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Recent Advances in Biology and Biomedicine
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NEW ASPECTS OF BIOMEDICAL ELECTRONICS AND BIOMEDICAL INFORMATICS

Proceedings of the 1st WSEAS International Conference on
BIOMEDICAL ELECTRONICS and BIOMEDICAL INFORMATICS (BEBI '08)

Published by WSEAS Press
www.wseas.org

ISSN:1790-5125
ISBN:978-960-6766-93-0

Rhodes, Greece, August 20-22, 2008





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All papers of the present volume were peer reviewed by two independent reviewers. Acceptance was granted when both reviewers' recommendations were positive.
See also: <http://www.worldses.org/review/index.html>

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Kwembe T., USA
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Preface

This book contains the proceedings of the 1st WSEAS International Conference on BIOMEDICAL ELECTRONICS and BIOMEDICAL INFORMATICS (BEBI'08) which was held in Rhodes, Greece, August 20-22, 2008. This conference aims to disseminate the latest research and applications Biomedical Circuits, Biomedical Devices, Biomedical Electronics, Biomedical Signal Processing, Biomedical Applied Electromagnetics, Biomedical Informatics, Tele-Health, Health Management, Hospital Engineering and Technology, Biomedical Physics and other relevant topics and applications.

The friendliness and openness of the WSEAS conferences, adds to their ability to grow by constantly attracting young researchers. The WSEAS Conferences attract a large number of well-established and leading researchers in various areas of Science and Engineering as you can see from <http://www.wseas.org/reports>. Your feedback encourages the society to go ahead as you can see in <http://www.worldses.org/feedback.htm>

The contents of this Book are also published in the CD-ROM Proceedings of the Conference. Both will be sent to the WSEAS collaborating indices after the conference: www.worldses.org/indexes

In addition, papers of this book are permanently available to all the scientific community via the WSEAS E-Library.

Expanded and enhanced versions of papers published in this conference proceedings are also going to be considered for possible publication in one of the WSEAS journals that participate in the major International Scientific Indices (Elsevier, Scopus, EI, ACM, Compendex, INSPEC, CSA see: www.worldses.org/indexes) these papers must be of high-quality (break-through work) and a new round of a very strict review will follow. (No additional fee will be required for the publication of the extended version in a journal). WSEAS has also collaboration with several other international publishers and all these excellent papers of this volume could be further improved, could be extended and could be enhanced for possible additional evaluation in one of the editions of these international publishers.

Finally, we cordially thank all the people of WSEAS for their efforts to maintain the high scientific level of conferences, proceedings and journals.

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Plenary Lecture I

Current State and Future of Omics-Based Medicine and Systems Pathobiology



Professor Hiroshi Tanaka
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Tokyo Medical and Dental University
JAPAN

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Abstract: In spite of the rapid increase of the biomolecular (“omics”) data such as genome, transcriptome, proteome and so forth, the substantial application of omics data to clinical medicine has not been realized yet. This might be ascribed to the fact that there has neither been explored nor established the systemic framework where the omics data are efficiently utilized in clinical medicine.

We have just started the national project for comprehensive omics-based disease database. In constructing the database, we adopted a new paradigm for viewing the disease as "a unified system", in which disease is described in the hierarchy of the clinical, pathophysiological and molecular omics, based on the leading concept that “disease organizes itself to form a unified system”: we call this paradigm “omics-based systems pathobiology”.

In our clinical omics database the relations between these molecular and clinicopathological data are explored by applying the data-mining method. After establishing the inter-hierarchical relation, we integrate these data into the unified hierarchical disease model. We also developed the user-directed functions such as deductive retrieval which replies various inquiries, for example, given the clinical syndrome, infer the possible molecular process of disease, or given the omics data, predict the prognosis of disease, etc. In constructing this database, we aim to establish new clinical medicine integrating clinical and omics data for realizing "predictive individualized medicine".

Brief Biography of the Speaker: Prof. Hiroshi Tanaka graduated from the University of Tokyo, Department of Mathematical Engineering in 1974. He received Dr. Med. from Graduate School of Medicine in 1981 and Ph.D. from Graduate School of Engineering in 1983, both at University of Tokyo. His thesis was related to the computational physiology, especially biomedical inverse problems.

