear Fractional Partial Differential Equations**

Authors: **Rodrigue Batogna Gnitchogna, Abdon Atangana**

Pages: **105-113**



**Abstract:** This paper follows up on a research paper presented at the 2014 International Conference for Pure Mathematics Applied Mathematics and Computations Methods in July Santorini Greece [1]. We paid attention to the methodology of two integral transform methods for solving nonlinear fractional partial differential equations. On one hand, the Homotopy Perturbation Sumudu Transform Method (HPSTM) is the coupling of the Sumudu transform and the HPM using He's polynomials. On the other hand, the Homotopy Decomposition Method (HDM) is the coupling of Adomian Decomposition Method and Perturbation Method. Both methods are very powerful and efficient techniques for solving different kinds of linear and nonlinear fractional differential equations arising in different fields of science and engineering. However, the HDM has an advantage over the HPSTM which is that it solves the nonlinear problems using only the inverse operator which is basically the fractional integral. There is no need to use any other inverse transform to find the components of the series solutions like in the case of HPSTM. As a consequence the calculations involved in HDM are very simple and straightforward.

---

**Title of the Paper: An Application of Simulation for Foundry Plants Investment Projects Estimation of Efficiency**

**Authors: Mikhail V. Zenkovich, Yury G. Drevs**

**Pages: 99-104**



**Abstract:** Methods and software enabling the estimation of efficiency and the comparisons of alternative designs of foundry plants on the basis of moulding lines are discussed. Problem of estimation of efficiency of investment projects of foundry plants is formulated in the terms of decision theory. Presented approach is based on the reduction of multicriterion problem of estimation of investment project to one-criterion problem. This paper describes: the structure of set of outcomes of admissible alternatives, set of vectorial estimations of outcomes, mapping of set of outcomes of acceptable alternatives to set of vectorial estimations of outcomes and structure of decision maker's preferences. Decision rule which allows carrying out required operation over the set of admissible alternatives is formulated. Application of simulation for estimation of technological and structural decisions, which was made during the plant design, is the central feature of presented approach. Model of moulding line refers to discrete-event class. Object-oriented approach was applied for designing of the model and programming language C++ for its implementation. Application of detailed simulation model of moulding line allows carrying out an accurate estimation of technological and structural characteristics of involved projects. Presented methodology of estimation of investment projects of foundry plants on the basis of moulding lines is tried-and-true method which applies on the phase of designing and engineering of foundry plant.

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**Title of the Paper: The Mathematical Modeling of Bound Component Extraction**

**Authors: Dagmar Janáčková, Hana Charvátová, Pavel Mokrejš, Vladimír Vašek, Ondrej Líška, Ján Pitel'**

**Pages: 91-98**



**Abstract:** The paper deals with application of mathematical modeling in process engineering. Our contribution contains mathematical deterministic models of extraction processes which are part of technology processes very often. We suggested them for their optimization. Without mathematical simulation and optimization are extraction processes of bound component connected with enormous consumption of extraction liquid.

---

Title of the Paper: **The Method of Discrete Singularities in the Diffraction Problem on a Closed Cylindrical Surface (the Case of H-Polarization)**

Authors: **Y. Bakhmat**

Pages: **87-90**

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Abstract: 2-D problem of monochromatic electromagnetic waves diffraction by a perfectly conducting closed cylindrical surface (the case of H-polarization) has been considered. The mathematical model of the diffraction problem above has been built. A new approach of the transition to discrete mathematical model has been considered. The discrete mathematical model is based on the method of the discrete singularities. The numerical experiment has been made.

---

Title of the Paper: **An Aspen Plus® tool for simulation of lignocellulosic biomass pyrolysis via equilibrium and ranking of the main process variables**

Authors: **A. Visconti, M. Miccio, D. Juchelkova**

Pages: **71-86**

[Download](#)

Abstract: Pyrolysis of non-fossil fuels is raising a growing interest in the nowadays scenario for the alternative supply of energy, fuels and chemicals. Biomass is among the most widely available and technologically promising candidate feedstocks. For simulation purposes and process design goals, kinetic-based models promise to be quite accurate in literature; however, they are computationally intensive and, more importantly, applicable only when kinetic data are available for the specific feedstock and pyrolysis equipment. Here, a different modeling approach is followed by considering that the pyrolysis reactor is under the thermodynamic equilibrium; then, the authors take advantage of the capabilities provided by the Aspen Plus® software. Therefore, this work is focused on the development of an input-output reactor model to simulate pyrolysis of a lignocellulosic biomass and to predict the effects of the main process variables. The trends of the predicted results as a function of the process operating variables are generally in accordance with those that are experimentally evident and published in literature. A limited comparison is provided against the experimental results of Honus[25]. It has to be noted that the Aspen code could not predict the composition of the liquid residue, i.e., tar.

