MODELING, SIMULATION AND EXPERIMENTAL RESEARCH ON TECHNICAL AND BIOLOGICAL SYSTEMS

Author: Veronica ARGEȘANU

Abstract

In order to optimize the functional design of a MFS one must take into account the antagonistic conditions: minimal or zero leakage and reduced friction and wear implying appropriate tribological conditions in the interface.
It is important for the operating conditions of a machine that the appropriate conditions of a machine that the appropriate sealing solution is chosen as well as the imposed conditions of the design and working are summarizing the contribution made by the author in the thesis are:

- the comparison of the limitative parameters which facilitates the chosen of the optimal solution of sealing
- the defining of the intensity of the power loss through friction in the contact area of the MFS, that can give a quantitive appreciation of the operating limits of a MFS.
- the analytical assessment of the flow-friction depending under a hydrostatic or hydrodynamic regime.
- modeling of the surface dynamic contact in the primary seal of a MFS
- the establishment of the theoretical relations of the thermo hydrodynamics of a MFS in a steady non-isothermal regime finite element analysis
- identifying the factors that influence the performance of a MFS
- mechanical and thermal modeling through computer simulations (with axially symmetric elements) of two types of MFS (EF and EF-S 103x45.4x13.3 19) manufactured by SC ROSEAL, taking into account 15 different pairs of friction materials for the primary seal of the MFS.
- the results allow the determination of other parameters (heat transfer coefficient, correction rate, etc.) that are not found in literature.
- the hypothesis of linearity of the heat flow (literature data are not confirmed)
- the effect of heat circulation in both rings simultaneously
- development of the relationship: temperature distribution-rotating rings-heat flux in the gap-geometry of the gap.

The results of modeling and computer simulation, effective in terms of input / output, being faithful to the experimental, have advanced the accuracy of modeling and their application to other pairs of materials can be considered as valid for assessment / optimization and selection of the optimal solution of a MFS.

◊ experimental design and test equipment and establishing the experimental program;

◊ attempt under research three different seals Front (EFS 103-S; 19 x 45.4 x 13.3 EF, EF 15 x 25.7 x 12.8) and three fluids to be sealed (water at 80° C detergent, industrial water at 80° C, water with antifreeze) that confirm the results of analytical modeling research.

Theoretical issues raised during the preparation of this thesis was initiated through a cooperation agreement with
SC ROSEAL S.A. – Odorheiul Secuiesc and recovered within the National Council of University Research annual research projects:
"Methods and devices for testing mechanical transmissions and their components" code 280/1998.

The full abstract at:
http://www.upt.ro/img/files/2015-2016/doctorat/abilitare/argesanu/Habilitation_thesis-teza_abilitare_Veronica_Argesanu.pdf

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THEORETICAL AND EXPERIMENTAL RESEARCH ON STRUCTURES AND HISTORICAL BUILDING USING ADVANCES SURVEY ENGINEERING METHODS

Author: Sorin HERBAN

Abstract

Present thesis summarises the research activity of the candidate after defending the PhD Thesis at The Politehnica University of Timisoara and confirmed by The Ministry of Education and Research, on the basis of Order no. 5764, dated 28.11.2006.
The research activity and achievements presented in the habilitation thesis, is developed in a few of main thematic directions that are coverage by the author.
The first one is - Contribution to applying topographic methods for studying and monitoring terrain and constructions, which continues and diversifies with new subjects, the topic of the PhD Thesis or others subjects related to this.
It should be noted that the activity of the candidate in the field of special surveying engineering and applying topographic methods for studying and monitoring terrain and constructions (20 years of research in this field), from the beginning, from September 1996, until the defending of PhD Thesis, and for the post-thesis period, is in line with the fields of research of the department of Overland Communication Ways, Foundation and Cadastre and especially with the team from Terrestrial Measurements and Cadastre from Faculty of Civil Engineering, Politehnica University of Timisoara, but also with private companies and departments from EU universities.
The new subjects of research in the post-thesis period can be synthetized in four distinguish them, developed in the present thesis, each of them related to the following aspects:
- Developing methods and models to evaluate and determine the real deformations of terrain ans structures.
- Reverse Engineering and Laser Scan Technology applied to Cultural Heritage domain, Development of 3D Models for Cultural Heritage sites;
- Using Open Source and Low-Cost solutions and GIS Platforms for different users to architectural and cultural applications;
- Educational platforms for e-learning processes.
The results of my scientific research are materialized mainly in speciality scientific articles and books. Therefore, I have always focused on this aspect, considering that not only the quantitative

aspect of the work is important, but also the quality and the value of the material published. It can be seen in the list of the scientific papers attached that I collaborated with colleagues from other Romanian and EU universities to contribute at enriching the literature in domain of applied Geodesy realated to Civil engineering domain.