He was appointed as Assistant Professor from 1982 to 1987, at Institute for Medical Electronics, Graduate School of Medicine, University of Tokyo. During this period, he stayed in Sweden and studied biosystems analysis from 1982 to 1984 in Uppsala University and Linköping University as Visiting Scientist. In 1987 he moved to Department of Medical Informatics, Hamamatsu University School of Medicine.

In 1990, he was visiting scientist in MIT Laboratory of Computer Science, where he began the study of bioinformatics which he now majors in. After returning Japan, He was appointed as Professor of Bioinformatics, Medical Research Institute, Tokyo Medical and Dental University in 1991. He is now also the director of the Information Center for Medicine at Tokyo Medical and Dental University. From 2004 to 2007 he was the president of Japanese association of medical informatics. In 2003, He was also appointed as professor of systems biology, and Dean of Biomedical Science Ph.D. Program, Tokyo Medical and Dental University. He is now responsible for promoting many government-commissioned projects of genome / omics-based medicines.

Plenary Lecture II

Health Informatics in Next Generation Health Care



Associate Professor Dechavudh Nityasuddhi
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Faculty of Public Health Mahidol University,
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Abstract: Due to the problem of unequal in health care for the people who live far away from the city center and unutilized health personnel to distribute to the rural area, we need Health Informatics to solve this problems. The Health Informatics here is cover for a lot of disciplines technology, mathematical model, system simulation, decision support system, cognitive science, biostatistics, epidemiology, computer networking , computer graphic and delivery health care. At the same time we need the discipline of public health area, nutrition, health education, public health nursing, environmental health, occupational health, family health, public health administration, sanitary engineering, microbiology and parasitology.

We combined all of these disciplines to do screening test for discriminate the high risk group from the low risk group. We treats the high risk group with special care. And at the same time we give some good advices of individual health care and make a surveillance system for the low risk group. Some group of people need to keep in touch with the medical doctor all the time, we can have online network technology to report the changing sign from the patient body to his medical doctor immediately.

This talk will discuss the opportunities and challenges in next generation health care, and present research results and future research directions in Health Informatics.

Brief Biography of the Speaker: Dechavudh Nityasuddhi graduated in Mathematics from Chiangmai Univeristy, Chiangmai in 1972, received the first Master Degree in Biostatistics from the Mahidol University, Bangkok in 1975; the second Master Degree in Medical Statistics from the London School of Hygiene and Tropical Medicine, London in 1982; the third Master Degree in Computer Sciences from Chulalongkorn University, Bangkok in 1996; the Ph.D. in Statistics from the National Institute of Development Administration, Bangkok in 2003. He is full university associate professor and Head of Department of Biostatistics, Faculty of Public Health, Mahidol University. He has done the research about the database system and the information system for self defense villages on the territory of Thailand, for cost-benefit analysis of setup cost of plastic industry, for city of metropolitan, for yearly physical examination and risk assessment of the oil company employee, for Automatic Computerized Emergency Response System for Chemical Substance Data Safety and for the Eye-Care Screening and Follow up for School Age Students under the Rajaprachanukrao Foundation.

His present areas of research activity are: Dynamic System Simulation, Informative Database System, Multivariate Analysis, EM algorithm and Expert system. He has published one book, various scientific journals and international conference proceedings.

Plenary Lecture III

Mechanobiological Models for Intervertebral Disc Tissue Engineering



Professor Mohammad Haghpanahi
Biomechanics Research Lab,
Department of Mechanical Engineering,
Iran University of Science and Technology, Tehran,
IRAN
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Abstract: Low back pain, which is often caused by disc degeneration, is a major health problem. Due to the limitations of the current treatments for degenerative disc disease, tissue engineering methods have been proposed. These methods present the opportunity to restore the functionality of the intervertebral disc by repairing or replacing the degenerated tissue. One of the major challenges in intervertebral disc tissue engineering is to recreate, in vitro, the physiological environment for optimal culturing of cells seeded in scaffolds constructs. So it is necessary to understand the link between the forces applied to a cell and its biological response. After a brief review of the fundamentals of the mechanical factors in tissue engineering, this lecture presents the mechanobiological models which are capable of optimizing the design parameters of the porous scaffolds and prediction of the stress distribution in different stages of the tissue engineering. On the basis of these infrastructure models and experimental results, we can gain a complete understanding of mechanobiology and the procedure of the tissue differentiation to finalize the setups of the instrumentations in intervertebral disc tissue engineering.

