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STIMULATION OF RESEARCH WORK IN STATE HIGHER EDUCATION SCHOOLS

Development of economy based on knowledge requires special attention to the mission of universities and their fundamental role in creation, introduction, evaluation, distribution and use of knowledge. The diversity of approaches to development of educational systems in EU countries gives a chance to Bulgarian higher education to adapt in accordance with foreign experience, thus forming a renewed Bulgarian model entirely in keeping with the modern conditions and still more increasing global competition in all spheres of life.

***University education**, especially in master's and doctoral programs, is impossible without active research activities, which strengthen the EU and bring benefits in combination with mobility of the research potential and in close collaboration with organizations with similar research activities. Research work is an integral part of the teaching process and is of great significance for the prestige of every university. It exercises influence both on the qualification of the lecturers' staff and on the training of students. Taking into consideration that besides fundamental a considerable part of research work is applied, it also influences economic development of the country and business.*

An instrument for conducting the Bulgarian state policy in this sphere is a competition "Promotion of research work in higher education institutions" organized by the Science Research Fund.

The competition is directed to:

- ✓ *conducting research work in higher education institutions with relevant quality level;*
- ✓ *stimulation of inter-institutional integration with other universities, research organizations, small and medium enterprises;*
- ✓ *stimulation of participation of university scholars and units in construction of the European university area;*
- ✓ *stimulation of creation of inter-university networks;*
- ✓ *development of the research infrastructure;*
- ✓ *creation of educative research laboratories;*
- ✓ *intensification of the link "science – industry" through joint projects with small and medium enterprises;*
- ✓ *possibility for financing the creation of inter-university research centers in certain research areas.*

Priority subject areas are as under:

- ✓ *Health and medicine;*
- ✓ *Energy efficiency and energy security;*
- ✓ *Nano sciences;*
- ✓ *Information and communication technologies;*
- ✓ *Cultural historical heritage.*

NACID

National Centre for Information and Documentation

MAIN OBJECTIVES

NACID is:

- The leading institution in the national information infrastructure in Bulgaria in the sphere of education, science and innovations.
- National information center for academic recognition and mobility (ENIC-NARIC center for Bulgaria).
- Contact point to the Directive 2005/36/EC on the recognition of professional qualifications and delegated coordinator for Bulgaria in Internal Market Information (IMI) system.

PRIMARY FIELDS OF ACTIVITIES:

- Processing and dissemination of bibliographic and reference data and analytical information in support of the policy in the sphere of education, science, technology and innovations.
- Building and maintaining specialized databases.
- Maintaining national stock and DB of dissertations,deposited manuscripts and other scientific publications in Bulgaria.
- Organizing application of ENIC-NARIC network decisions in the field of academic recognition.
- Realizing information assistance in procedures for academic and professional recognition.
- Performing activities resulting from the functions of ENIC-NARIC center.
- Furnishing citizens and contact points in the rest of the member states with information in connection with recognition of professional qualifications and rights for practicing regulated professions in conformity with the Directive 2005/36/EC.
- Performing functions of institutional contact point of the EU's Seventh Framework Programme.

INFORMATION PRODUCTS AND SERVICES

- **NACID** offers a wide range of information products: subject profiles, paper reviews, subject bibliographic and reference information.
- **NACID** offers a great variety of information services through its own databases and resources, as well as through information brokerage to external databases. Online access is provided to NACID's own databases grouped in two basic information blocks:

"Bulgarian Science" Databases

- *"SIRENA",* R&D *reports and dissertations*;
- *"Scientific and Technical Publications in Bulgaria"*;
- *"Register of the Scientific Degrees and Titles";*
- *"Who is Who in Bulgarian Science*;
- *"Papers".*

"Science and Industry" Databases

- "*Partnership for Innovation and Development";*
- *"Knowledge for Innovations and Development"* .

Information brokerage and servicing from external databases gives access to over 1200 databases of the leading information centers, including STN International – Germany, DIALOG – USA, EBSCO, etc.

- **Library Services**

Central Research and Technical Library (CRTL) with library information complex in pedagogics is one of the largest Bulgarian libraries and main supplier of information in the field of science, education, pedagogics, engineering, technology and economy with more than 4 million registered items, including books, periodicals, dissertations, publications on CD ROM, DVD. It offers:

- Lending of library materials;
- Online access to the library catalogues since 1980;
- Searching in electronic catalogues and databases;
- Electronic Document Delivery;
- Interlibrary loan.

INTERNATIONAL ACTIVITY

- Represents the Republic of Bulgaria in international organizations on the subject of its activities.
- Joint actions and projects with related national information and documentation centers in the EU.

CONTENTS

NATIONAL SCIENTIFIC PROGRAMMES WITH EUROPEAN DIMENSIONS

OPTIMIZATION OF ENERGY INTERACTION BETWEEN BIOLOGICAL STRUCTURES AND ELECTROMAGNETIC DEVICES

Iliana Marinova[1], Valentin Mateev[1], Ivan Yatchev[1], Ludmila Kuncheva[2], Ana Chakarova[3]

[1]Technical University of Sofia, Department of Electrical Apparatus
8, Kliment Ohridski Blvd.1756 Sofia, Bulgaria

[2]Bangor University, Bangor, Gwynedd, LL57 1UT, Dean Street, United Kingdom

[3]National Specialized Hospital for Active Treatment of Oncology, Department of Radiotherapy
6, Plovdivsko pole Street, 1756 Sofia, Bulgaria

Abstract

Electromagnetic devices used for medical diagnosis and therapy need high power to produce high magnetic fields, which makes such devices considerable energy consumers. Optimization of the fields and processes during energy interaction between electromagnetic devices and nonlinear, inhomogeneous and complex biological structures opens up the possibility to develop high quality, energy saving electro-medical devices. The aim of the project is to reduce significantly electrical energy consumption, allowing at the same time for precise and effective medical diagnosis and therapy. This will be achieved by optimization of the energy interaction between electromagnetic devices and biological structures. The study of the factors and conditions for increasing energy efficiency of these electromagnetic interactions is of great importance. Mathematical models, algorithms and approaches for the analysis and synthesis of fields and processes will be developed and experimentally verified. Up-to-date methods for optimization, visualization, data manipulation, signal and image processing will be used for the computer modeling. For the analysis and synthesis of electromagnetic fields we will use the three-dimensional finite element method. For the experiments, computer-controlled setups will be developed with a possibility for continuous control and recording of data during the experiment. The proposed approaches will be applied for optimization of energy interactions between biological structures and electromagnetic devices. The expected outcomes of this project are new energy efficient, compact and high quality devices for wide applications in hospitals and medical centers.

INTRODUCTION

Medical electromagnetic devices are widely used in hospitals and medical centers. Precise medical diagnosis and therapy requires in-depth knowledge of energy interaction between biological structures and electromagnetic devices. The energy interaction is determined by the examination and modeling of the fields, processes and phenomena in biological structures as well as in electromagnetic devices [1-20]. This relies on the development of up-to-date electromagnetic devices as well as on advances in bioinformatics, biomaterials, measurement systems, information technologies and so on. The need to address such a diverse set of issues determined the multidisciplinary character of the project.

Electromagnetic devices used in medical diagnosis and therapy are characterized by high power needed to produce high magnetic fields. Due to that, these devices are considerable energy consumers. Optimization of the field distri-

butions and processes during energy interactions between electromagnetic devices and nonlinear, inhomogeneous and complex biological structures opens up the possibility to develop high-quality energy-saving electromagnetic medical devices. Our recent experience with electromagnetic field distributions in biological structures showed interesting phenomena, conditions and biological media parameters of which are worth deeper studies [1-11]. The project is especially important in view of the perspectives opened up by the magnetic therapy of cancer cells, which leads to reduction in the cell's dimension and growth [12-14]. Thus the project is in tune with the current state-of-the-art, and answers some modern challenges in biomedical engineering.

RESEARCH TEAM

The project team is composed of scientists and specialists working in different areas, with profound experience and knowledge in investigations of fields and processes of electromagnetic devices and biological structures. Members of the project team have participated in many national and international projects, both in academia and industry. The project team consists of: Assoc. Prof. Dr. Iliana Marinova (project leader), Prof. DSc Ivan Yatchev, Assoc. Prof. Dr. Mariana Goranova, Assoc. Prof. Dr. Plamen Tzvetkov, Assoc. Prof. Dr. Valchan Georgiev, Assoc. Prof. Valentin Mateev, Assoc. Prof. Galia Georgieva-Taskova and Assoc. Prof. Dr. Petar Goranov are from Technical University of Sofia (TU-Sofia); D-r Ana Chakarova is from National Specialized Hospital for Active Treatment of Oncology - Sofia (SBALO); Georgi Petrov is from New Bulgarian University - Sofia (NBU); Dr. Georgy Miluchev is from UNITECH PK - Sofia; Prof. DSc Ivan Dotsinsky is from Central Laboratory for Biomedical Engineering, BAS (CLBME); Prof. Dr. Andrzej Krawczyk is from CIOP - Warsaw, Poland and Prof. Dr. Ludmila Kuncheva is from University of Bangor, UK. Prof. DSc Sava Papazov, Prof. DSc Alexandar Alexandrov and Prof. Dr. Jecho Kostov are consultants of the project. The scheme of the project partners and participants is shown in Fig. 1. The collective team's expertise covers: modeling, simulation and visualization of fields, processes and phenomena in electrical apparatus, power electronics, electrical measurements, computer science, neural networks and more. Recently, the scientific and research interests and work of the project team are directed to development of the models, methods, approaches and algorithms for modeling, simulation and visualization of fields, processes and phenomena with applications to bioelectromagnetism. Another recent area of interest has been construction of electromagnetic systems used in medical devices. The part of the team from TU-Sofia have sound experience in the area of analysis and synthesis of electromagnetic fields, especially in the application of numerical methods with both own and commercial software. Relevant results have been published in the form of journal and conference papers in Japan, Germany, USA, Bulgaria, etc. The work of the colleagues from CLBME, BAS, is directed to analysis and modeling in biology and medicine, including Computer Aided Design (CAD) systems. There has been a long-standing collaboration between TU-Sofia and CLBME in the area of electromagnetic fields in biological structures. SBALO-Sofia is the main consumer of the project results. The cooperation with colleagues from SBALO-Sofia will enable the realization of the project outcomes for effective medical diagnosis and therapy. UNITECH PK has experience in automated systems, including systems for data acquisition, measurement and power electricity consumption. NBU offers expertise in signal and image processing of biological data, visualization, data manipulation, computer software and measuring systems. The colleagues from University of Bangor, UK focus on pattern recognitions and image processing. The group led by Prof. Krawczik from CIOP Warsaw, Poland, has substantial achievements in the investigation of biological structures, magnetic stimulations and electromagnetic devices.

PROJECT WORK PROGRAM

The aim of the project is to reduce significantly the electrical energy consumption of the interaction between biological structures and electromagnetic devices. This will be achieved by optimization of the energy interaction between electromagnetic devices and biological structures. The study of the factors and conditions for increasing the energy efficiency of electro-

magnetic interactions is of great importance. Mathematical models, algorithms and approaches for the analysis and the synthesis of the fields and processes will be developed and experimentally verified. Up-to-date methods for optimization, visualization, data manipulation, signal and image processing will be used for the computer modeling. For the analysis and synthesis of electromagnetic fields we will use the three-dimensional finite element method.