The full abstract at:
http://www.upt.ro/img/files/2016-2017/doctorat/abilitare/herban/Rezumat_habilitation_thesis_en.pdf

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NEW MATERIALS USED FOR ARSENIC REMOVAL FROM WATER

Author: Adina Georgeta NEGREA

Abstract

Present habilitation thesis was structured in two different parts, and was prepared based on 31 research papers and one national patent. I am the leading author of 17 of these papers and the coauthor of 14. Of these papers, 18 are indexed in Clarivate Analytics, 12 are indexed in different other international databases, and one is a book chapter published by an international book publisher.

First part of habilitation thesis is briefly presenting my main professional, scientific, and academically achievements from the moment I defended my PhD thesis (2002) until now. During this period, I worked into the chemical engineering and in environmental protection areas. In this chapter are firstly presented the main aspects regarding the arsenic content into the worldwide natural waters as also in our country, natural and anthropic arsenic sources and the effects of his presence onto the human health, emphasizing all personal contributions. All these studies were focused on arsenic presence in West Romania ground waters, which represent a real problem. High risks associated with consumption of arsenic contaminated water made me identify new extraction materials and processes. New arsenic removal strategies emerged. Because current technology used for arsenic removal processes are quite expensive and generate too much waste and byproducts, we focused on obtaining, describing and testing new environmental friendly materials, technologies and methods. Clean technologies, such as the adsorption would recover or eliminate the arsenic from waters.

Exhausted inorganic materials due to arsenic removal were immobilized in vitreous matrix used to produce decorative glazes. Organic materials used for arsenic removal were regenerated and reused for several times. Based on experimental studies can conclude that all studied material present good adsorption properties, and can be used for arsenic retention from waters in dynamic or also in static regime. Adsorption process is better described by the pseudo-second order kinetic model, is spontaneous, endotherm, and has a physical or chemical nature. Also, it was revealed that the contact surface and also the presence of iron ions present a high importance into the arsenic adsorption on studied materials.

In second part of habilitation thesis are presented the further objectives regarding didactic career, research, and further development of academic career. Present habilitation thesis contains 306 references.

The full abstract at:
http://www.upt.ro/img/files/2016-2017/abilitare/negrea/Negrea_Adina_rezumat-engleza.pdf

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REHABILITATION OF EXISTING CONCRETE AND/OR MASONRY STRUCTURES IN SEISMIC REGIONS. A PERMANENT CHALLENGE FOR CIVIL ENGINEERS

Author: Sorin DAN

Abstract

The assessment of the protection level of constructions generally and particularly of reinforced concrete and/or masonry structures has become a constant preoccupation of all the specialists involved in design, construction and monitoring of structures.
The habilitation thesis presents research and case studies connected to the structural rehabilitation aspects as follows:

- Introduction to: durability problems; behaviour at seismic actions; repair and strengthening of existing structures.
- Rehabilitation of existing concrete and masonry structures: experimental research; case studies.