---

Title of the Paper: **Explicit-Implicit Variable Structure Algorithm for Solving Stiff Systems**

Authors: **Eugeny A. Novikov, Anton E. Novikov**

Pages: **62-70**

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Abstract: An algorithm of variable structure for solving stiff problems is constructed using L-stable and explicit methods. It is based on explicit and L-stable methods, both schemes of order two, and on an explicit method of the first order, which interval of stability is extended. On each step an efficient numerical scheme is chosen by criterion of stability. The numerical results of modeling the simplest oregonator and the modified oregonator exhibiting complicated limit cycle are given.

---

Title of the Paper: **Inclusion Properties for a Certain Class of Analytic Function Related to Linear Operator**

Authors: **F. Ghanim**

Pages: **56-61**



*Abstract*— In this paper, we introduce a new class of analytic functions defined by a new convolution operator  $L'_a(\alpha, \beta)f(z)$ . The new class of analytic functions  $\Sigma_{\alpha, \beta}^{a, t}(\rho; h)$  in  $U^* = \{z : 0 < |z| < 1\}$  is defined by means of a hypergeometric function with an integral operator associated with the Hurwitz-Lerch Zeta function and differential subordination. The author also introduces and investigates various properties of certain classes of Meromorphically univalent functions.

---

Title of the Paper: **Gaussian Distributed Scattering Rings-Based MIMO Channel Modeling for Wireless Communication**

Authors: **Illa Kolani, Bertrand Moubagou**

Pages: **51-55**



Abstract: This paper presents a MIMO channel performing the prediction of wireless channel behaviour particularly in fast fading scenario. The proposed spatial channel model is elaborated assuming a scattering environment system consisting of multiple contiguous one-ring scattering with different beamwidth seen at the enodeB (base station). Since an arbitrary one ring scattering channel (Reference Model) in this model stands for channel realization, therefore the motion of the User Equipment (UE) over multiple scattering rings will induce the channel to experience many realizations. Following a given Probability Density Function (PDF) of beamwidth, an estimation of the behaviour of the channel can be available at the enodeB by averaging upon the overall channel realizations. AS application of the proposed model, we provide a performance analysis of LTE downlink performing and suggesting the optimal and suitable choice of the transmission mode in real MIMO channel spatial correlations environments.

---

Title of the Paper: **Comparison of Selected Stochastic Mortality Models**

Authors: **Jan Gogola**

Pages: **44-50**



Abstract: Insurance companies are affected by many different kinds of risks. In the case of life insurance there are two main risks: the investment risk and the demographic risk. The latter can be split into insurance risk due to the random deviation of the number of deaths from its expected value, and longevity risk deriving from the improvement in mortality rates. Numbers of stochastic models have been developed to analyse the mortality improvement. We compare three stochastic models explaining improvements in mortality in the Czech Republic. This paper focuses on Lee-Carter and Cairns-Blake-Dowd models. We use data on males deaths and exposures for the Czech Republic from the Human Mortality Database. We write the code associated with models in R. We show graphical comparison of the model fits. We find that an extension of the Cairns-Blake-Dowd model that incorporates a cohort effect fits the Czech Republic males data best.

---

Title of the Paper: **Evaluation of Performances of Indexes Used for Validation of Simulation Models Based on Real Cases**

Authors: **Jacopo Bongiorno, Andrea Mariscotti**

Pages: **29-43**



Abstract: When simulation models are validated against experimental data, model adequacy and accuracy are evaluated using performance indexes that quantify distances between simulated and measured data vectors: amplitude, derivatives, slopes, peaks and valleys, etc. are all possible curve features. Performance indexes have appeared in the literature from different fields of science and are tested for suitability to problems involving electric networks. Indexes are evaluated for sensitivity to typical signal characteristics and the capability of detecting usual differences; tests are performed on synthetic and real cases.