The project objects are fields, processes and phenomena in electromagnetic devices as well as in biological structures during medical therapy and diagnosis, for example magnetic stimulations and defibrillations.

The originality in this case is in the development of accurate mathematical models, approaches and adaptive algorithms for studying the factors and conditions at different modes of electromagnetic device operation. At the same time, the nonlinear, inhomogeneous and complex media parameters of biological structures must be taken into account.

The main hypothesis of this project is that the energy interaction between biological structures and electromagnetic devices depends upon physical and geometrical characteristics of the former and modes of operation of the latter. We will look for the optimal factors and conditions of energy interaction, which will lead to effective medical diagnosis and therapy realized by energy-saving electromagnetic devices.

In our previous studies we found that inadequate energy interaction between magnetic stimulation coils and nerve fibres make magnetic stimulation inefficient and non-effective. In addition, this method tends to produce large amount of heat during stimulation, limiting the repetition rate and the duration of stimulus. Hence we designed a coil leading to significant improvement in localization. Different coil constructions have been studied and analyzed [1-11], but the results are inconsistent from the point of view of energy-saving technologies and efficient therapy. Thin and flat coils minimize the stimulation energy but are less effective than solenoid-type coils. Spiral coil with higher diameter produced better expiratory function results than those of the smaller-sized coils. As for the relationship between the efficiency and the magnetic pulse duration, it was found that the threshold energy increases with the pulse duration. However, the threshold energy decreases with pulse width. Therefore, it is still not clear what the optimal design should be for maximum efficiency.

In-depth studies are required to find the accurate theoretical explanation of the phenomena observed in our experience with electromagnetic devices as well as in biological structures. Such explanations will provide the basis for determining the optimal energy interaction, tightly linked to practical applicability.

The main problems in achieving the goal of this project are as follows:

Scientific Problems and Activities

Problem 1: Analysis of the energy interaction between biological structures and electromagnetic devices. Activities related to this Problem

Analysis of electromagnetic devices used for magnetic therapy and diagnosis; analysis of different constructions, material characteristics, parameters and characteristics of devices; analysis of existing theoretical models as well as experimental results of electromagnetic field distributions in biological structures. Analysis of power supply systems as well as control systems used in diagnosis and therapy devices; analysis of existing software for electromagnetic device studies as well as existing software for biological structures studies. Analysis of biomedical visualization systems, approaches, state-of-the-art of signal and image processing, image reconstructions, virtual reality used in medicine.

Problem 2: Development of a computer modeling system for fields, processes and phenomena study of electromagnetic devices at different modes and media parameters. Activities related to this Problem

Formulation of forward problems for field, processes and phenomena analysis of electromagnetic devices; development of three-dimensional models, approaches and algorithms for electromagnetic device study. (An example is given in Fig. 2, where the construction of magnetic stimulation coil and its magnetic field distribution are presented); development of computer soft-

ware realizing the proposed approaches and algorithms, combining commercial and own software; electromagnetic device selection and software design; studying three-dimensional models at different electromagnetic device modes and various media parameters; visualization of the databases obtained during the studies.

Problem 3: Development of computer modeling system for fields processes and phenomena study of biological structures. Activities related to this Problem

Formulation of forward problems for field, processes and phenomena in biological structures; development of three-dimensional models, approaches and algorithms for biological studies (An example of 3D model building process is shown in Fig. 3); three-dimensional models potentiality study at different modes, conditions and biological media parameters; computer software development realizing the proposed approaches and algorithms, combining commercial and own software; (An example of a thorax model and the electric and magnetic field distribution are shown in Fig. 4). Selection of biological structures and application of the developed computer software; analysis of the influence factors on electromagnetic field distributions in biological structures; determination of electrical and magnetic parameters and characteristics of biological media (An example of an impedance measurement system is shown in Fig. 5).

Problem 4: Analysis of power supply systems of electromagnetic devices used for medical diagnosis and therapy. Activities related to this Problem

Electric circuits modeling of power supply systems of medical diagnosis and therapy devices; determining the influence of electric circuit parameters on energy interaction with biological structures; application of energy-saving technologies to the power supply systems of the electromagnetic devices used for medical diagnosis and therapy.

Problem 5: Development of a practical approach for optimization of the energy interaction between biological structures and electromagnetic devices. Activities related to this Problem

Formulation of inverse electromagnetic problems for field, processes and phenomena synthesis in biological structures during interaction with electromagnetic systems (An example of an inverse reconstruction process is shown in Fig. 6); development of three-dimensional models, approach selection and algorithm set up for solving the inverse problems.

Study of the potential of three-dimensional modeling at various conditions and biological media parameters; design of computer software for the proposed approaches and algorithms for solving inverse electromagnetic problems; design of generalized theoretical system for energy in-

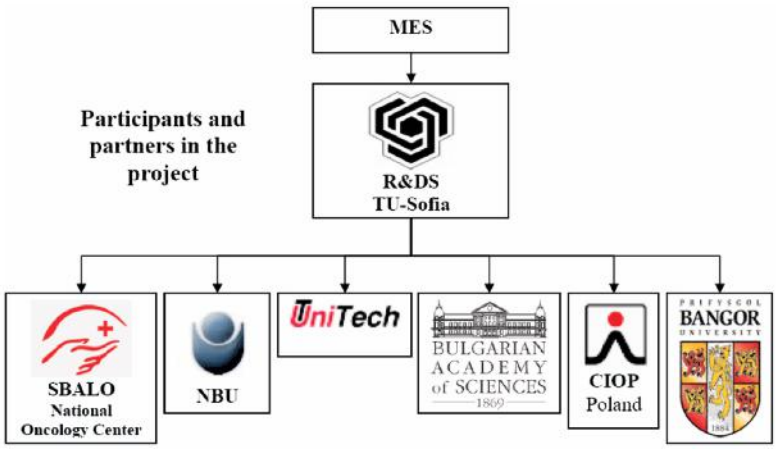


Fig. 1. Participants and partners in the project

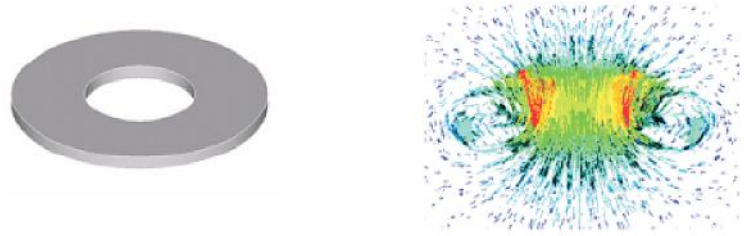


Fig. 2. Magnetic stimulation coil and field distribution

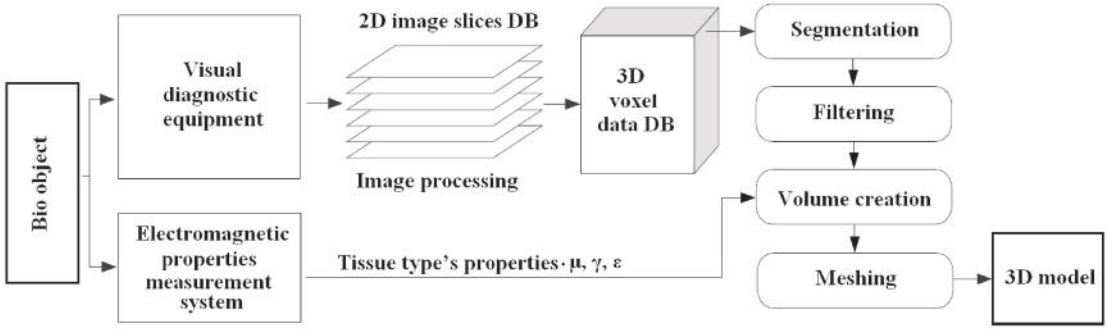
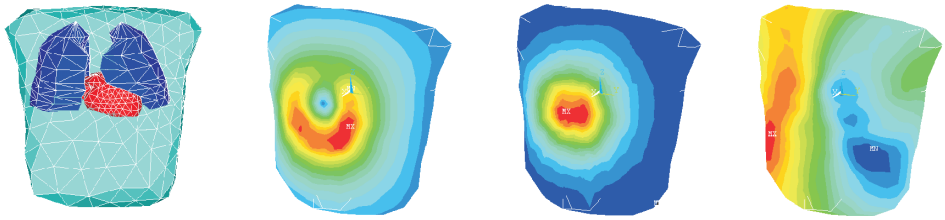
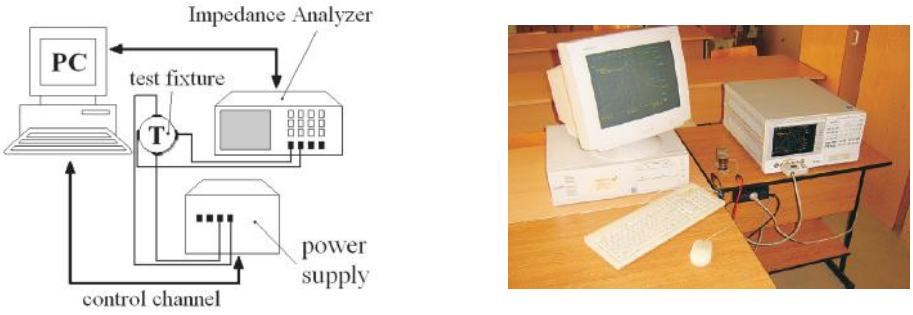


Fig. 3. 3D model building process



(a) (b) (c) (d)

Fig. 4. Thorax model (a); magnetic vector potential distribution (b); magnetic flux density distribution (c); and scalar electric potential distribution (d).



(a) (b)

Fig. 5. Impedance measurement system

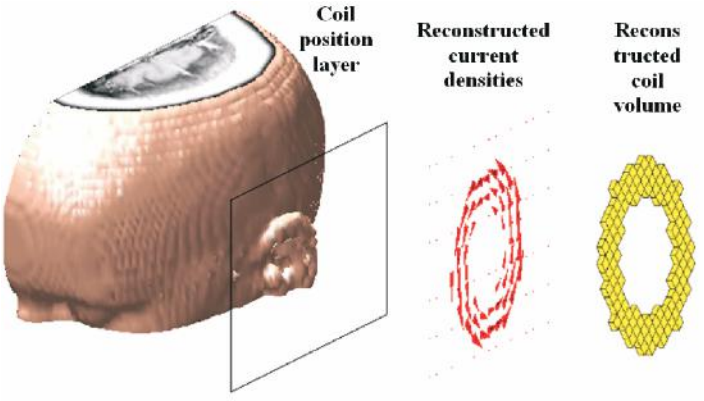


Fig. 6. Inverse reconstruction process

teraction between biological structures and electromagnetic systems; study of the influence factors on energy interaction between biological structures and electromagnetic systems; analysis of the practical applicability of the results obtained; adaptation of the developed system.