Brief Biography of the Speaker:

Name: MOHAMMAD
Family Name: HAGHPANAHI
Birthday: 4th March 1956
Situation: Married
Children: 2 Daughters
Address: No 68, Building E2, Phase 3, Ekbatan City, Tehran, Iran
Telephone: +98-21-4465-7870
Mobile: +98-912-124-5626

Educational Background:

-Master of Mechanical Engineering: 1979 Shiraz University
-Master of Solid Mechanics: 1981 ENSAM, Paris
-Doctor of Engineer in Biomechanics: 1985 ENSAM, Paris

Course Taught:

- Strength of Material
- Theory of Vibration
- Machine Element Design
- Vibration of Continuous Systems
- Finite Element Analysis
- Advanced Topics in Finite Element Analysis

Research Interest:

- Biomechanics of Orthopedics
- Stress Analysis of Systems by Finite Element Analysis

- Extraction of Biomechanics of Spine
- Sport Biomechanics
- Static and Fatigue Analysis of Welded Joints
- Vocational Education and its role toward Technology Transfer

Publications:

- More than 60 journal and conference papers

Executive positions:

- | | |
|---------------|--|
| 1987-1992 | Dean of Mechanical Engineering Department, Iran University of Science and Technology |
| 1992-1993 | Visiting Professor, Ohio State University |
| 1993-1995 | Vice president in Education Affairs, I.U.S.T |
| 1995-2000 | Vice president in Student and Education Affairs, U.A.S.T. (University of Applied Science and Technology) |
| 2001-2005 | Chancellor of U.A.S.T |
| 2005- Present | Dean of Biomechanics Department, Iran University of Science and Technology |

Member:

- International Society of Biomechanics
- Iranian Society of Mechanical Engineering
- Iranian Society of Biomedical Engineering
- UNIP (United TEVET Network on Innovation and Professional Development)

Plenary Lecture IV

Probabilistic – Fuzzy Inference Procedure for Knowledge Based Diagnostic Systems



Professor Anna Walaszek-Babiszewska

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POLAND
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Abstract: Probabilistic methods have a long history of applications to data analysis and statistical inference in many fields of human activities.

Zadeh's theory of fuzzy systems, especially theory of approximate reasoning, gave the grounds for creating knowledge based systems, where human experiences and knowledge expressed in linguistic categories are prepared and used for the prediction, diagnosis or control.

In this work we present the methods of applications both, the sets of numerical data, collected in real systems, and expert's experiences to modelling knowledge bases, by using linguistic fuzzy models with weights of rules.

A structure of the reason-result fuzzy model is predefined at the beginning of the task. Probability of fuzzy events has been used to formulate probabilities of the occurrence linguistic values of input and output variables in a product-space. Collected data are used to compute empirical probability distributions of linguistic variables.

The calculated probabilities of fuzzy events have been included into inference procedures. Diagnostic exemplary calculations are presented.

Brief Biography of the Speaker: Anna Walaszek-Babiszewska, at present, is a professor at the Opole University of Technology, Department of Control and Computer Engineering. She has obtained a MSc degree in Control Engineering from the Wrocław University of Technology and a PhD as well as a DSc (Habilitation) degrees from the Silesian University of Technology in Gliwice, Poland.

Her research interests include stochastic modeling, fuzzy systems, data analysis, and applications in technological and managerial situations.

She has supervised 3 completed PhDs and reviewed 5 PhDs in technical and economic sciences. She has published 2 monographic books on stochastic and fuzzy modeling and over 80 scientific papers.

She is a member of the Editorial Boards of Management (since 2000) and of Lecture Notes in Control and Computer Science (in 2003) of the University of Zielona Góra Press. She is a member of the Section of Cybernetics in Mining, Mining Committee of the Polish Academy of Sciences (since 1999).

Plenary Lecture V

Saccharomyces cerevisiae Metabolic Process by Mathematical Modelling and *in-vivo* ^{13}C -NMR



Professor Claudio Rossi

Director of the Department of Chemical and Biosystem Sciences,
University of Siena,
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2 – 53100 Siena
ITALY
E-mail: rossi@unisi.it

Abstract: The understanding of the metabolic behavior of complex systems -such as eukaryotic cells- needs the development of new approaches able to deal with the complexity arising from the huge amount of interactions occurring within a living system. Since these interactions are ultimately responsible for an organism's form and functions we developed a mathematical model including many metabolic compartments interacting each other by fluxes of material.