---

Title of the Paper: **Modeling Processes of Inferring Good Maximally Redundant Tests**

Authors: **Xenia Naidenova, Vladimir Parkhomenko**

Pages: **21-28**



Abstract: Good test analysis is considered. Two kinds of classification subtasks are defined: attributive and object ones. Some ideas of modeling and optimization of inferring good maximally redundant tests are formalized. An algorithm of inferring good maximally redundant tests based on the decomposition into attributive subtasks is given, where good maximally redundant tests are regarded as concepts of formal concept analysis. An approach to incremental inferring good maximally redundant tests is considered.

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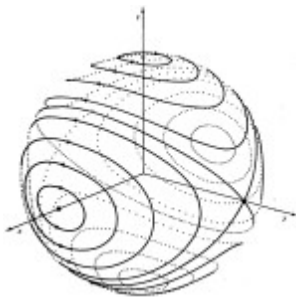
Title of the Paper: **Functional Statistical Classification of Non-Linear Dynamics and Random Surfaces Roughness in Control Systems**



Abstract: This paper addresses, in a nonparametric functional statistical framework, the problem of classification of nonlinear features of curve and surface data in control systems. Specifically, on the one hand, in the detection of nonlinear dynamic features, wavelength absorbance curve data are analyzed for different meat pieces to discriminate between two categories of meat in quality control in food industry. On the other hand, in the nonparametric functional classification of deterministic and random surface roughness and irregularities, in the field of railway engineering, train deterministic and random vibrations are analyzed to discriminate between different nonlinear features characterizing roughness and irregularities of railway.

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### ◦ **January 7th 2015:**

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New Special Issue on International Journal of Mechanics: [Special Issue dedicated to the 100th Anniversary of Russian Academician Yury N. Rabotnov](#) by Professors Yury A. Rossikhin and Marina V. Shitikova

### ◦ **October 28th 2013:**

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International Journal of Materials  
International Journal of Computational Intelligence

### ◦ **October 25th 2013:**

The Editorial Boards of our journals are under constant update. New Associate Editors are being invited to assist with the review process.





# Appraisal of the extraordinary contribution in General Regulatory Plan of Rome

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**Abstract** — With the new General Regulatory Plan for Rome, adopted with D.C.C. No. 33/2003 and approved with D.C.C. No. 18/2008, in the part concerning the criteria for equalization, they introduce/insert the so-called “Extraordinary Contribution” to urbanization, one of the most important innovations, introduced by the new Plan, which fixes an amount in addition to the cost of primary urbanization and those related to building permit, borne by the promoter of urban transformation development project.

However, at a distance of eleven years after the adoption of the new General Regulatory Plan for Rome and more than six after its final approval, the regulation for the calculation of the Extraordinary Contribution was finally approved by the Rome City Council. One of the reasons for this delay is identified in the legal basis of the additional financial obligation of the project developer, and an appeal brought before the Regional Administrative Court of Law [T.A.R.] was put to rest with the Legislative Decree No. 78/2010 converted into Law No 122/2010 where Article 14(16) permits the introduction of Extraordinary Contribution with the exact wording of the technical conditions of the new GRP for Rome and with the decision of the Council of State, Section IV No 4545 of 13/07/2010.

Several attempts have been made to regulate this additional cost, the last of which was the approval by the Board of Councillors in February 2014 definitively ratified by City Council Resolution No. 128/2014 of a regulation stating, in summary, that the real estate value to which the extraordinary contribution for urbanisation must be applied, i.e. at the rate of 66.6% as described in Article 20(3) of the Rule for Implementation (NTA), is equal to the difference between two distinct transformation values (below VT) of the property transformed: VT1-VT, i.e. the difference between the Value of the Transformation of the property, calculated taking into account the additional construction foreseen by the proposed intervention (VT1), subtracted from the Value of Transformation of the same property under normal urban regulations without further negotiations, so setting the parameters and the method of calculation.