Problem 6: Visualization of biomedical information and the project results. Activities related to this Problem

Application of state-of-the-art technologies for data manipulation, storage and archiving of large biomedical databases obtained in theoretical and experimental studies; development of new approaches and tools for signal processing, image processing, image recognitions, etc; application of virtual reality and microscopy (An example of reconstructed magnetic and current field distributions at leg region is given in Fig. 7-10).

Problem 7: Experimental study of energy interaction between biological systems and electromagnetic devices. Activities related to this Problem

Development of an approach for field and process measurement; development of an approach for process measurements in power supply and control circuits of electromagnetic devices; development of an approach for field and process measurement in biological structures; development of a computer-controlled setup with possibilities for continuous data control and recording. Analysis and evaluation of the experimental results.

Problem 8: Energy interaction estimation between biological structures and electromagnetic devices. Activities related to this Problem

Comparison of the results obtained during the theoretical and experimental studies of the energy interaction between biological structures and electromagnetic devices; modification of the

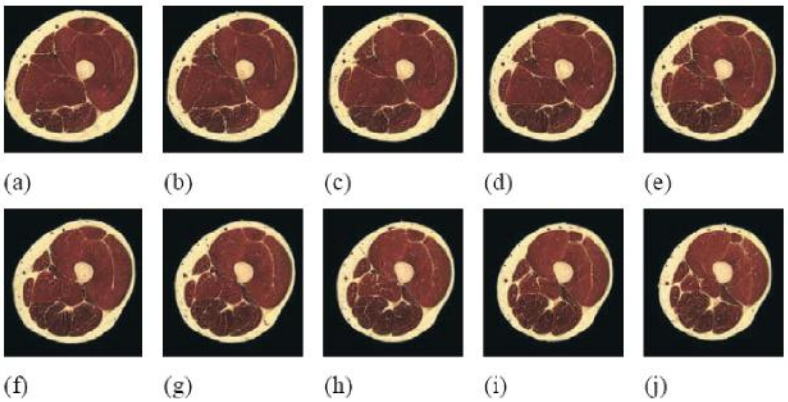


Fig. 7. Leg slices used for model reconstruction

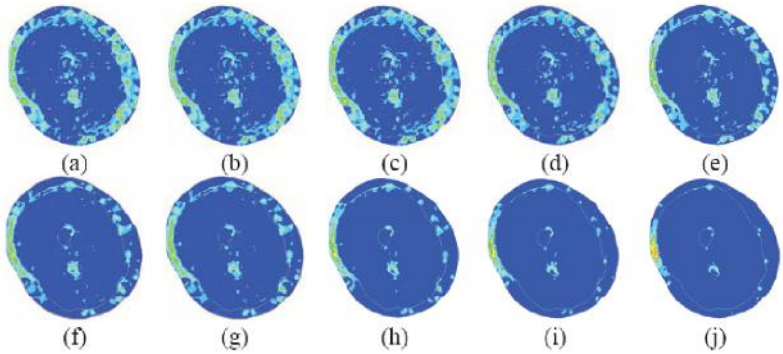


Fig. 8. Magnetic field distributions

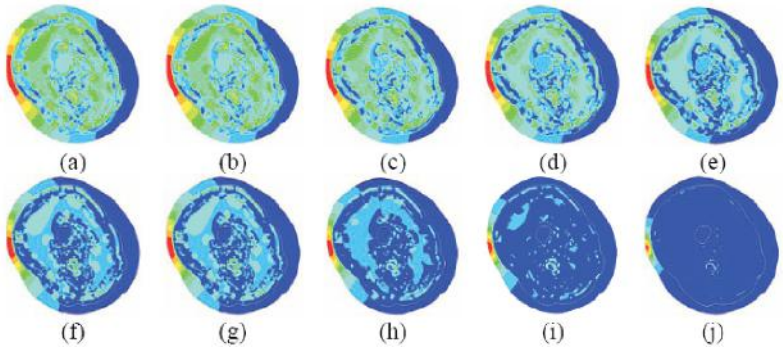
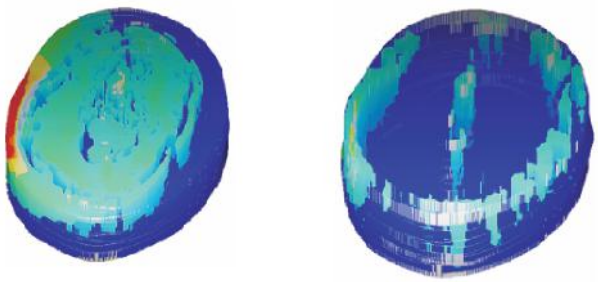


Fig. 9. Current distributions



(a) (b)

Fig. 10. Reconstructed magnetic (a) and current (b) field distributions at leg region

computer modeling system if necessary; determination of the possibilities and conditions for optimization of the energy interaction between biological structures and electromagnetic devices.

Methods and tools for achieving the project goals

• The three-dimensional finite element method will be used for computer modeling of electric and magnetic field.

• The theoretical studies will be carried out using combining the finite element method with a method for solving ordinary differential equations. New approaches will be proposed for the solution of inverse electromagnetic problems.

• The optimization of the energy interaction will be approached through state-of-the-art optimization methods, e.g. neural networks combined with three-dimensional field analysis.

• The visualization part will be done with the

help of the finite element method, Fourier and Wavelet transforms, image reconstructions with field theory, pattern recognition, etc.

• Automatic data recording will underpin the experimental study of the computer controlled setup. Specified sensor systems, electronic elements and components, as well as corresponding computer software and hardware will be developed.

EXPECTED IMPACT OF THE RESULTS

Several areas are expected to benefit from the results of this project.

Scientific impact

Building of three-dimensional accurate mathematical models, taking into account all essential features of the processes at corresponding modes of electromagnetic device operation as well as media parameters of the biological structure, will give deeper understanding and insight about the influence of the factors and conditions on the fields, processes and phenomena.

New approaches will be developed on the basis of the three-dimensional models with application of up-to-date methods and technologies in the area of numerical methods, signal and image processing, optimization, image reconstructions and visualization. The models developed could be applied for solving other problems in different scientific areas. The models and approaches will be generalized in theoretical aspect for solution of forward and inverse problems in electromagnetism and bioelectromagnetism.

The experiments will be carried out using cutting-edge equipment and measurement systems, ensuring precision, accuracy and reproducibility of the results. The set up will be designed so as to allow for a spectrum of experimental studies, not only the ones planned for this project.

The optimal energy interaction between biological structures and electromagnetic devices will be determined at different conditions and modes.

The results obtained from the computer modeling and the experiment will be visualized by the developed visualization approaches, which could be used for other studies.

Economic impact

Upon successful completion of the project we expect the following economic benefits:

• introduction of energy-saving technologies for effective and accurate medical diagnosis and therapy;

• determination of factors to improve energy effectiveness of electromagnetic devices used in medicine;

• developing compact, high-quality and energy saving electromagnetic devices suitable for hospitals, medical centers, etc.

Social effects and results

The social effects and results are in bringing together scientists and specialists with deep knowledge and experience from different institutions and areas of research, to join their efforts in completing an innovative, challenging and timely project.

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SMARTBOOK – A VISION FOR THE FUTURE OF E-BOOK

Ivan Koychev[1,*], Roumen Nikolov[1], Darina Dicheva[2]

[1]Faculty of Mathematics and Informatics, University of Sofia, Bulgaria,

E-mail: koychev@fmi.uni-sofia.bg

[2]Computer Science Department, Winston-Salem State University, USA,

E-mail: dichevad@wssu.edu

[*]Also associated with Institute of Mathematics and Informatics, Bulgarian Academy of Sciences

Abstract

This paper presents a vision for the future of e-books as part of the growing collective intelligence. The vision entails further development of technologies that will facilitate the creation and use of a new generation of 'smart' books: e-books that are evolving, highly interactive, customizable, adaptable, intelligent, and furnished with a rich set of collaborative authoring and reading support services. The proposed set of tools will be integrated into an intelligent framework for collaborative book authoring and experiencing called SmartBook. The paper also discusses the opportunities of using SmartBook as an educational hypermedia.

INTRODUCTION

Around 400 BC, Socrates said about books: *"and yet if you ask them a question they preserve a solemn silence. ...You would imagine that they had intelligence, but if you want to know anything and put a question to one of them, the speaker always gives one unvarying answer. And when they have been once written down they are tumbled about anywhere among those who may or may not understand them, and know not to whom they should reply, to whom not: and, if they are maltreated or abused, they have no parent to protect them; and they cannot protect or defend themselves."*

IT technologies available today have made possible the advent of e-book that overcomes a number of weaknesses of the classic scroll described so well by Socrates 24 centuries ago. Many of the numerous recent e-book projects, such as the Gutenberg Project [9] and Google's Books project [10], focus on digitizing printed books and organizing them in online repositories. The ability to present information in new ways, including display of multimedia content,

interactivity, and customization, gives the e-book an enormous potential to extend the fundamental concept of the book and its impact on readers. In addition, taking advantage from the emerging social web, e-book authors can publish drafts of their books online to get early feedback, thus transforming book writing into a form of collective brainstorming. This could result in better 'live' books and a shorter writing cycle. Such e-books could be continuously updated and refined by many stakeholders; for example, readers could discuss published online content with the author or publishers could recommend extensions with information in demand.

Current technologies provide opportunities for building tools not only for authoring interactive multimedia content, but also for enhancing readers' experience beyond multi-media presentation, for example, through *sharing comments, in-book search, browsing, skimming, visualization, summarization, and non-linear reading.* Although software tools supporting individually some of these functionalities are currently available, *there is a need for an integrated environment* that provides a complete set of social and intelligent tools to facilitate book writing and reading.

RELATED WORK

E-books come from a complimentary tradition originating from early efforts to get existing texts online, e.g., the Gutenberg Project, followed by the early digital text publishers such as Hard Shell Word Factory [11] and Online Originals [12]. These texts are typically linear; popular formats include Plain Text, HTML (HyperText Markup Language), PDF (Portable Document Format), Word, Open Standards such as IDPF (International Digital Publishing Forum (formerly Open eBook Forum)), or Proprietary formats such as Kindle's AZW (Amazon Whispernet) or Mobipocket's PRC (PRC is a format for code databases in Palm OS, used by the Mobipocket e-book-reader). Although most e-books can be read on a standard PC, a number of specific devices have emerged - such as Sony LIBRIé (2004), Sony Reader (2006), and Amazon Kindle (2007) [13] - that take advantage of better book-like form factors, and new display technologies that are easy on the eye (known as e-paper or digital paper).

The new generation of Web 2.0 systems (including blogs, wikis, personal journalism and sharing sites) is changing the general attitude to public writing, sharing, and artistic collaboration. This new Web literacy is changing people's expectations of digital media and challenges our existing notions of authorship, making it the right time to explore how community-driven writing and reading could be applied to more formally published materials. The existing work in this area includes Amazon's open publishing system called Digital Text Platform [13], which allows authors to self-publish to their Kindle platform, and Hypertext publishers, such as Eastgate Systems [14], which offer self-contained hypertexts that have many of the combined properties of open hypertexts and e-books. The latter, although formally authored, multimedia and non-linear, include no community or annotation aspects.