In this lecture we will discuss the ability of this approach to describe the metabolic responses of *Saccharomyces cerevisiae* –which represents an ideal eukaryotic cell - to exogenous and endogenous stress conditions.

Metabolic data of the fermentative process in yeast has been collected by *in vivo* ^{13}C NMR spectroscopy; consecutively the data has been used to validate the compartmental model allowing also the estimation of kinetic constants associated with the fluxes within the model.

The robustness of the model is confirmed by the excellent agreement between the experimental and simulated data; furthermore the model correctly predicts the fermentative metabolism of yeast undergoing different stress conditions.

Brief Biography of the Speaker:

Claudio Rossi, was born in Siena, Italy 2nd, October 1952.

Academic Curriculum:

- Research associate, Institute of General Chemistry, University of Siena, from November 1981.
- Associate Professor of Physical Chemistry, Department of Chemistry, University of Siena, from November 1987.
- Full Professor of Physical Chemistry, Department of Chemistry, University of Siena, from November 1994.
- Honorary Professor of the “Universidad del Salvador”, Buenos Aires, Argentina, from June 2001.
- Director of the Department of Chemical and Biosystem Sciences, University of Siena, from November 2002.
- Coordinator of the Scientific Committee of the “Polo Universitario Colle di Val D’Elsa”, University of Siena from April 2004.

Professor Claudio Rossi is referee of international scientific journals and he is also in the list of the experts for the evaluation of national and European projects. He was chairman of important scientific conferences: "Ecological Physical Chemistry" (1990), "Tempos in Science and Nature, Structure Relation and Complexity", (1998), "Brownfields" (2004). He was also "Guest Editor" of a special issue of "Ecological Modelling" Volume 186, issue 1, (2005), dedicated to publish the results obtained from the investigation of aquatic regions. In 2001, prof. Claudio Rossi was nominated "Honorary professor" of the University "Del Salvador", Buenos Aires, Argentina.

The research activity was funded by international, national (FIRB-MIUR, CNR etc.) and local (PAR-University of Siena, Province of Siena, etc.) programs.

Prof. Claudio Rossi, coordinated the following european projects:

- Chairman of the European Advanced Study Course Programme UE, Environmental and Climate: "Environmental Change, Valuation methods and sustainable indicators". S.Miniato (Pisa), 29th August-5th September 1998.
- Coordinator of the Alfa EU Project ALR/B7-3011/94.04-4.0058.7 (1997): "Esteros del Iberà",
- Coordinator of the EU Project, ERBIC 18-CT980262 (1998-2002) (IN-CO Program): "The sustainable managements of wetlands resources in Mercosur", (IN-CO Program).
- Coordinator of the EU Project ICFP500A4PR02 (2001-2005), (IN-CO-DEV Program): "Tools for wetland ecosystem resource management in Eastern Africa, ECOTOOLS".
- Coordinator of the EU Project ICA4 2002-50027 (2003), (IN-CO-DEV-Accompanying Measure Program): "Regional aspects of the sustainable managements of wetland resources, REGWET".

Plenary Lecture VI

Biotransistors, Voltage Gated Nanopore Forming Proteins, and their Application in Drug Delivery, Practical and Theoretical Approach



Assistant Professor Hamid Mobasheri
Laboratory of Membrane Biophysics,
Institute of Biochemistry and Biophysics,
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Abstract: The fundamental physics of biological matters provides vast opportunities to control manipulate and organize its vital activities electronically. The traffic of different hydrophilic solutes, nutrients, drugs, and to some extent genetic materials is being conducted by pore forming proteins situated in hydrophobic barrier made by cell membrane. Similar to transistors these proteins are biased in certain manner in the membrane and are gated by means of its potential difference. Though the setting up the potential difference between inside and outside of the cell is well implemented by these channels, they, themselves are influenced by the very same potential. Furthermore, there are different means to change their conductance, gating pattern, selectivity and working status in general.

Working at single molecular level, the gating dynamics of these channels were studied in real time, and the situation was manipulated in a way to make them translocate molecules they wouldn't pass otherwise. Recordings of the channel activities in different physicochemical condition and also in presence and absence of different antibiotics made it possible to find the way to control these nano-valves.