The vulnerability of existing structures under seismic motions may be due to structural system weaknesses and specific detailing. Structural weaknesses are characterised by various irregularities and discontinuities or by general structural vulnerabilities. Specific detailing of existing structures is function of building materials: reinforced concrete; steel; masonry; wood. The rehabilitation solutions adopted in the case of deterioration of building component parts depend on the structural material.
EXISTING REINFORCED CONCRETE STRUCTURES are strengthened in order to increase its strength, stiffness and ductility. In case of reinforced concrete framed structures, these goals are to be achieved by jacketing of beams, columns and joints. The jacketing is performed by reinforced concrete, steel profiles, carbon fibres CFRP, etc. CFRP may be used for increasing ductility and slightly increased stiffness.
Experimental studies were performed on the RC jacketing strengthening method. Different techniques for increasing the bond between the old (existing) and new (jacketing) concrete layers were studied and presented in the thesis.
Experimental studies were also performed for strengthening of reinforced concrete framed structures in seismic zones by using Carbon Fiber Reinforced Polymers (CFRP). The main system's advantages as rehabilitation solution are: increase of load-carrying capacity; structures designed at gravity loads will be able to withstand seismic loads.
The reinforced concrete structures' rehabilitation case studies presented are: Western University of Timisoara; tanks supporting structure; office building; Palace Building; apartment house affected by a gas explosion; reinforced concrete silos; industrial building; frame structure at the Timisoreana Brewery; block of flats.
EXISTING MASONRY STRUCTURES present some important vulnerability in seismic zones: the overall lateral stiffness values along the two main axes are different; lack of seismic joints to divide building parts having different dynamic characteristics; lack of reinforced concrete straps at each level; defects of wall connections at corners, crossings and ramifications as well as the presence of cracks; inadequate bearing capacity at normal forces on the walls.
Experimental research was performed on modern rehabilitation solution known as Near-Surface-Mounted Reinforcement (NSMR), which implies that steel bars/rods mainly of CFRP are bonded in sawn grooves in the masonry or concrete cover. The main advantages of this technology are: no requirement for surface preparation work, no change of the existing structure dimensions.
The masonry structures' rehabilitation solutions presented are: Banatul Museum, Timisoara – by classic solution; historical structures – by modern solution; tower structure – by modern solutions.

The full abstract at:
http://www.upt.ro/img/files/2016-2017/doctorat/abilitare/dan/Rezumat_habilitation_thesis_en_Sorin_Dan.pdf

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NETWORK SCIENCE IN COMPUTER ENGINEERING AND INFORMATION TECHNOLOGY

Author: Mihai UDRESCU-MILOSAV

Abstract

Since the beginning of the new Millennia, we have witnessed the emergence of the New Science of Complex Networks, which encompasses multiple elements from physics, mathematics, and computer science. Specifically, Complex Networks describe the structure and behavior of complex systems that can be modelled as graphs, namely mathematical structures consisting of objects, nodes, or vertices, which are connected by lines, links, or edges. As opposed to conventional graph theory, complex networks have many nodes (up to several millions) and complex irregular interconnection topology. The field of Complex Networks bridges the gap between complexity and algorithmic models, which in turn pave the way for innovative computer applications in fields such as biology, medicine, economy, social sciences, or physics.

The overarching field of Information Technology includes various approaches where computer algorithms and applications are used for the advancement of biology, medicine, pharmacology, or social physics. Indeed, the last decade has witnessed significant progress in personalized or precision medicine, based on big data techniques and computer technologies such as Complex Network Analysis, Machine Learning (including Deep Learning). Moreover, the advance in social system physics has gain a lot of momentum since the global dissemination of Online Social Networks.

Our approach to using complex networks in information technology is twofold. First, we propose new computer-based models for simulating the dynamics of opinion is social networks. Further, we validate our tolerance-based opinion diffusion model against social behavior detected in real-world data from Twitter, Facebook and Yelp. We also analyze and confirm our hypotheses by providing a comprehensive probabilistic interpretation of our tolerance-based computational model. Second, we apply a dual complex network clustering, which relies on both modularity classes and force directed network layouts, to advance the fields of network medicine and network pharmacology. In the case of network medicine, we cluster networks of Obstructive Sleep Apnea Syndrome patients, to generate patient phenotypes that can be effectively used for managing patients according to precision medicine principles. In the case of network pharmacology, we use our dual clustering methodology to extract pharmaceutical properties for available drugs, only from information on drug-drug interactions. To this end, we build a drug-drug interaction network and process it, by algorithmically defining functional drug communities; analyzing the generated drug communities leads to recovering previous drug repositioning examples, as well as to proposing new important repositionings.

Our future research will focus on applying complex networks in computer engineering. As such, we provide an extensive overview on how network analysis can be used to optimize multi-core communication in Network-on-Chip (NoC) systems. Indeed, our initial assessment proves that – from a conceptual standpoint – fractal topologies can provide a low power, reliable and performant communication infrastructure for NoCs.