While technologies and tools for searching documents on the Web or in a digital library that best match a query have been the subject of tremendous interest and research in the last decade, the task of *locating relevant information within documents* has remained in the shadow. Recently, this task has become increasingly important as longer documents, including many e-books, have begun being published. Several approaches have been proposed for within-document retrieval including passage retrieval [4] and content-based document browsing. Harper et al. [3] proposed a tool called ProfileSkim that enables users to identify relevant passages of text within long documents by integrating passage retrieval and content-based document browsing.

Adaptive and recommender systems use user models aiming to help users in finding information, products, services, etc., that they are presumably interested in or prefer. There are two basic approaches pursued so far. *Content-based filtering* systems take into account individual preferences for certain object features and make recommendations on the base of the similarities between items [7, etc.]. *Collaborative filtering* systems, typically build on similarities between users with respect to the objects they are implicitly or explicitly interested in [5, etc.]. There are also *hybrid* systems, which combine both approaches to

avoid some of their limitations and improve the quality of their recommendations [1, etc.].

THE SMARTBOOK VISION

Even today a significant amount of multimedia content is often made available as a book companion (for example, on CDs, DVDs or on the Web). Book authoring and reviewing using digital facilities has influenced the workflows adopted by publishers and the processes followed by individuals. Collaborative work using social network infrastructures as well as the fan art and fan fiction that often accompany books on the Web are significant developments in both authoring and reading. The way in which we experience books has therefore changed dramatically. Books can be experienced on print, on the Web or on portable devices and they can be discussed in forums, enhanced by fans and be part of a shared experience among creative communities.

We advocate that it is possible to *re-conceptualize the book* by examining the essence of what the book means to individuals, society and culture at large, and how this could be supported and extended by digital platforms, connectivity and the emerging digital literacy. We believe that a new generation of e-books will better support creative communities, foster talent and promote innovation. The vision entails further developing of technologies that will facilitate the creation and use of a new generation of 'smart' e-books that are: evolving, highly interactive, customizable, adaptable, intelligent, and equipped with a rich set of author and reader support services. We propose a set of tools that will be ultimately integrated into an intelligent framework for collaborative book authoring and reading called *SmartBook*. It will contain three 'spaces': an author's space, a reader's space, and a collaboration space.

The *author's space* will provide authors with personal and collaborative editing tools. The major difference between these tools and the emerging wiki-based collaborative authoring tools (such as those in Wikibooks) is the ownership. Whereas the wiki approach allows all users to act as co-authors, SmartBook will preserve the traditional distinction of the roles of authors and readers; one or more authors, the book owner(s), will be responsible for content creation. One of the main goals of SmartBook is to provide authors with a set of smart tools to facilitate presentation of the semantics of the text (better and easier than it is currently possible) by employing emerging technologies and recent findings in the areas of semi-automatic mark-up, natural language processing and text mining. The tools will make suggestions needing final tuning and/or approval by the author.

In the SmartBook *reader's space*, readers will be able to create their own electronic copy of a book, in which they could mark, underline and comment, in the same way they commonly do with paper books. Readers will be able to edit only their own copies; the original book content will be preserved. A reader could further share an annotated personal copy with other readers and the author(s). Semantic Web and personalization technologies will be used to provide efficient and context-aware search and browsing of the book content and reader's comments.

The *collaboration space* will provide users with a virtual place where the involved stakeholders can discuss subjects of common interest related to a book. For example, there will be two default "meeting rooms" for each new book - one for writers and one for readers. Additional rooms could be created as needed. Writers' meeting rooms will be restricted to agents involved in book creation, including writers, reviewers, and editors. The publisher will set the access rights. Readers' rooms will be open and accessible by both the readers and the book creators. The collaboration rooms will be furnished with state-of-the-art tools for *sharing information* and thoughts in written and oral form, such as a virtual white board, online video, voice conversation, etc. The aim is to bring together the most recent advances in technology in collaborative working environments in order to promote social contacts and facilitate interaction and knowledge exchange between readers, authors, and publishers. Thus SmartBook will be a promising candidate to become a key launch pad for growing and cultivating the emerging collective intelligence [8].

In this context, we have to identify how the role of the *publisher* will evolve. On the Web,

anyone can publish anything. Quality control (e.g. peer reviewing) is not common, which makes content less trustworthy than scholarly publications. There are no selection guidelines for search engines. This situation makes the task of the readers searching relevant trustworthy information difficult, especially in the case of tight time constraints. This is even more important in educational scenarios, where the readers need trusted information presented in a suitable for learning way.

With regard to *personalization*, current advances in the fields of adaptive hypermedia will be used: e.g. user modelling and recommender systems. A variety of semantic technologies for ad hoc discovering and presenting associations between terms/concepts, ontologies, contexts, etc. will be employed. User profiles will be utilized in helping users to find information resources and services of interest or preference. The personalization will employ both above-mentioned approaches for recommendation - content-based and collaborative or social. The framework will be a *plug-in architecture* allowing integration of third party tools, such as collaborative editing tools and online communication facilities.

SMARTBOOK DESIGN AND DEVELOPMENT

We identified three main dimensions of the project as follows:

• Building a collaboration environment that facilitates the interaction between book stakeholders. In particular, it will support:

- Enabling *rich media content* management;

- Developing an integrated collaborative *authoring* space including support for 'live' feedback from readers about the book before and after its completion;

- Developing an interactive social *book reading* space including discussion forums; comments, bookmarks, annotations, and tags sharing, etc.

• Developing tools for intelligent information retrieval.

- Supporting (semi-automatic) semantic content annotation, including building 'knowledge maps' of the book content (a generalization of the traditional 'back-of-the-book' indexes);

- Efficient semantics-aware in-book search, browsing and summarization;

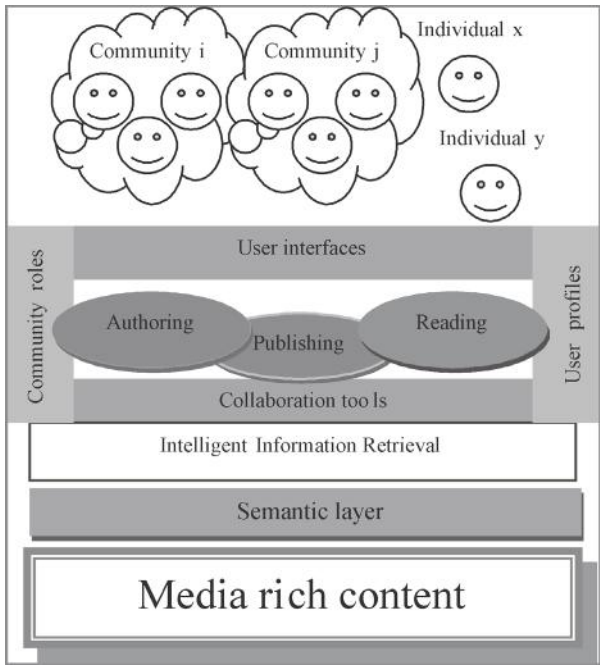

Fig. 1. SmartBook architecture

- Visualization of content structure and semantics;

- Context-aware 'live' search and recommendations of relevant resources.

• Developing *personalization* support for SmartBook.

- Designing and prototyping a user modelling server;

- User model acquisition from log files;

- Personalization of the content and its presentation.

Fig. 1 presents the overall architecture of the SmartBook framework.

With regard to content organization, SmartBook uses semantic models at three different levels:

• *Object level:* content objects annotated using metadata standards (such as Dublin Core or IEEE LOM) and expressed in popular multimedia formats. Such objects are interoperable and can be imported from other sources such as personal archives, or online repositories.

• *Book level:* an open SmartBook ontology of book structure (referencing the object level) and further annotated with author and contribution information. This ontology will be open.

• *Conceptual level:* knowledge maps concep-

tually modelling knowledge domains. This layer plays the role of a global schema, providing a declarative description of the subjects *within the content* in terms of key concepts and relationships between them. Knowledge maps are presented in standards-based formats (such as SKOS) and are therefore interoperable.

At a simple level, the latter will provide support for readers to easily search inside book content. However, since it is much richer in structure as compared with a simple index, it will provide much more to the reader - for example, such a structure can present concepts in the context of their relationships to other concepts. This in turn will allow for efficient semantic search and browsing of the learning content.

SMARTBOOK AND EDUCATIONAL HYPER–MEDIA

Recent research and development efforts in learning content authoring have concentrated on authoring educational hypermedia, focusing on system adaptivity. The resulting hyper-books are interactive, rich in terms of employed modalities for content presentation, and easily browsable. However, their structure (hyperlinks connecting selected concepts to Web pages explaining them) departs significantly from the traditional sequential textbook structure, which in many cases is more appropriate for story-telling or a narrative introduction of a new topic. Since readers are used to conventional printed media, hyper-books can often be more difficult to follow, as shown by studies reporting *cognitive overload* for readers [2, 6].

An innovative form of electronic book could combine the advantages of both conventional printed books and educational hypermedia. To reach this goal, we propose two basic perspectives for *organizing learning content* in SmartBook:

• A collection of hypermedia units modelling the traditional organization of a book: sequential book pages containing the content structured in chapters, subchapters, sections, etc., using multiple modalities for presenting the information (text, graphics, video, audio, etc.). This organization should be supplemented with functionalities that model traditional practices when reading conventional books, such as highlighting text, adding readers' notes, and book-marking.

• *A semantic structure* of interrelated concepts representing a knowledge structure of the academic subject domain (conceptual classification).

The second perspective can be seen as playing the role of a *back-of-the-book index* for SmartBook, which provides support for readers to search easily inside the book content. SmartBook will also be furnished with within-document text retrieval tools that efficiently support users trying to identify information within long documents.

In general, SmartBook is envisaged to impact four key areas that are highly relevant to University education:

• participative and communicative forms or content;

• enabling publishing of innovative and trustworthy content;

• automating the collection and distribution of knowledge;

* automate links between scientific data and discussion.

It will have a significant impact on the first three of these areas and will indirectly make contributions to the fourth one.

CONCLUSIONS

The SmartBook vision implies re-conceptualization of the book as rich-media, inter-active, intelligent content serving as a focus point for community discussion. It employs technologies that facilitate the creation and use of a new generation of *published* SmartBooks. Although research and educational scenarios most clearly demonstrate the need for more formal notions of publishing in digital texts, the ideas are general in nature and are transferable to other book genres.

SmartBook is not focused on the e-Science domain in particular, and will support general writing, discussion and publishing workflows, rather than those more tightly associated with experimentation and sharing of results. SmartBook is advocating a revolution in the way digital material is published, and will enable evolutionary creation of text over many iterations. It also employs personalization techniques that could be extremely useful in dissemination of

scientific results - either for scholarly discussion in expert communities or to aid the discourse and relationship between experts and the general public.

Acknowledgements

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[13] https://dtp.amazon.com

RESEARCH OF THE CULTURAL AND HISTORICAL HERITAGE OF THE HISTORICAL AND GEOGRAPHICAL REGION OF THRACE – A PREREQUISITE FOR NATIONAL IDENTITY AND SOCIO–ECONOMIC DEVELOPMENT

Tsonka Kasnakova–Ivanova

Trakia University, Student's campus, 6000 Stara Zagora, Bulgaria

Abstract

The main goal of the project is to research the condition and perspectives of the cultural and historical potential of the historical and geographical region of Thrace as a basis of its social and economic development, establishing and development of the Euro-region of Thrace. This will lead to creation of a foundation for further scientific and research activity between the main units of Trakia University with common scientific interests. The project is planning to put the foundations of international collaboration between Trakia University and other universities and cultural institutions from Greece and Turkey for the purposes of researching the historical and geographical region of Thrace with its specific characteristics. The project will encourage and intensify the connection between the scientific research and the tourism business.