The current traces then were used to be analyzed theoretically and mathematically to further understand the way these valves behave at molecular level and to model their molecular dynamics in real time. Consequently, it seems biomedical electronics has to dealt with such a systems in order to manipulate the living systems electronically, and to evaluate data using algorithms and theorems to learn the modern approaches in treatment of diseases that will be further discussed here.

Brief Biography of the Speaker:

Hamid Mobasheri
PhD in Biophysics,
Born in 1960, Iranian, Married and have 3 Children
(2008)

Member of: American Biophysical Society, British Biophysical Society, Australia Biophysical Society, ELSO

Postgraduate courses taught:

- Computer in Biology
- Membrane Biophysics
- Cellular Biophysics
- Biophysics for (Immunologists, Medical physicists, Physiologists, Biotechnologists, etc)

Achievements:

- MSRT Scholarship
- Distinguished Postgraduate student of 2000
- Welcome Trust Post Doctrate Grant
- Marquis Who's Who (USA) nominate as one of distinguished scientist of 2004
- IBC (UK) nominate as one of distinguished scientist of 2006

Research fields:

- Biosensors and biophysics of nanopore forming protein ion channel, Biotransistors
- Computational and theoretical biophysics of channel gating
- Biophysics of nerve regeneration and spinal cord injuries
- Biotransistors application in drug delivery and DNA/RNA sequencing
- Biophysics of electric and magnetic field effects on neural cell culture
- Biophysics of molecular effects of high frequency electromagnetic fields
- Biomaterials and nerve regeneration

Plenary Lecture VII

Biomedical Image Processing & Analysis via Artificial Intelligence and Information Fusion



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Abstract: Medical imaging mainly manages and processes missing, ambiguous, complementary, redundant and distorted data and information has a strong structural character. The understanding of any image involves the matching of features extracted from the image with pre-stored models. The production of a high-level symbolic model requires the representation of knowledge about the objects to be modeled, their relationships, and how and when to use the information stored within the model.

This presentation reports new (semi)automated methods for the segmentation and classification of images of cerebral structures using an information fusion technique based on soft computing (fuzzy logic) and specific knowledge. Fuzzy logic acts as a unified framework for representing and processing both numerical and symbolic information (“hybridization”), as well as structural information constituted mainly by spatial relationships in biomedical imaging. Our applications are mainly for the segmentation of brain structures for magnetic resonance (MR) and CT (computer tomography) images, based both on atlas and real data. Promising results show the superiority of this knowledge-based approach over best traditional techniques in terms of segmentation errors. The classification of different cerebral structures is made by implementing rules yielded both by domain literature and by medical experts. Though the proposed methodology has been implemented and successfully used for model-driven in the domain of MR and CT imaging, the deployed methods are generic and applicable to any structure that can be defined by expert knowledge and morphological images.

Another branch of applications of soft-computing and data fusion is represented by PET-CT image registration, both for a single PET-CT scanner and for separate PET and CT images. We first apply a mutual information based registration algorithm and then fuse the PET and CT images using the 2v-Granular Support Vector Machine. The fused image contains the properties of both PET and CT images and is an efficient tool for image registration.

Brief Biography of the Speaker: Prof. dr. eng. Hariton Costin, BS in Electronics and Telecommunications (1980), Ph.D. in Applied Informatics, MBA diploma, is full professor and chief of the Medical Electronics Department at the University of Medicine and Pharmacy / Faculty of Medical Bioengineering, Iasi, Romania, (www.umfiasi.ro). Also, he is senior researcher at the Romanian Academy, Institute of Theoretical Informatics – Iasi Branch, within the Image Processing and Pattern Recognition Lab, (<http://iit.iit.tuiasi.ro/~hcostin>), where he studies image processing and analysis by using Artificial Intelligence methods and data fusion.

Competence areas include: medical electronics, biosignal and image processing and analysis, artificial intelligence (soft-computing, expert systems), hybrid systems, HCI (human-computer interfaces), telemedicine. Scientific activity can be resumed by about 90 published papers (26 in Romania and 64 abroad), 5 books, 4 book chapters in foreign publishing houses, 3 patents, 2 national awards.