The ful abstract at:
http://www.upt.ro/img/files/2016-2017/abilitare/udrescu/Rezumat_teza_abilitare_en_Udrescu.pdf

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NANOSTRUCTURED OXIDE MATERIALS AND FUNCTIONALIZED MATERIALS WITH APPLICATIONS IN ENVIRONMENTAL PROTECTION

Author: Cornelia-Veronica MUNTEAN

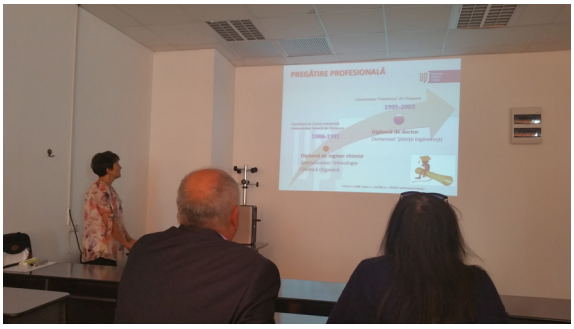
Abstract

The habilitation thesis is structured in two parts, and is based on 28 personal scientific papers (14 as lead author), of which 24 published in ISI ranked journals and 4 published in journals indexed in other international databases.

In the first part of the thesis are presented the main professional, scientific and academic achievements obtained after the candidate defended the PhD thesis in 2004.

The scientific research activity that is the subject of this thesis was directed towards the synthesis and characterization of two types of materials: nanostructured oxide materials and materials functionalized by impregnation with various extractants. Some of the materials obtained have been tested in environmental applications. These have been successfully used for the adsorption of dyes and metallic ions from dilute aqueous solutions, in view of applying these processes either for treating wastewater or for recovering valuable chemical species.

For the synthesis of nanostructured oxide materials, the thermal decomposition of carboxylate complexes (precursor) was used. This method produces oxide powders with nanometric particles at relatively low temperatures, with a yield of practically 100 %. Carboxylate precursors were obtained by the redox reaction between metal nitrates and polyols. The decomposition of carboxylates at relatively low temperatures (300-350°C) led to single/mixed oxide mixtures with high reactivity. By calcining them at suitable temperatures, the oxide systems with the desired compositions were obtained. With this new method, several spinel oxide systems with nanometric particles were prepared: ferrites MFe_2O_4 (M = Co, Cu, Ni, Zn), maghemite γ-Fe_2O_3 and zinc aluminate $ZnAl_2O_4$. ZnO-Zn_2SiO_4-SiO_2 nanocomposites having different compositions and properties were prepared by the sol-gel method modified by an original procedure, involving the thermal decomposition of Zn (II) carboxylates dispersed in the pores of silica gel. Cobalt, copper, nickel and zinc ferrites have been tested for adsorption of Congo red dye from aqueous solutions, and have proven to be materials with remarkable adsorbent properties.



In view of improving their adsorbent properties, magnesium silicate and Amberlite XAD7 resin have been functionalized with extractants containing nitrogen, phosphorus and sulfur functional groups (tetrabutylammonium dihydrogen phosphate, tetraethylammonium bromide, sodium β-glycerophosphate, and thiourea), which are considered "green", being environmentally friendly. The so-functionalized materials were used for the adsorption from aqueous solutions of rare metals ions: Eu (III), La (III) and Nd (III). Experimental results have shown that these are effective adsorbent materials, with remarkable efficiency. Moreover, these materials have the advantage that they have been obtained by easy and non-polluting methods.

In the second part of the habilitation thesis are presented the plan of evolution and development of the professional, scientific and academic career, the proposed objectives and the future research directions.

The full abstract at:
http://www.upt.ro/img/files/2016-2017/abilitare/muntean/Rezumat_teza_abilitare_en_Muntean.pdf

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FROM NANOSCALE EFFECTS TO MACROSCOPIC QUANTITIES BEHAVIOR: EFFECTS OF ELECTRIC AND MAGNETIC FIELDS ON TWO-PHASE MEDIA

Author: Floriana - Daniela STOIAN

Abstract

This thesis presents the contributions to the main research themes that continued and developed from of my PhD studies, starting 1998. These main research themes are: (i) study of the liquid – vapour phase transition control by electric fields and (ii) magnetic nanofluids: heat transfer control by magnetic fields and thermal properties.

The first theme was approached in 1999, with the aim of understanding the basics of phase-change phenomena at nanoscale and how manifest at macroscopic scale in change of measurable quantities. In order to accomplish these goals, I used molecular dynamics method to study the near-critical point phase transition in either two-dimensional or three-dimensional systems, of hundreds up to one thousand molecules, interacting via Lennard – Jones potential. The study was extended to the effects of external electric fields on the structure and thermodynamic properties of these molecular systems. The results of this study matched the macroscopic observations of the electric field effect on the liquid – vapor phase transition in microgravity.