The question about the cultural and historical heritage of the historical and geographical region of Thrace, situated in three neighboring countries, has been widely discussed in the studies of Bulgarian historians, archeologists and ethnographers ever since the 19th century. As a result of their efforts today we have a huge amount of literature which grasps a number of aspects of the material and spiritual culture of different nations, ethnic and religious groups which have lived in the region during different historical periods. In the last fifteen years some very important surveys on the lifestyle, identity and social communities of the Thracian region were performed and published. The focus of the attention fell upon not only the well-known groups like the Turks and the Armenians, but also upon not so well-known ones, like the Karakachans. Special attention was paid to the Romas,

considered to be problematic because of their social lifestyle. Surveys were also done on the folklore, language and history of the Thracian and Rhodope Bulgarians, as well as the Bulgaro-Mohamedans. Great achievements were made in the research of pre-historic cultures, the Thracian and the Roman cultural heritages. Nevertheless, the potential of the regional cultural and historical heritage for stabilization of the national identity in the conditions of the growing globalization remains hardly known and not enough researched. This problem has mainly been raised within the frames of conference discussions, the attention of the authors being particularly on the institutional representation and advertising of the regional heritage. Social and cultural role of museums in the dynamically changing parameters of social and personal stereotypes and interests is in the centre of the discussion. International scientific conference which was held in Stara Zagora in November 2006 is a good example in this respect. A considerable part of the papers was dedicated to the links between the work of museums, cultural and historical heritage and cultural tourism, regional and local culture, cult places and religious tourism in Thrace and its adjacent mountain regions of the Rhodopes (Bulletins of the historical museum of Stara Zagora - Volume II, 2007, Volume III, 2008). The information which was revealed and discussed at the conference traced the way for a thorough consideration of the place of the cultural and historical heritage in the context of European integration of Bulgaria, international collaboration in the sphere of culture and the continuity of the national identity. After Max Webber (1930) many economic sociologists underline the meaning of culture for economic development. This role has been up-dated with the interpretation of Douglass North (1990) who said that it is a "new type of economics" of the 20-th century.

Within the frames of the EU, the social, economic and civilization potential of the cultural and historical heritage has been appreciated for a long time and has actively been exploited in the execution of a large number of integration policies and practices. The cultural sector is increasingly being perceived as a border field of interaction between social and economic activities. Through realization of an effective communication policy both the state and private business are generating the message that the mediator in this communication is the cultural heritage by means of which a good image is created and good financial results are achieved. Cultural identity is threatened by the contemporary conditions of globalization, integration, especially identity of small nations, minorities, ethnic groups which forces us to attend to the protection of cultural identity.

Taking into consideration the fact that cultural heritage is, on the one hand, one of the most important pillars of national memory and, on the other hand, a subject of increasing attention, interpretations and even speculations, we are focusing our research interest on the influence it has nowadays on the character of international, group and personal relations. In the context of expectations for the future constitutionalization of the historic-geographic region of Thrace, there is a sharp need of a complete research which will throw light over the problem. Our knowledge is even more restricted in terms of opportunities for initiating an international dialogue and a dialogue between different religions which will overcome the load of prejudices and stereotypes. Most economies which have gone through transition of the past 15 years have turned into a new challenge for research on the connection of "culture-development". Regardless of the fact that culture, history and traditions are difficult to measure "path-dependant" determinants, implementation of the activities of the project might lead to conclusions questioning the direct or opposite relation between cultural-historic models and resources from the one side and the dynamics of the main factors of social-economic development on the other side.

The idea is to make preservation of cultural and historical heritage as an element of the stable contemporary social and economic development an important part of the strategic plans for development at local, regional and national levels, with active participation of different institutions, organizations and interested people.

Preservation and enriching of cultural resources increases the attractiveness of the prod-

ucts of cultural tourism connected with them, which presupposes the enforcement of a special kind of management on the part of the state institutions, based on developed and controlled standards and mechanisms.

Historical memory enhances meeting of specific needs of an individual in the context of preserving his national confidence by opening new economic opportunities for him. By preserving their national identity, the Bulgarians of today could turn their hard fate into a geopolitical advantage, becoming an economic, political and cultural mediator between the East and the West, paying special attention to a tolerant dialogue between otherwise principally different traditions, values and ideas.

The main task of this project is to research cultural-historic heritage of the historic-geographic region of Trakia, as a factor of the continuum of national and regional identity in the face of European integration, in order to create conditions for suitability of social-economic development. This will lead to creation of a basis for further cooperation among scientific and research units in Trakia University. The project outlines foundations of international cooperation between Trakia University and other cultural, educational, research-oriented institutions in neighboring countries, as well as other Members of European Union. The project will assist for creation of closer cooperation between national educational-research institutions working in the area of cultural, historical, social-economic regional development (Sofia University "St. Kl. Ohridski", Bulgarian Academy of Sciences, University for National and World Economy, National Historic Museum, Regional Historic Museum - Stara Zagora, Kardzhaly, Ethnographic Museum-Plovdiv, RAO - "Trakia" , ARIR - Stara Zagora, Union of Thracian Associations in Stara Zagora, etc.)

Successful implementation of the project is also planning to elaborate the study plans and programs in the specialties of Trakia University which are related to cultural and economic development, by including modules reflecting the results of the research work performed by the project.

The project will encourage and intensify the connection between the scientific research and the tourism business.

The tasks planned within the project are as follows:

- *To study humanitarian aspects of cultural and historical heritage;*
- *Establishing the importance of regional culture and cultural-historic heritage in the collective memory of ethnic, religious, national identities in the region;*
- *To research the customs and traditions of the region of the Upper Thracian Plain from the middle of the 20-th century to the present as an element of lifestyle and historical and cultural heritage and improving the quality of life of the local population;*
- *Study of traditions and innovations in the means of livelihood and the lifestyle of the local population as a basis for estimating the contemporary and anticipating the future social and economic development of the rural areas in the region of the Upper Thracian Plain from the middle of the 20-th century to the present;*
- *Study of the functional role of the English language as a means for intercultural communication and a prerequisite for the building of European identity.*

Protective mechanisms

1. Equal and substantial participation of all the participants in the project.
2. Regular work meetings of all the participants for exchange of knowledge and ideas for the joint planning of future activities during the stages of the project.
3. Directing a resource search process in case the participants' experience proves insufficient.
4. Decision - making for expertise in a specific field.
5. Critical verification of the conducted activities by means of achieving publicity of the results.

Analysis of the moral dimensions of the decisions in case of eventual moral conflicts.

Successful project realization is guaranteed by concrete and well-defined aims, a condition which minimizes the risk of any inconformity between the goals and expected results. The aims and tasks are subject to reconsideration if necessary, regardless of the order and duration

of the activities and due to the need for flexibility and immediate reaction. Although any new information may influence the predefined aims, it is important that the integrity of the project remains intact. For good project management the team has decided on specific goals subject to quantitative and qualitative analysis, action-oriented and realistic in terms of deadline completion.

Personal responsibilities, duties and expectations for each of the participants in the project are well defined in accordance with the participants' knowledge and skills and previous experience. All the team members will work closely together meeting on a monthly basis, as well as every third month as part of the administrative scheme and in order to provide regular access for observation and evaluation of the conducted activities.

Possible risks as well as necessary counteractions are anticipated as protective mechanisms against any negative impacts. Risk management for each of the tasks is part of a protective network that can be used in case of necessity. Time, however, remains the major risk factor which could interfere with the project realization. Therefore some extra days have been planned for each of the activities in order to avoid possible risks.

Trakia University Stara Zagora is the beneficiary organization of the project, which in term is an interdisciplinary one in nature and relies on the partnership between two of the faculties - Faculty of Education and Faculty of Agriculture.

Responsible for the project management are the project manager, the coordinator and the accountant, whereas their work will be supported by other members of the team. The project manager will also function as a project coordinator and will be in charge of the following:

- organizing work meetings
- distributing tasks
- observing the time schedule
- observing the work program
- observing the financial issues and payments
- coordinating the expertise work
- guaranteeing publicity of the project
- promoting the project's goals and results
- accessibility to project information
- establishing media connections
- writing the final technical report

Financial management will be conducted in compliance with the law regulations in Bulgaria regarding scientific funding and grants.

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BULGARIAN ADDED VALUE TO ERA

SIMPRO – BUSINESS PROCESSES AND SIMULATION COMPETENCE CENTRE

Nedyu Popivanov
Faculty of Mathematics and Informatics, Sofia University "St. Kliment Ohridski"
15, Tsar Osvoboditel Blvd., 1504 Sofia, Bulgaria

SimPro was co-founded in 2009 by the Faculty of Mathematics and Informatics of Sofia University "St. Kliment Ohridski" and InterConsult Bulgaria (ICB) with the purpose to provide research, consultancy and training in business process modelling and simulations.

The Faculty of Mathematics and Informatics (FMI) of Sofia University "St. Kliment Ohtidski" is widely recognized as a leading Bulgarian institution in the field of computer science, mathematics, informatics, and information and communication technologies (ICT). Over the last decades, it has proven its competence in applied mathematical research and high quality education. FMI has achieved European wide reputation and has built good partnerships as well. FMI has also won a number of scientific projects in Bulgaria, funded either by the National Science Fund (NSF) or by the business.

ICB is a leading Bulgarian software and consulting company established in 1996. It is a high technology provider offering IT services to the international and Bulgarian market as well as management consulting services in Bulgaria. ICB employs more than 80 highly qualified professionals - experienced IT and management consultants from the private and public sectors. ICB was the first company to provide services in the field of business process modelling in the country, which makes it one of the pioneers in this area on the local market. The company has worked as an authorized partner of IDS Scheer (Germany) for Bulgaria since 1999.

SimPro is the first centre of its kind in the region aiming to strengthen the link between the business, academic environment and decision-makers. It aims at incorporating the interests of various stakeholders and to act as an innovative partner in the search for large public solutions. Thus, it strives to promote a good practice for cooperation, which could be replicated in the future.

SimPro works as a meeting point between academic research and practical solutions. It unites the theoretical insights of its academic staff with the solution-orientation of its business professionals. The training activities have as their ultimate goal to provide courses in the state-of-the art technologies and create highly skilled workforce, which will contribute to the reduction of implementation costs of public platforms. The consultancy activities aim at exporting the value added of SimPro activities in the search of public solutions.

THE PROJECT

The centre was established within the framework of a project funded by the National Science Fund with duration of three years. The project has been organized in two stages consisting of eighteen months, and the first stage was launched in January 2009. The overall project value amounts at 490 000 BGN, which are equally distributed between the two periods.

The goal of the SimPro Project is to develop a pool of experts using the latest interdisciplinary methodologies and technologies for the

research and improvement of work organization, information systems and physical processes. The core project activity is the research, simulation, and visualization of business processes with a view to the design of adaptive software systems. In order to achieve it, the project is going to use a 3D Simulation and Visualization Laboratory which is going to be established in the coming months in FMI.