**Keywords**— extraordinary contribution, general regulatory plan, value of transformation

## I. TECHNICAL PROBLEMS INHERENT IN THE CALCULATION AND LEGAL ISSUES OF EXTRAORDINARY CONTRIBUTION

The General Regulatory Plan (hereinafter “GRP”) for Rome, adopted with City Council Deliberation (CCD) No 33/2003 and approved with CCD No 18/2008, in the part concerning the criteria for equalization, i.e. Article 17(2)(B) extraordinary contribution (CS) states: “In the existing urban settlement system, the majority of the leading real estate valuations generated by new urban development projects are subject to

the payment of an extraordinary financial contribution that the City Council shall use to finance public works and services in distressed urban areas, with the aim of urban regeneration”;

The successive Article 20(3) specifies that the CS is an additional charge and is established in an amount equal to 2/3 of the real estate value achieved with the increase of gross usable surface (SUL)<sup>1</sup> and/or changes in the intended use compared to planning regulations previously applicable. Paragraph 9 successively adds that the City Council defines criteria and procedures for the estimation in a separate regulation.

The Co-planning Conference<sup>2</sup> report identifies, in the guiding factors and regulations, that the economic value gained by the new GRP (through additional building rights and changes of intended use) is for the most part “returned” to the City (the community) through the payment of extraordinary financial contributions.

This new and onerous obligation on the implementing body prompted an appeal to the TAR<sup>3</sup> in which the applicant challenged the legitimacy of the CS in view of the lack of the necessary legal basis at both State and regional levels. The judgment of 04/02/2010 accepted the applicant's argument on the issue. The first Judge, in fact, considered the introduction of CS to be without legal basis, believing that the methods adopted in this manner for the pursuit of the objectives of urban (and financial) equalization violated the principle of legality because the extraordinary contribution would constitute a property tax, albeit of non-tax nature, and it as such lacked an express basis for calculation and therefore was in breach of the legal reservation *ex* Article 23 of the Italian Constitution.

As a result of Article 14(16)(f), Decree Law 31 May 2010 No 78, converted into Law No 122/2010, the introduction of the CS was permitted when formulated exactly as in the technical regulations of the new Rome GRP. It seemed to have been

<sup>1</sup> Article 4(1) of NTA Gross floor area (SUL): measured in square meters. The sum of the gross floor areas of the building unit, including within the outer perimeter of the walls, excluded from the calculation are stairwells, hallways, elevator shafts, technical volumes, not completely closed spaces, basements, parking space outside walls over 30 cm, glass- or greenhouse surfaces, fireplaces and ventilation surfaces

<sup>2</sup> According to Article 66-bis of Regional Law 38/99, the co-planning conference must be convened to reach an agreement on the approval of the GRP, and that the managers of the of the City Council, Regional and Provincial technical facilities must participate

<sup>3</sup> General Registry Appeal No 6274 of 2008

issued by the municipality of Rome with the express purpose of legitimizing *ex post* the estimations of the CS.

The judgment of the Council of State No 4545 of 13/07/10 recognizes conclusively the legitimacy of the estimates of the CS for urbanisation, stating that it constitutes a levy applicable to the determined higher value of the building in the area upon completion of the construction negotiation process and the definition of indirect intervention programmes, or upon issue of the qualifying title; and also that the authoritative predetermination of the CS does not affect the "optional" nature of institution but rather respects the need to "ensure a level playing field between the owners of the soil in urban regulatory matters" by defining the terms and conditions which the parties to the agreement pursuant to Article 11 of Law 241/90 must guarantee to the city administration in exchange for the increased building volume that the GRP permits them.

## II. HINTS ABOUT THE PROVISIONAL CALCULATION METHOD OF THE CS (DEPARTMENTAL CIRCULAR 13/04/2013)

Once finally overcome the criticalities related to the juridical aspects, the City Council Executive Committee passed the resolution with Decision No 20/2013 entitled: "Rules for the determination of the extraordinary contribution" and, pending approval by the City Council, a departmental circular was issued illustrating the method of calculation. Summarizing, these calculation procedures, partially adopted in the final version, prescribed that the method was that one used for the Value Transformation with the analytic process according to the following prescription: the references must be taken from the list of property market observatory of the Italian internal revenue service ( hereinafter "OMI") and from the costing list compiled by the Engineers and Architects order available from DEI publishing house; commercial surface area is not less than 8% of the SUL, the costs of preparing the site go from 2 to 5% of the cost of technical realization; marketing costs may affect the estimated market value of the completed project by 2-3%, the profit of the property developer of 15-25%, the borrowing costs have been estimated through the analysis of the cash flows.