The second theme is comprising the main results in terms of my scientific contributions to three subsequent research topics concerning the use of a special class of smart materials in heat transfer related problems, which were studied in a multidisciplinary team, at the Research Center for Complex Fluid Systems Engineering, Politehnica University Timisoara, in framework of several national and international projects. The first topic envisaged the possibilities of using magnetic nanofluids as cooling agents in microgravity thermal management systems. A fundamental study was carried out with respect to the dependence of characteristic parameters of nucleate boiling with the applied magnetic field and the magnetic nanofluid magnetic properties. The second topic envisaged also fundamental aspects regarding the natural convection in water based magnetic nanofluids, in view of their use in cooling applications for automotive engineering. The third topic had both fundamental aspects as well as application-oriented, the targets being related to the use of transformer oil based magnetic nanofluids in electric transformers,

either as cooling and insulating medium in power transformers or as magnetic liquid core in high frequency planar transformers.

The results of the research reported in this thesis were disseminated in 9 ISI articles and 7 ISI proceedings papers. Also, part of the scientific contributions to the second theme are included into two national patents awarded by OSIM.

The full abstract at:
http://www.upt.ro/img/files/2016-2017/abilitare/stoian/Rezumat_habilitation_thesis_en_Stoian.pdf

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PROCESSES AND MATERIALS IN ELECTROCHEMICAL ENERGY SYSTEMS

Author: Andrea KELLENBERGER

Abstract

The habilitation thesis entitled "Processes and materials in electrochemical energy systems" presents the main scientific, professional and academic achievements of the author after defending the PhD thesis at the Politehnica University Timisoara, together with future plans for evolution and development of the research and university career. The main research directions of the author are part of the broad area of electrochemical energy systems, with special emphasis on electrocatalysis of hydrogen evolution reaction and electrochemical synthesis of conducting polymer films and study of charge transport mechanism within such films. The entire research activity is reflected in 71 publications, of which 29 papers published in ISI ranked journals (h-index 11), author and co-author of 3 books, co-author of 1 national patent, project leader of 3 research grants and member of 1 international and 10 national research projects. The electrocatalysis of hydrogen evolution reaction is a research direction initiated in the Laboratory for Electrochemistry, Corrosion and Electrochemical Engineering of UPT. The investigations aimed at accelerating the hydrogen evolution reaction by using electrocatalysts added in the solution. These catalysts, also called proton carriers, have the ability to increase the proton concentration in the electric double layer from the metal-solution interface by transporting protons from the bulk of the solution to the interface. Various aromatic or aliphatic amines were investigated as proton carriers, since the ability to carry protons is given by the lone pair of electrons of the nitrogen atom. The originality of our work reside in that we have shown that the catalytic effect of the proton carriers is manifested not only for electrode materials with high hydrogen overpotential, such as copper, but, more important from a practical point of view, even for electrodes with low hydrogen overpotential, namely gold and platinum. Also, we have explained the catalytic effect of the amines based on their molecular parameters obtained by modeling, the most important being the dipole moment and the surface coverage degree. Thus, the highest catalytic effect was obtained for amines with a low surface coverage, which is equivalent to a larger number of molecules present at the interface, so an

increased proton concentration, and respectively for a large dipole moment, which indicates a favorable orientation of the molecules at the interface, namely with the nitrogen atom and the attached proton directed towards the metal, where the charge transfer is greatly facilitated. Considering the expertise in electrocatalysis of hydrogen evolution reaction, our research group is partner and work package leader in a HORIZON 2020 project approved for financing from 2018: "Novel modular stack design for high pressure PEM water electrolyzer technology with wide operation range and reduced cost".

The full abstract at:
http://www.upt.ro/img/files/2016-2017/abilitare/kellenberger/Rezumat_teza_abilitare_en_Kellenberger.pdf

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NEW GENERATION OF MATERIALS WITH APPLICATIONS IN METAL IONS REMOVAL FROM WATER