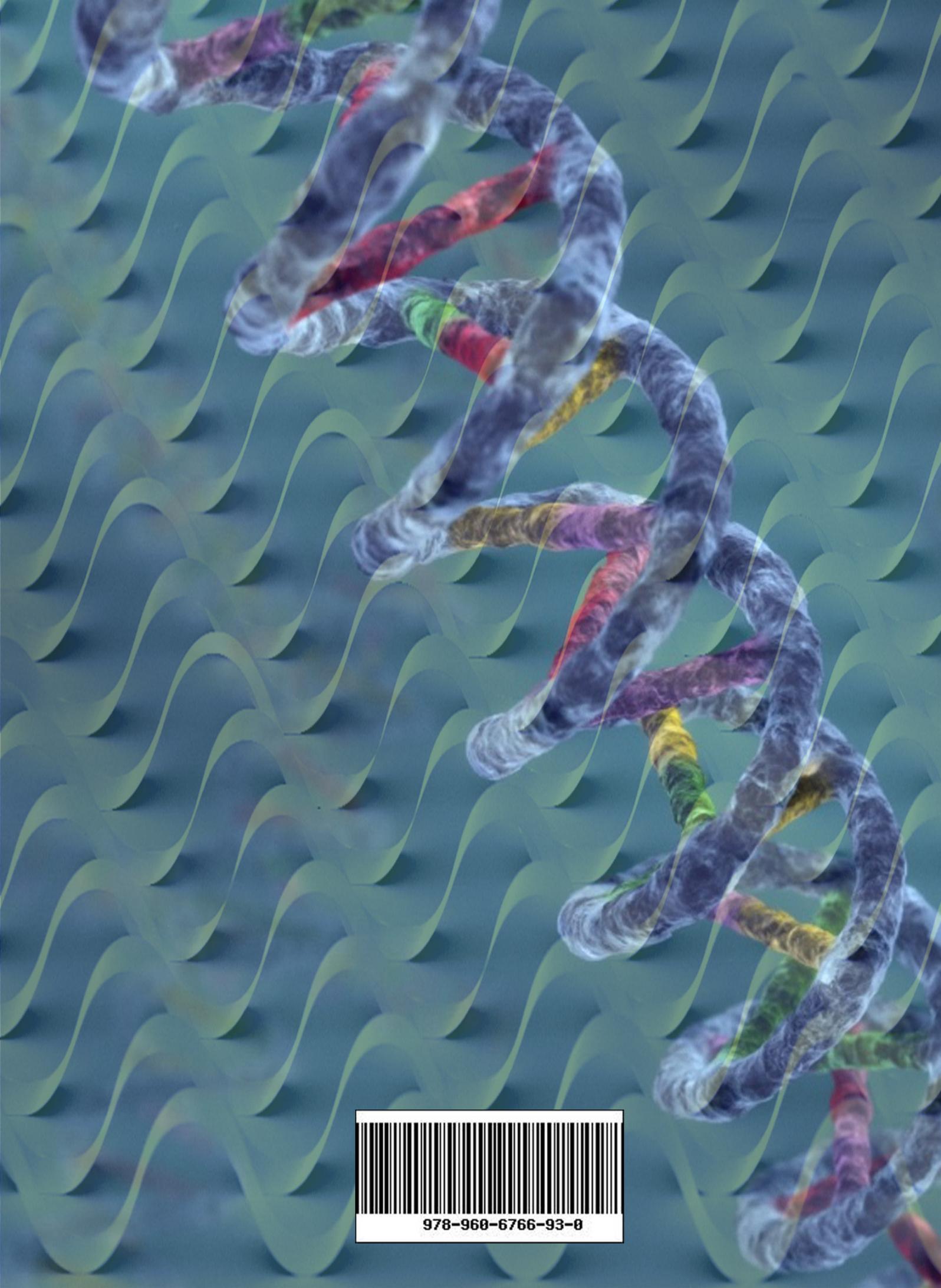
Research activity: 28 research reports, technical manager within FP5/INES 2001-32316 project, for a telemedicine application (www.euroines.com ; „Medcare” project); responsible for the first Romanian pilot telemedical centre in Iasi, (CEEEX programme – research of excellence - www.mct-excelenta.ro and for the National Programme for R&D 2007-2013, www.cnmp.ro), director for 5 national granted projects in bioengineering and (biomedical) image processing / analysis, invited postdoc researcher at the University of Science and Technology of Lille (France, 2002, medical imaging), invited talks at international conferences.

Prof. Costin is a member of the I.E.E.E./Engineering in Medicine & Biology Society (EMBS) and of other 8 scientific societies.

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978-960-6766-93-0