## III. FINAL CALCULATION METHOD (TO REPLACE DEPARTMENTAL CIRCULAR 13/04/2013)

As what was planned by City Council hasn't been approved before the end of the mandate, the new administration planned a new resolution, approved by the Council during February 2014 that resumes the prior methodology.

In particular, the method of calculation, criteria and coefficients to be used for the calculations of the greater financial value of the development project are defined consistently and clearly for all the actuators.

The benchmark on which to base the improved real estate value achievable with the implementation of the planned development, and consequently to determine the amount of the extraordinary contribution due by the implementing body, is made up of the feasible real estate value of the property in

question on the basis of normal urban estimates, i.e. based on the building not subject to an extraordinary contribution as established by the urban planning instruments in force.

To ensure full compliance with the principles of fairness, consistency, uniformity of treatment and impartiality, the estimated real estate value achievable is to be calculated with the analytical method for the value of transformation, as normally applied in cases of economic benefit. This method is commonly accepted and practised, and having specific scientific validity, it allows objectivity, consistency and reliability.

The method is the subject of much literature and its inequalities are the subject of mathematical formulation research.

The parameters which govern and collate the values for all the actuators are described and defined below, in order to ensure the correct application in compliance with Article 20 of the NTA of the GRP, in particular with the requirements of paragraph 9.

It must always be assumed in every case that the transformation plan is both consistent with the characteristics of real estate (buildings, areas) and is within the limits of what may be feasibility developed.

The analytical method of Value Transformation considers the property affected by the transformation as a product from which - through the expenditure of a certain amount of capital which constitutes the cost of development or transformation - a final product is attained, i.e. the developed or transformed building.

The Value Transformation ( $V_t$ ) of the property is given by the difference between the Market Value of the building product achieved by the transformation ( $V_{mt}$ ), less the processing cost consisting of the sum of the costs ( $K$ ) incurred in the related transformation, and the Market Value of the building product in the ordinary conditions ( $V_{ma}$ ), where  $V_t > V_{ma}$ .

The Market Value of the finished building product ( $V_{mt}$ ) is taken from the latest figures released by the OMI. If this published data is used, the OMI, an agency of the Italian Internal Revenue Service, must be quoted as the source.

The  $V(m)$  for objects in a condition conservatively defined as "normal" corresponds to the "maximum" real estate Market Value per square meter of marketable surface of the building.

Where OMI quotations are related to a real estate conservative defined as "optimal", in the case of new constructions, the Market Value of the finished building product ( $V_{mt}$ ) of reference is that described as "maximum". In cases of interventions on existing buildings, the Market Value of the finished building product ( $V_{mt}$ ) where the conservative state may now be defined as "optimal" the value of reference is to be the average of the values "minimal" and "maximum".

It should be noted at this point that studies of a considerable number of cases have shown that the commercially marketable surface (SCV) cannot be less than 8% of the gross usable surface in the case of properties destined for residential use.

For details relating to destination definitions must see "Land Agency - glossary of technical definitions in use in the real estate sector." [Agenzia del Territorio – glossario delle definizioni tecniche in uso nel settore economico immobiliare] Appurtenant car parks, pursuant to Article 41sexies of Law 1150/42, paragraph 2, are freely tradable, contributing therefore as real estate units to the calculation of the Market Value.

In the event that the interventions are undertaken on existing buildings, the value of the transformation is calculated on the basis of the proposed construction project involving the preservation of uses and forms of conduct and management of the property in force at the time of presentation of the proposed action;

In the event that the proposed interventions are undertaken on existing buildings, and/or foresee the construction of buildings destined for usage categories not included among those for which the OMI provides Market Value data, the market values required for the calculation of the transformation values should be determined with indirect or analytical estimation procedures (by applying the income generated by the operation and management of the property as a result of the transformation of the asset, and that generated by the operation and management of the property in the event of a preservation of the intended use and the forms of tenure and management in force at the time of submission of the proposal).

The cost of transformation (K) is the sum of the costs ( $\sum iK_i$ ) incurred in carrying out the development or transformation, which are the following:

- the cost of the construction work itself;
- the cost of preparing the site and of utility connections;
- costs relating to the charges pursuant to Article 16 of Presidential Decree No 380/2001;
- the cost of professional services - unforeseen technical and related costs;
- marketing expenses;
- financial expenses;
- profit or gross margin of the developer.