The SimPro Project team has been composed of Sofia University "St. Kliment Ohridski" academics, ICB IT professionals and business experts. A major focus has been laid on the attraction of young scientists and master/PhD students who are willing to advance in the thematic area of the centre. The team also includes foreign research partners and consultants. It is envisaged that the project team will attract and employ other young scientists in the future.

The project management structure has been designed to address both the project internal needs and its public outreach. The two key bodies responsible for its management are its Management Board and its Advisory Board. If the first one is composed of the project coordinator and vertical project managers and provides the overall strategic guidance of the project, the second one includes representatives of all relevant stakeholders and targets the incorporation of their interests into the project activities.

The project management structure has been shown on Chart 1.

PROJECT ACTIVITIES AND EXPECTED OUTPUTS

The project activities have been organized in three vertical lines of action:

- Research and Development;
- Training and Education;
- Transfer of Knowledge.

There have also been formed two horizontal dimensions of project activities, i.e. management activities and activities associated with the dissemination of project results.

The structure of the project activities has been displayed on Chart 2.

The research activities have been organized in three main fields: business processes, differential equations and physical processes. There have been constituted three working groups allocated to the respective subject matter. So far, for the first six months of their work, the working groups have managed to publish a couple of articles on differential equations and physical processes, and significant progress was registered on the study of the transition from business processes to software programs. The overall goal of the latter is to come up with a model illustrating how to obtain software programs from business processes.

The exploration, simulation, and visualization of business processes with the purpose to design adaptive software systems for simulation has been defined as a base activity of the centre. The following key scientific research tasks have been

Chart 1.

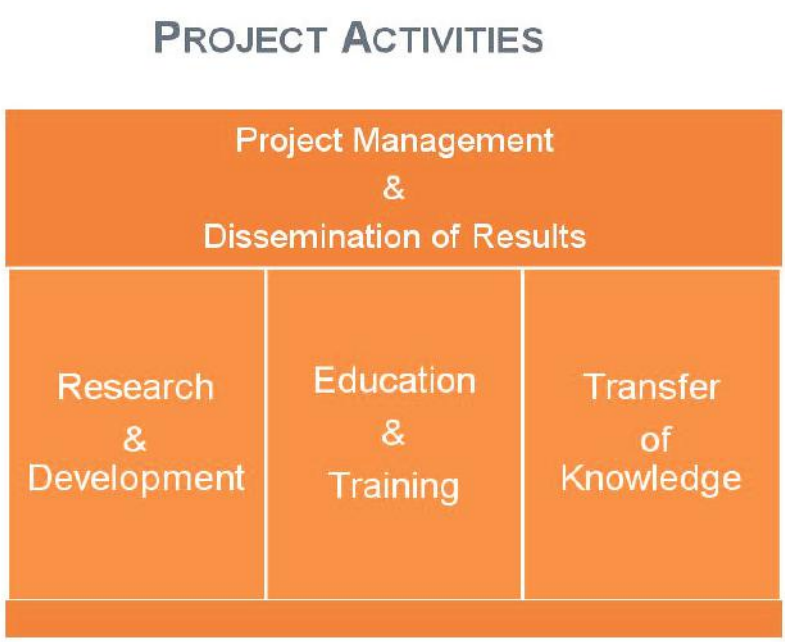

Chart 2.

planned to be implemented:

• Creation of a scientific research laboratory for visualization and numerical simulations.

• Creation of software infrastructure models for simulation and software design on the basis of processes.

• Pilot application of the created models in different economic sectors.

The training and education activities have been logically divided into university education and professional training. The education activities focus on the preparation of student exchange programs, launching of new courses and a master program, and establishment of a PhD school. The target groups of training activities on the other hand include students, professionals, experts from small and medium-sized enterprises, political and industrial decision-makers. The training concept is to focus on the newest technologies and methodologies, which will lead to significant improvement of the level of trainee skills. So far, a couple of Erasmus exchange visits with some of our Western Universities Partners have been implemented. Also, a preliminary review on the status of relevant courses in the higher Bulgarian educational institutions has been conducted, and some preparatory activities for the joint master and PhD programs have been started.

It is worth noting that the training activities have been oriented to achieve clear public benefits. By providing trainings in the state-of-the-art technologies, the centre is building capacity of a highly skilled work force. The latter is going to be well prepared to work for big public platforms such as e-government and e-health, by thus reducing the costs for their implementation.

Finally, the knowledge transfer activities aim at strengthening the public effect of SimPro's work. They target establishing partnerships with the industry and government, identifying their needs for innovative solutions, and commercializing project results. The forms of cooperation include conducting workshops and seminars, launching joint initiatives, developing show cases for industry giants, etc.

It is expected that the results of project activities will have their effects on three broad levels. First, on university level, the project aims at boosting research in the subject area under consideration, creating a pool of academics with shared understanding and beliefs, and providing stimuli for young scientists to work and study at the centre. At national and regional level, the project has committed to establish itself as an innovative centre of excellence and strengthen the country's capacity in the fields of business processes and simulations. Further, the project is trying to launch a good practice of cooperation between the academia and the business, which

may be replicated in the future. Last but not least, at European level, the project is contributing to the achievement of the goals of the Lisbon agenda as well as to the development of knowledge economy.

The sustainability of project results is going to be pursued in a couple of ways. First, it is ensured by the SimPro founding partnership, which guarantees the centre support by both university and business resources. Secondly, SimPro has formed an EU Projects section, specialized in identifying new project opportunities and developing relevant applications. Thirdly, the centre is going to explore the possibilities to commercialize its research findings, which will be done with the purpose to ensure economic sustainability of its results.

PARTNERHSIP DEVELOPMENT STRATEGY

No matter that it is in the early months of its establishment, the centre has elaborated a clear partnership development strategy with the purpose to position itself as an innovative player, to focus and sustain its efforts, as well as to incorporate the interests of various stakeholders.

SimPro is open to establishing partnerships with key entities such as:

• High technology companies: the centre is interested in giving its students access to the latest technological developments. What it can offer is the back up of its human, knowledge and technical resources, elaboration of show cases and conduction of trainings.

• Other European research institutes specialized in business processes, simulations and virtual reality: SimPro is interested in launching joint research initiatives with European partners in order to enrich its research expertise and implement value added projects.

• Bulgarian ICT companies: SimPro aims at developing high-level local knowledge which to disseminate in the Bulgarian ICT sector with the purpose to achieve its public goals. The companies from the Bulgarian ICT sector are natural partners in implementing the project results.

• The Bulgarian government: SimPro has streamlined its efforts into developing highly qualified expertise which can be applied in the form of consulting assignments to different public projects.

• Other stakeholders such as representatives of other vertical markets and industrial leaders.

The establishment of key partnerships is at the core of SimPro's development vision. It is believed that this is one of the possible ways in which the centre may advance its full potential. The ultimate goal of the centre is to establish itself as a competence centre uniting academic excellence and business entrepreneurship.

A COMPLEX SCIENTIFIC–EDUCATIONAL CENTER FOR GEOLOGY AND GEOPHYSICS AT THE UNIVERSITY OF MINING AND GEOLOGY "ST. IVAN RILSKI"

Radi Radichev, Strashimir Strashimirov, Stefka Pristavova, Stefan Dimovski, Nikoleta Tzankova

University of Mining and Geology "St. Ivan Rilski", Studentski grad, 1700 Sofia, Bulgaria

INTRODUCTION

The increased interest of the society in problems of the Earth sciences reflects in the fact that the period 2007 - 2009 is announced by the United Nations and UNESCO as "Triennium of the Earth". It is dedicated to the modern development of Earth sciences and their importance for further development of human civilization. The extreme actuality of the problematics is a result of some rather negative tendencies in misbalance between exploration and consumption of mineral and energy resources, that reflect in very significant increase of the price of large number of metal and energy resources in the world market in recent years. Exploration and extraction of mineral and energy resources as well as geological-geophysical estimation of natural hazards in different regions is no doubt

in the base of modern development of human civilization and disparage of them will cause serious problems and challenges in the nearest future. Decreasing in geological and geophysical studies and reduction and closing large part of mining industry in Europe caused some serious problems in supplement with mineral and energy resources for industry. The same tendency is valid for Bulgaria as well, where the negative tendencies in this branch were intensified by the specific difficulties of the transitional period from centralized to market-orientated economy.

The project supported by the National Scientific Found integrates scientific disciplines that study natural geological objects at least in four different aspects of the Earth Sciences - petrology, ore mineralogy, gemology and applied geophysics. The base for the integrated characteristics of studies is the necessity of solving not traditional tasks related to the complex exploring of natural resources, prospecting of deep-seated mineral and energy resources, increased requirements in estimation of geological hazards, implementation of interdisciplinary studies in relatively new branches of sciences such us geoarcheology, archeogemology, ecomineralogy and others.

The main aim of the project is to create a new Center for complex geological and geophysical studies, which could be used either in scientific researches or in training students in the University of Mining and Geology "St. Ivan Rilski".

Academic education and researches in geology and geophysics at present are performed in Faculty of Prospecting geology at the University of Mining and Geology "St. Ivan Rilski", Sofia University "St. Kliment Ohridski" and fundamental researches and training of PhD fellows is also performed in units of the Bulgarian Academy of Sciences. Geological and geophysical studies are realized mainly in two directions - research projects financed by Bulgarian or foreign funds and more practical tasks related to the practice of geological and geophysical companies operating in the country (such as State Enterprise "Radioactive Waste", "Geoprecise Engineering" Ltd., "Balkan Mineral and Mining" Ltd. and others). Gemology is a relatively new branch of geology, which is recently included in curriculums for master level in programs of UMG "St. Ivan Rilski", SU "St. Kliment Ohridski" and New Bulgarian University.

In some cases teams including colleagues from different institutions are organized ad hoc for developing some specific projects, but in general, complex geological-geophysical researches are not large due to the limited sources of financing in the recent years.

UMG "St. Ivan Rilski" is a well-known educational and scientific center for education of engineers in geological, mining and electromechanical specialties, providing fundamental and applied researches, and it offers all forms of post-graduate specializations. Well-balanced combination of fundamental engineering training with much specialized knowledge and skills give possibilities for realization of our students in the country and abroad. Over 15 000 engineers in geology, geophysics, mining, as well as in civil and industrial engineering, environmental protection have graduated from our university during the years. Citizens of about 40 countries from Europe, Asia, Africa and South America are also graduates of our University.

The intensive development of research methods for studying geological and geophysical processes in the last years in the world is not adequate to the old devices and apparatuses used in many Bulgarian laboratories. The main laboratories in UMG "St. Ivan Rilski" cover a large part of the spectrum in engineering Earth Sciences and in order to provide high quality of education and researches in the mentioned above fields their modernization is obvious.

SCIENTIFIC TASKS

The ecological usage of mineral and energy resources is the base for development of modern human industry. Contemporary increasing scale of material production needs increasing of the knowledge of natural geological processes. Geological and geophysical studies are the basis for exploration and prospecting of mineral and energy resources, studies of deep parts of Earth's crust, tectonic zonation, evaluation of geological hazards in realization of civil engineering projects, evaluation of polluted areas and recultivation of the environment and others.