Author: Elvira Mihaela CIOPEC

Abstract

Habilitation thesis entitled "New generation of materials with applications in metal ions removal form water" summarizes scientific and research activity carried out after defending my PhD thesis. Habilitation thesis was structured into three main parts: Part one – Scientific, professional and academic achievements; Part II – Proposal of professional, scientific and academic career evolution and development and Part III – References, based on 31 Thompson Reuters (ISI) indexed research papers plus 10 papers indexed in other national and international data bases. First part of habilitation thesis is shortly presenting my main professional, scientific and academic achievements from the moment when I defended my PhD thesis (2007) until present. Research directions developed and deepened during postdoctoral period are conducted in close relation with chemical engineering and environmental protection areas. Main objective of the scientific and research activity, in which I was involved was represented by preparation of a new generation of materials used in environmental protection, and especially for metal ions removal from water by using adsorption. Starting from the fact that metal ions water pollution represents one of the greatest environmental problem, a major concern is represented by their removal from water, which impose development of physical, chemical, physical-chemical and biological methods in order selective elimination of pollutants. The most eloquent method forms the economical and efficiency point of view is adsorption. Starting from these premises habilitation thesis follows the projection and development of an experimental model for production of new generation materials, whose adsorptive properties are improved through functionalization with nitrogen, phosphorus and sulfur. Two functionalization methods were used: physical (impregnation) using SIR- Solvent-Impregnated-Resin methods and chemical (synthesis) using „One–Pot" Kabatachnik–Fields reaction.

Into studies performed, in addition to classical material bearing by impregnation, also studied and mentioned in research papers, was developed a new functionalization method in dynamic regime, on the column. After obtaining and characterization of materials, these

were tested to establish their adsorption capacities for metal ions removal from water.

In this sense were performed thermodynamic, kinetic and equilibrium studies.

From studies presented was demonstrated that all obtained materials present representative performance for metal ions removal from water by adsorption and the process efficiency is higher in the case of materials obtained by the physical functionalization method – Solvent- Impregnated- Resin- SIR.

Second part of habilitation thesis present the development plan of didactic, research and academic career.

The references are included in the third part of habilitation thesis, these are 186.

The full abstract at:
http://www.upt.ro/img/files/2016-2017/abilitare/ciopec/Mihaela_Ciopec-Teza_abilitare_ro.pdf

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CONTRIBUTIONS TO CONTINUOUS AND DISCRETE DYNAMICAL SYSTEMS

Author: Gheorghe TIGAN

Abstract

The results described in the habilitation thesis are grouped in four sections.

1) The first section describes the results we obtained on periodic, homoclinic and heteroclinic orbits in several three-dimensional differential systems, namely in Chen, Lu, T and Shimizu-Morioka systems. For the first three systems we used a method based on Lyapunov-like functions and showed that the systems under some constraints of their parameters have neither homoclinic nor closed orbits but they have heteroclinic orbits. We showed that the Chen system has two symmetrical homoclinic orbits. For the T system we studied also periodic orbits arising from Bautin bifurcation. For the Shimizu-Morioka system used a different method, namely a method based on detecting the traces left by the separatrices of a saddle point on certain surfaces. With this method we could prove the existence of homoclinic orbits in the Shimizu-Morioka system.

2) In the second section we give details about the results we obtained on nonsmooth dynamical systems. We have studied a two-dimensional discrete non-smooth system (map), which is continuous but non-differentiable with respect to one of the variables. The map generalizes in some sense the so-called Nordmark map, which is related to one-dimensional impact oscillators near grazing points. Examples of impact oscillators range from simple to complex phenomena such as, a ball bouncing on a vibrating table and a charged particle moving in strong magnetic fields in tokamaks.

3) The third section presents the results we obtained on perturbed Hamiltonian systems. We studied firstly a one-and-a-half degrees of freedom perturbed Hamiltonian system with a quartic unperturbed part and broad perturbation spectrum. An approximate interpolating Hamiltonian system was firstly studied. We pointed out results on the behavior of the Poincare-Birkhoor dimerised chains in their routes to reconnection when the perturbation parameter varies. A discrete system associated to the full Hamiltonian system was constructed and studied.

4) In the fourth section we present details on the results we obtained on degenerate fold-Hopf bifurcations. We studied degenerate with respect to parameters fold-Hopf bifurcations in three-dimensional differential systems. Such degeneracies arise when the transformations between parameters leading to a normal form are not regular at some points in the parametric space. The fold-Hopf bifurcation (or zero-Hopf) occurs in smooth differential systems of minimum dimension three and having minimum two independent parameters. The hallmark of the bifurcation is that at certain values of the parameters the linearized system has an eigenvalue equals to zero and two purely complex eigenvalues. We obtained new generic results for the dynamics of the systems in such a degenerate framework.

The full abstract at:
http://iosud.utcluj.ro/teze-de-abilitare.html

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