The cost of the building construction work is to be estimated parametrically using the values per square meter of the building as in the price list for buildings published by the College of Engineers and Architects of Milan (referring to the latest edition available from DEI at the time of the estimate), with reference to the specific use destinations. In the case where relevant parameter values are not available, the calculations by analogue, referring to the category most similar; in the case of demolition and reconstruction the cost of the demolition of existing buildings should also be considered in addition to the parameter value derived by the price lists quoted; in the case of restructuring, the construction cost is derived from an itemised bill of quantities based on rates in force in the Lazio Region and duly sworn to by the person responsible for the design of the urban transformation/construction project.

The cost of preparing the site and of utility connections may constitute from 2% to 5% of the building construction work

cost and offset all reclamation, site preparation and connections, and investigation archaeological, geological, etc. undertaken. The evaluation shall take into account the average of the values, the differences should be adequately justified, and it remains understood that the minimum and maximum amounts will not be exceeded.

Costs relating to the charges pursuant to Article 16 of Presidential Decree No 380/2001 include charges of primary and secondary urbanisation and contributions to the construction cost, calculated according to the values established by the Rome City Council in the Council Deliberation in force when calculating the extraordinary contribution for urbanization.

Professional-technical costs and related-unforeseen costs include all costs of a technical-professional nature (urban, architectural, structural and plant engineering studies, safety services, works supervision, performance testing, cadastral requirements etc.). The value is estimated as a percentage of the cost of the works to be carried out when calculated as the sum of the technical cost of construction of the building, the cost of site preparation and of archaeological surveys. From trial calculations carried out using previously applicable professional fees (Ministerial Decree 04/04/2011) and the Ministry of Justice Decree No 140, 20.07.2012, taking into account the current low values present in the real estate market, it is seen that the percentage can vary between 8% and 12% of the cost of the building construction work, the cost of site preparation and of utility connections. The evaluation shall take into account the average of the values, the differences should be adequately justified, and it remains understood that the minimum and maximum amounts will not be exceeded.

Financial expenses are the costs of the capital employed in the investment. This cost is a function of the amount of capital required, the duration of exposure and the rate of interest payable.

The borrowing costs are calculated considering the cost of debt capital during a planning and construction time horizon when the interest on the debt is the sole responsibility of the project supervisor. The time horizon is fixed at five years unless otherwise justified by the size of the project.

The debt cost or the interest rate to be applied is equal to the Euro Interest Rate Swap EurIRS/Euribor spread for a final term loan of fifteen years.

EurIRS is the Euro Interest Rate Swap, the index of fixed rate mortgages; Euribor is the index of the variable-rate mortgages. The source for nominating the EurIRS and Euribor values shall be the Italian financial daily "Il sole 24 ore" or the web site [www.Euribor.it](http://www.Euribor.it).

The spread (deviation or margin) is a percentage value that fluctuates on average between 2.50% and 3.50% and is dictated by the major European banks such as Deutsche Bank, BNP Paribas, Credit Agricole. It represents the remuneration for the credit institute granting the loan.

Unless another value is justified, only the pre-amortisation period of five years as follows will be considered:

- first year 10% (construction permits issued)
- second year 30% (advance for early intervention implementation)
- third year 40% (advance for early intervention implementation)
- fourth year 20% (balance on project realisation)
- fifth year 0% (marketing)

The percentages reflect the gradual assumption of risk on the part of the lender relative to the progressive completion of the works placed under warranty.

The interest on the debt accumulated as the five year period progresses constitutes the financial burden of the investment. In practice, the advance paid in the first year is equal to 10% of the total requested and the interest is for all five years of construction, in the second year the bank advances 30% and the interest accumulated is calculated for four years, and then progressively 40% for three years and 20% for two years.

The burden of the financial charges can thus be calculated for each of the phases of pre-amortisation according to the table attached below, evaluating the interest rate to be applied at the moment of loan request.

From the sixth year, the interest on the debt becomes the burden of the purchasers.

The profit or gross margin of the developer is the total profit that the promoter of the project derives from the use of all funds in the real estate transaction. In appraisals using the Value Transformation method, and using the Operation Manual of the Italian Territorial Real Estate Agency estimates, the profit of the developer is expressed as a percentage of revenues in relation to a number of variable factors both for external conditions and for the intrinsic characteristics of the project: general economic conditions, industry intervention, market trends, financing methods, type of real estate transaction (location, size, intended use), cost forecasts and revenues and their reliability, commencement of the time of return, as well as additional variables specific to a real estate transaction.