In the Earth Sciences, optical and geophysical diagnostics of natural objects are basic studies,

which form the core of several main disciplines that are taught in the University of Mining and Geology "St. Ivan Rilski". Proposed complex Center will cover a large spectrum of geological and geophysical studies of minerals, rocks, ores and synthetic materials for determination of their characteristics and perspectives as potential mineral resources. Special attention will be paid to studies of synthetic minerals and materials as one of the very dynamic sectors of modern technology.

The proposed project for creation of a complex scientific-educational Center for geological and geophysical researches at the Faculty of Prospecting Geology at UMG "St. Ivan Rilski" will be realized by the academic staff of several leading departments in the Faculty - "Mineralogy and Petrography", "Geology and Prospecting of Mineral Resources", "Applied Geophysics" and others. The existing equipment in University's laboratories for optical and geophysical studies as a rule is old-fashioned and not effective according to modern requirements. Delivery of highly effective modern devices will allow developing of scientific studies on adequate contemporary level and will support training of qualified future specialists.

The main task of the complex scientific-educational Center for Geological and Geophysical Researches is complex studies of the substrate that forms upper parts of the Earth's crust using various (geophysical, petrological, ore-mineralogical and gemological) methods.

Scientific studies in petrology and ore mineralogy include:

- microscopic studies of the main genetic rock types - igneous, sediment and metamorphic;

- microscopic studies of metasomatic types of hydrothermal alterations and determination of their facial characteristic and relations with the potential ore mineralization;

- studies of mineral composition of metal and industrial mineral resources, their texture and structures for determination of their genesis and technological methods for their processing;

- studies of archeological artifacts - ceramics, petrological characteristics of archeological objects, etc.

Tasks in the field of gemology are in close relation with other geological sciences (mineralogy, crystallography and others), but there are also significant differences because scientific methods and techniques should not destroy the studied object or change its features. This determinates the need for specific devices for diagnostics of the studied material.

The scientific tasks of gemological laboratory include:

- determination of the type of gemstones studied;

- determination of its genesis - natural or synthetic;

- determination of the presence or absence of additional processing of the material through coloring, radiation, thermal or chemical treating;

- diagnostics of composite stones - doublets and triplets.

Scientific tasks in the field of applied geophysics include:

- studies of petrophysical features of rocks:

• measuring density of samples (by classical scheme with densitometer);

• measuring the magnetic susceptibility by field and laboratory measurements using kappameter;

• measuring the specific resistance of parallelepiped-shaped and cylinder-shaped samples by dual-electrodes resistivitymeter;

• measuring the cross (P) and share (S) velocity of elastic waves for solid parallelepiped-shaped and cylinder-shaped samples.

- applying geophysical methods for the needs of:

• searching and investigation of mineral resources and fossil fuels;

• engineering geology, hydrogeology and construction;

• ecology and archeology.

- studying the applicable complex of geophysical methods to solve prognostication problems.

- design of geo-geophysical models and adapting them to precise conditions in order to produce and analyze geophysical anomalies.

The complex scientific program that reasons the need for creating such a centre is based on the necessity of integration of geological and geophysical studies in the process of solving dif-

ferent scientific and practical problems. The precise determination of the petrophysical characteristics of minerals, rocks and ores is in tight connection to their accurate petrographic and mineralogical definition. This integrated approach requires the choice of real nature etalon objects on the area of which the complex of field and laboratory geophysical studies to be applied. In the proposed project the methodology of such a type of investigations will be probated and later it can be applied in different regions of the country.

A geological-geophysical surveying of the Panagyurishte Ore Region is proposed in the presented project as a model study. It will be performed after the delivery of the main part of the required equipment and will take place in the second half of the project time schedule. In the spread of the Panagyurishte Ore Region three etalon areas will be selected in which a representative number of rock and ore samples will be collected (20 samples for each etalon area). These samples will be subject of detailed mineralogical, petrographic and geochemical studies. Laboratory geophysical parametrical studies will also be performed over the collected samples. In the three etalon areas specialized geological-geophysical profiles will be surveyed in order to establish the interconnection between the metasomatites, the ore mineralizations connected to them, and the deep ore-generating structures. These compound studies will be summarized in complex geological-geophysical maps, containing information about the anomalies tied to different types of ore mineralization.

As a final result of the accomplishment of the proposed project atlases of different rock types and metasomatic changes and their geophysical characteristics will be developed. This result will contribute new information to the present knowledge about geological and geophysical peculiarities of the region and will help the solution of future scientific and practical problems connected with estimation of perspective areas in the region.

The approbated model will be used as a base for a complex scientific program that afterwards can be developed on the territory of other ore regions in the country (Bourgas Ore Region, Strandzha-Sakar Ore Region, Central Rhodopes Ore Region, etc.)

EDUCATIONAL TASKS

The main educational task of the Center is to improve the training process and current research studies with fundamental and interdisciplinary characteristics, modernization of the existing and creating of a new laboratory base for further development and innovation in optical and geophysical studies of minerals, rocks and ores, according to the world tendencies in academic education and in training of highly qualified specialists with respective competencies and complexity in research work.

It is expected that in the proposed Center will be trained: students on Bachelor and Master levels in the University; postgraduate fellows from the university and from other institutions in Bulgaria, such as Sofia University "St. Kliment Ohridski", institutes of the Bulgarian Academy of Sciences or students and graduates specializing in UMG under programs within the frame of Socrates program or other European programs.

Academic staff from UMG "St. Ivan Rilski" will cover the main teaching and research activity of the Center, but it is expected that colleagues from Sofia University "St. Kliment Ohridski", Geological and Geophysical Institutes of BAS, Central laboratory for mineralogy and crystallography "Acad. Ivan Kostov", National museum "The Earth and Man" will also be involved and use the Center facilities. The Center will be open for students and graduates from Sofia University "St. Kliment Ohridski" and New Bulgarian University in periods according to the possibilities within the frame of the academic year, vacancies and summer period.

EQUIPMENT

Delivery of the equipment will be organized according to the plan for project development within the frame of three years.

Optical equipment includes polarised microscopes for transmitted light for training and research purposes, polarised microscopes for transmitted and reflected light for training and research purposes; polarised microscope for transmitted and reflected light for research purposes; digital cameras for trinocular microscopes.

Geophysical equipment includes proton

memory magnetometer (one as base station magnetometer plus one for field measurements); portable relative gravity meter.

Gemological equipment will cover gemological microscopes; refractometer; spectroscope; dichroscope; polariscope; gem filter set; diamond testers; all purpose loupe, tweezers and etalone kits; additional accessories.

The devices supplied will be fitted and probated with the support of supplying company consultants according to the contracts, which will organize initial training of colleagues that will work with these devices. Additional training for work with devices in gemological apparatus is proposed in a specialized course organized in the International Gemological Institute in Antwerp, Belgium. It is obvious because since now in Bulgaria complex licensed training in diagnostics of diamond and colored gemstones is not offered.

Creation of special additional guidebooks, atlases, monographies, digitalized maps and other materials that will be used in student training and research work realized in the Center is proposed as a function of the Center. New atlases of textures and structures of the main genetic types of rocks and ores, products of metasomatic processes and others will be prepared on the basis of material collected by the team that will realize the proposed project. New proper materials for visualization and distance education of important topics will be done on the basis of these sources as well.

PILOT RESEARCH STUDY

After supplement of the main devices in the Center, the team which works on the project will perform a special research task that includes complex geological and geophysical study of real geological object. Panagyurishte ore region is proposed as a suitable geological object because it offers good possibilities for combining mineralogical, petrological and ore studies with geophysical investigations. Some studies in this field were done in the past and they reflect an earlier period of studies in this region. It is expected that the possibilities of the complex Center and recent studies will give more detailed understanding of the geology of the area, which is adequate to the modern level of geological and geophysical studies.

The studies will be directed to the correlation between detail diagnostics of rock and ores with respective petrophysical characteristics established by methods of geophysical research. Object of studies will be typical fresh and metasomaticaly altered rocks from representative deposits located in northern part of the region (porphyry-copper deposit Elatzite, epithermal copper-gold deposit of Chelopech), central part (porphyry-copper deposits Medet and Asarel) and soutnern part (epithermal copper deposit Elshitza and porphyry-copper deposit Vlaykov vrah). Geophysical measurements will be done on real ore bodies and data obtained will be compared with data obtained during the exploration of deposits. Results will be probated on perspective areas and proper geological-geophysical models will be prepared to suggest new "blind" ore bodies.

The new Center and the establishment of its possibilities during realization of the above-mentioned studies will allow participation of the team in preparation of larger research projects within the frame of Bulgarian and European programs. Enlarged possibilities for modern training in the Center will be attractive for involving students and postgraduates from the neighboring countries and other European countries, as well.

EXPECTED RESULTS FROM CREATION OF THE CENTER AND POPULARIZATION OF ITS ACTIVITIES

During the project realization a web page on the Internet will be created, where development of the project will be presented. By the end of the three-year period proper materials - as flyers, posters, etc. will be prepared that will be distributed between the potential partners of the Center and other institutions in Bulgaria and Europe that will be interested in its activity, which will advertise its possibilities. Information about the Center will be included in all printed and electronic materials that are prepared in the university for the purpose of advertising.

Presence of the new equipment and integrated activity of specialists from different branches in Earth Sciences is proper basement for realization of complex and modern research works of fundamental and practical types. Possibility for direct connection between training

and scientific studies is expected through involving students and postgraduates in development of different scientific projects.

Creation of a new gemological laboratory as a part of the proposed Center will give possibility to educate qualified specialists in diagnostics of gemstones, which are very limited in the country till now. They could realized their knowledge as professional evaluators in banks and insurance companies of precious and semiprecious stones, design and production of jewelry, study of properties of synthetic materials with or without analogues of natural minerals, imitations and methods of beneficiation, training in these fields.

Taking into account the possibilities for combining geological, geophysical and gemological methods and new possibilities for interpretation of obtained results, it is useful to prepare suitable handbooks which will support students during their training and they will provide necessary knowledge about modern methods in their training.

The proposed project for a complex scientific and training Center for geological and geophysical studies is harmonized with the strategy of the University for further development of training in the fields of engineering geological specialties and creation of suitable atmosphere for further specialization of postgraduates, PhD fellows and young scientists. The University has highly qualified lecturers and researchers - mineralogists, petrologists, regional geologists, geophysicists, specialists in mineral and energy resources which could be involved in the future activity of the center.

The proposed new database with guaranteed access to specialized scientific library, teaching and etalon collection and specialized software will be very useful for students and young scientists. This database will be in direct contact with the other departments in the university and similar units in Sofia University "St. Kliment Ohridski", institutes of BAS and other organizations with which transfer of information and data is possible.

The new equipment will support the increase in quality of practical training of students and their formation as qualified specialists in their specialties, which will reflect in their professional realization. It is expected that diploma thesis prepared in the Center will cover actual scientific topics with practical application. The Center will stimulate mobility of students and postgraduates from other universities in the country and abroad.