The detailing of these values according to the specific characteristics of the project, provided with adequate justification, allows for an exact evaluation of each case. The default levels for the lower threshold are set in any case at 15%, and the upper threshold at 25% of the Market Value of the finished building product ( $V_{mt}$ ).

The percentage values referring to the individual cost items shall be adequately modulated in order to respect the above percentage thresholds, with reference to the specificity of the individual urbanisation projects.

The Value of Transformation is then calculated with the formula:

$$VT = V_{mt} - \sum iK_i > V_{ma}$$

where:

- VT is the Value of Transformation of the property;
- $V_{mt}$  is the Market Value of the object of the property development project;

- $\sum iK_i$  is the summation of all the processing costs incurred during the property development;
- $V_m$  is the Market Value of the building product under conditions in force.

In conclusion, the value subject to the CS for urbanisation, defined as 66.6% in Article 20(3) of the NTA, is equal to the difference between two distinct transformation values of the property in question:  $VT_1 - VT_2$ . That is to say, the difference between the Value of the Transformation of the property, calculated taking into account the additional construction foreseen by the proposed intervention, and the Value of Transformation of the same property under normal urban regulations without further negotiation processes.

The Value Transformation ( $VT_1$ ) is computed in the manner described above, on the basis of the proposed enhancement of the property in question, as a result of the negotiation process.

The Value Transformation ( $VT_2$ ) is calculated in the manner described in this Circular, theorising the development of the same property on the basis of urban norm estimates, namely the realization of the intervention urban construction categories and building dimensions (SUL) for which, on the basis of the existing urban norms, the CS for urbanisation is not due.

In the event that the proposed interventions are undertaken on existing buildings, and/or foresee the construction of buildings destined for usage categories not included among those for which the OMI provides Market Value data, the market values required for the calculation in the manner described in this report of the values of the transformation  $VT_1$  (related to the proposed enhancement of the property covered by the measure) and  $VT_2$  (the value relative to the same property assuming that the use destination and forms of tenure and management in force at the time of submission of the proposal) must be determined using indirect or analytical estimation procedures.

The scope of this methodology covers all direct or indirect development where the required urban planning permits have not yet been signed or where a required permit has not yet been issued.

#### IV. FIRST APPLICATION

Only in order to give a concrete meaning to the effect of C.S. it is reported the first City Council resolution (No. 63 date 29/9/2014) that approved the urbanistic transformation program called "Via Longoni" according to the procedure described earlier. In this case the total SUL is  $Sqm\ 10.835,10$  which  $Sqm\ 2.929$  destined to residential use and were subject to an extraordinary contribution that was earlier estimated in  $\text{€}\ 508.474,40$  ( $\text{€}\text{Sqm}\ 173,60 \times Sqm\ 2.929$ ) but according to the new criteria during the phase of approval it was updated in  $\text{€}\ 983.681,88$  equal to  $\text{€}\text{Sqm}\ 335,84$ . It is absolutely clear the high effect of this aspect in the price making Dynamics, reason why the underestimation of this topic in an phase could lead to remarkable appraisal criticalities to the whole productive process.

## V. DEFINITIVE APPROVAL AND CONCLUSIONS

The first consideration is that despite the new GRP adopted by the City of Rome with CCD No 33 of 19/20 March 2003 and finally approved with CCD No 18 of 12 February 2008, the expected regulation for the calculation of C.S. was approved six years later.

Continued uncertainty in this period has inevitably resulted in it not always being applied in a homogeneous manner. This includes by offices which deal with direct intervention projects and by those which work with programme agreements.

Another consideration is that inherent in the fact that the new GRP provides for compensation planning<sup>4</sup> (reduction and transfer of the volumes foreseen to another site) based on the equivalence of property values. These values could also be regulated using calculation methods analogue with the method designed for the calculation of the CS, as this compensation process also deals with the calculation of property values.

Last but not least is the fact that OMI calculations do not have probative value, and with Law 88/2009 the OMI values were demoted from legal presumption to mere indications of evasion. The values deduced from the OMI data base therefore constitute only a reference range, useful for the assessment of the value of the property. It would, however, be correct to refer to known prices of similar properties to that being valued. A market-oriented evaluation cannot make use of automatic and conventional calculations.

One is also left perplexed by the fact that the proposed calculations make no reference, considered within the rate of return of capital industrial ( $r^1$ ), to the risk factors, market uncertainties, unpredictability, inflation, devaluation, anxiety linked to the complexity of the transformation within time horizons rarely much longer than five years, and of the unknowns in the lease market.

Finally, operators increasingly demand a change of use from commercial and tertiary sectors to residential, transformations which would seem uneconomical because the OMI values often identify higher values for non-residential use, resulting theoretically in a negative extraordinary contribution.

The summation of all the critical points mentioned above, not corrected before approval by the City Council, in the implementation phase could end up creating values which penalize operators, or worse, could be damaging the municipal revenue to the detriment of the entire community.

The Rome City Council proceeded with Resolution No 128 of 11/12/2014 to the final approval of the calculation of the extraordinary contribution [hereinafter CS, contributo straordinario] without making any substantial changes, the previously expressed observations remaining unchanged.

In confirmation of what was explained regarding concerns about the requirement set out in the Regulation in reference to the most current prices reported by the OMI, the following is that published on the website of the Italian Revenue Office<sup>5</sup>:

"the values contained in the database of property prices in the OMI:

- cannot be meant to substitute the "estimate", but only to aid the same.
- refer to the ordinary character of buildings and, in particular, the conservative state prevalent in the homogeneous area.

The use of OMI quotations as part of the estimation process can only lead to indications of the widest maximum values. Therefore an estimate made by a professional technician is the only one able to represent and describe the property exhaustively and with full effect and provide the reasons for the value attributed to the asset itself.

Furthermore, we are unable to agree with the obligation in the absence of OMI reference value data for properties "destined for usage categories not included among those for which the territorial OMI provides market value data, that the market values required for the calculation of the transformation values should be determined with indirect or analytical estimation procedures (by applying the income generated by the operation and management of the property as a result of the transformation of the asset, and that generated by the operation and management of the property in the event of a preservation of the intended use and the forms of tenure and management in force at the time of submission of the proposal).<sup>6</sup>

The first consideration is the lack of clarity in the phrase: "by applying the income generated by the operation and management of the property" seems to relate more to the assessment of a company rather than to its real estate. It is impossible not to note that the cited Regulation in the calculation of the CS indicates for each entry, references and mandatory maximum and minimum thresholds (e.g. OMI values, the cost of the construction itself, area preparation and utility connection costs, costs relating to the charges pursuant to Article 16 of Presidential Decree No 380/2001, the cost of professional services - unforeseen technical and related costs, expenses for marketing, financial expenses, and the profit or gross margin of the developer) while nothing explicit about the calculation of the Market Value through "indirect estimation or analytical procedures." This procedure makes use of two fundamental aspects:

1. Net Income ( $R_n$ ), that is, the contracted annual fee received by the owner (Gross Income) with the deduction of all expenses, such as routine maintenance expenses, the amount of depreciation, insurance, vacant and uncollectable, taxes and fees.
2. The Capitalization Rate ( $r$ ) which expresses the price of use of the monetary savings transformed into real estate capital within a time unit. This ordinarily falls in a range from 1% to 5%, Carlo Forte considered it possible to admit that the 400 points of variation between the minimum and maximum rate were

<sup>4</sup> Article 17(2)(c) and Article 19 of the NTA

<sup>5</sup> <http://www.agenziaentrate.gov.it/wps/content/Nsilib/Nsi/Documentazione/omi/Banche+dati/Quotazioni+immobiliari/>

<sup>6</sup> Rome City Council Assembly Resolution No 128/14

determined by a number of "ascending and descending influences that act, each with a positive sign (ascendant) or negative (descendant) on the average rate.

Whereas, therefore, in estimating practice the Market Value is obtained by:

$$(V_m) = R_n / r$$

It is obvious with that the assessment based on the capitalization of net income, with the current average interest rates so low (3%), the movement of even a quarter of a point in appreciation of the capitalization rate results in significant variations of the values and thus the degree of discretion of the evaluator also with regard to the analysis of the costs to be deducted from the Gross Income, on which a homogeneity of evaluation does not always exist.

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