During a long period UMG "St. Ivan Rilslki" has developed many fruitful contacts with similar universities and scientific institution in the country and abroad. It should be mentioned on the first place the scientific contacts with colleagues from Sofia University "St. Kliment Ohridski", Geological Institute, Geophysical Institute and Central Laboratory in Crystallography and Mineralogy at Bulgarian Academy of Science, National Museum "The Earth and Man", as well as Leoben University (Austria), Brandenburg Technical University in Cottbus (Germany), University of Oviedo (Spain) and other European universities. Academic society in our University realized many projects with Bulgarian and foreign partners mentioned above under Bulgarian or European programs.

Creation of the complex Center will contribute to extension and development of traditions in trans-institutional and international cooperation of UMG "St. Ivan Rilski". The enlargement of contacts no doubt will be very useful as a proper environment for development and professional specialization of the young members of the academic society in Faculty of Exploration Geology as well as for other departments in the university such as Mineral Processing and Recycling of Waste Products, Underground Mining, Open Pit Mining and others. The Complex Center is expected to develop proper scientific contacts with laboratories and departments with similar profile initially with our traditional partners and later with some new partners in the country and Europe. The Center will provide opportunity for students, PhD fellows and young scientists from the university as well as from other scientific organizations and partner universities from the country and abroad to realize studies related to their practicum, diploma and doctoral thesis.

The proposed Complex Center has high potential for collaboration with geological, geophysical and mining, civil-engineering and other companies, which realize projects in Bulgaria and abroad. Increased interest during the recent

Students trained to work with new gemological microscope

Students trained to work with geophysical equipment

years to prospecting and exploration of mineral and energy resources, implementation of new administrative requirements for evaluation of geological hazards and geoseismical hazards as well as the need of highly specialized scientific researches in solving these problems are very favorable predictions for expected high grade of integration between the scientific researches that will be realized in the Center and the practical needs of industry.

On the other hand, realization of mutual projects with companies from industry is the natural field for beneficiation of training of students and PhD fellows and for preparation of scientific publications with colleagues from industry. This is a very suitable way for distribution and transfer of contemporary knowledge from academic society to the practical sphere and for realization of geological and geophysical studies with scientific and practical characteristics.

It is proposed to design a system for tracing the realization of graduates and close contacts with companies where they are employed. In this field the Center will work together with the mission of the Center for professional career development at the University is to support students in finding proper job and to support companies from industry in finding motivated and qualified young specialists.

The Center will offer short time qualification courses for additional qualification of specialists from industry, which fits to the European strategy for long-life learning process. It is expected that companies in geology and geophysics will use the facilities of the Center for additional qualification of their specialists and realization of specific tasks related to their activity. Distribution of the results of the project and possibilities of the new Center will be realized as follows: preparing materials about the facilities of the Center; preparing and periodically actualization of the web page of the Center; creation and actualization of a list of addresses of potential universities and institutions to which general and specialized information about the Center will be sent (by Internet or as paper materials).

The opening of the Center will be accompanied by proper presentation for universities, companies and other potential partners, which will advertise its facilities. Invitations to mass media and specialized geological and geophysical magazines will be sent for this presentation as well.

The Center facilities and the new teaching materials will be included in all materials that advertise our university. The teaching materials will be used directly in lectures and seminars during the process of education. Results from the realized scientific task about the Panagyurishte ore region will be presented to the geological and geophysical societies at proper scientific forums and the most significant results will be published in Bulgarian and foreign magazines. It is expected that the complex approach used in these studies will be implemented by other teams that work on similar problems. The facilities of the new gemological laboratory will be presented to potential customers, such as trading companies, insurance companies and others, the activity of which is connected with evaluation and diagnostics of precious and semiprecious gemstones. The above-mentioned activities for distribution of results are expected to continue after the end of the project.

MADE IN BULGARIA WITH EUROPEAN SUPPORT

DEVELOPMENT OF A NEW TECHNOLOGY FOR PET COMPATIBLE WITH MRI

Nevena Ilieva[2], Venelin Kozhuharov[1], Iglika Lessigiarska[1], Leandar Litov[1], Stoyan Markov[3], Borislav Pavlov[1], Peicho Petkov[1]

[1]Atomic Physics Dept., Faculty of Physics, University of Sofia "St. Kliment Ohridski"

[2]Institute for Nuclear Research and Nuclear Energy, Bulgarian Academy of Sciences

[3]Institute for Parallel Processing, Bulgarian Academy of Sciences

Abstract

RPCPET is a multidisciplinary project which integrates physics and device-and-information-technology areas for the development of a novel hybrid imaging system, which combines Positron Emission Tomography (PET) with Magnetic Resonance Imaging (MRI) and provides non- and minimally invasive quantitative methods for diagnostics and therapy. The system is based on a novel technology for gamma-quanta detection which makes use of gas-operated Resistive Plate Chambers (RPC), modified for the detection of gamma rays. The RPC excellent position resolution for the gamma quanta impact point and the time-of-flight measurement accuracy will allow reconstruction of the image with precision better than 1 mm. The ability of RPC to work in strong magnetic fields makes possible the combination of PET and MRI in a single device. The moderate price of the RPC allows the construction of scanners with both essentially larger field of view (FOV) and higher sensitivity, and in the same time - with a significantly reduced radiation exposure.

Scientists and specialists from the Faculty of Physics of the University of Sofia "St. Kliment Ohridski" (leading organization), Institute for Nuclear Research and Nuclear Energy and Institute for Parallel Processing of Bulgarian Academy of Sciences and Imaging Diagnostic Department of Tokuda Hospital - Sofia take part in the project. The project is supported by Bulgarian National Science Fund.

THE SCIENTIFIC TOPIC, PET AND MRI BASICS

Technological improvements in medical imaging in the past two decades have enabled the creation of high-resolution images of the human body and its internal structures. Good image quality yields more accurate case information, which allows better clinical decision making. Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Positron Emission Tomography (PET), and Single Photon Emission Computed Tomography (SPECT) are clinically established imaging modalities. Among them, CT and MRI provide high spatial and tissue resolution but with limited physiological information, while SPECT and PET can provide physiological information, but with poor spatial resolution.

PET is a nuclear medicine imaging modality for registration of the whole-body distribution of positron-emitting biomarkers [1, 2]. The invention of PET dates more than 30 years back but its acceptance as a routine clinical diagnostic tool has been detained by the need for an on-site cyclotron for production of the short-lived radiotracers. The number of PET centres now totals more than 2000 worldwide. PET uses γ-rays produced by positrons annihilating with electrons. Different positron emitting forms of common elements with a short half-life, such as

^{11}C (~20 *min*), ^{13}N (~10 *min*), ^{15}O (~2 *min*), and ^{18}F (~110 *min*), are used to mark biologically active molecules participating in the investigated process. When injected, these radionuclides or radiopharmaceuticals undergo β+ decay; the emitted positrons pass some minimal distance in the body before an annihilation with a body electron takes place, resulting in the production of pairs of 511 *keV* γ-quanta emitted simultaneously at nearly 180°. The PET scanner is a ring, consisting of a large number of scintillating crystals, in which the γ-quanta generate light, registered by photomultiplier tubes (Fig. 1). The acquired information allows one to determine the metabolic activity of living cells.

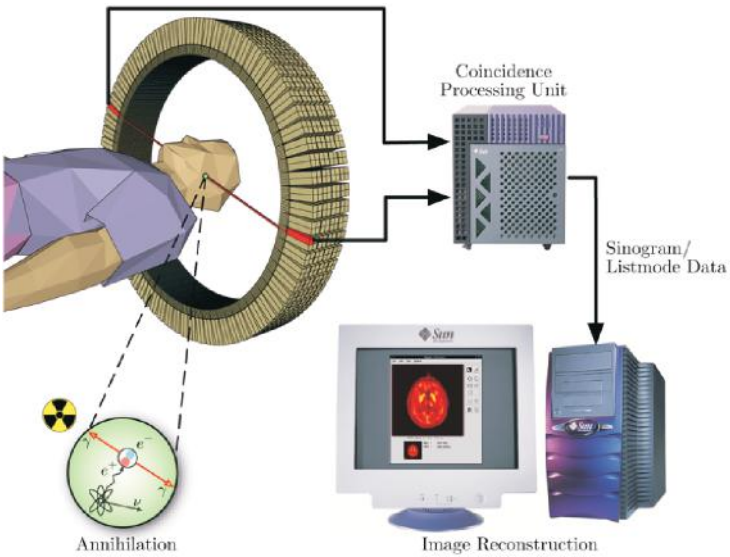

Fig. 1. PET-process: a schematic view

Unlike x-rays, CT and PET scans, which use radiation, MRI uses powerful magnets and radio waves [3]. The magnetic field produced by an MRI is about 10 thousand times greater than that of the Earth. It forces hydrogen atoms in the body to line up in a certain way. The response of the lined-up atoms to radio waves depends on the type and functionality of the tissues and by reconstruction produces an image of the examined structure. One exam produces dozens or sometimes hundreds of images - the MRI signal has a greater information density than is available through any other imaging modality. MR images can use this increased information density to provide multiplanar high-spatial-resolution anatomic images with excellent soft-tissue contrast [4]. The potential of MRI goes beyond anatomic imaging and already encompasses functional investigations, such as the processes of brain activation, the energy status of the myocardium, membrane expansion, etc.

STATE-OF-THE-ART: PET/MR IMAGING HYBRID PROTOTYPES

Multimodality image registration and fusions play an increasingly important role, as the selected modalities mutually compensate their stand-alone disadvantages. A well developed hybrid modality is the combination PET/CT. Although it has shown its clinical value, it still bears some limitations, not the least being the relatively high radiation exposure of the patients during the CT [5, 6].

The combination of PET and MRI is a perfect match, because each can provide unique information not attainable with the other. However, biologic systems are inherently dynamic and sequential PET and MRI does not permit temporal correlations of the individual examinations. The fusion of these two excellent diagnostic tools into a single scanner will improve diagnostic accuracy by facilitating precise registration of molecular aspects and metabolic alterations of the diseases with exact correlation to anatomical findings and morphological information, with registration of the process dynamics and of the temporal correlations in the tissue response. Therefore, it is considered by many experts to be a major breakthrough that will potentially lead to a paradigm shift in health care and revolutionize clinical practice [7].

While there are weighty advantages in creating a combined MRI/PET scanner, there are also some significant obstacles to this melding [7]. The major difficulties come from the strong static and gradient magnetic fields required for MRI, as they degrade the performance of standard photomultiplier tubes (PMT) used in most PET. The result can be a reduction or even a complete loss of the device response to radiation. Thus, a combined PET/MRI scanner, based

on photomultiplier tube detectors, can be realized only by means of optical fibres transporting the scintillation light outside the magnetic field fringe. This causes light losses, resulting in degradation of energy and timing resolution, and in complicated design. Also, the extent of the FOV of an optical-fibre based PET/MRI system will always be limited.

One solution to this challenge is the replacement of PMT with avalanche photodiodes (APD), which are solid-state devices with a lower gain than PMT. They are relatively unaffected by the presence of magnetic fields but have relatively low signal-to-noise ratio, problematic short- and long-term operational stability, and the temperature dependence of their gain. Despite these technical challenges, combined MRI/PET scanners based on the APD technology have been proposed [8, 9]. However, to produce a human PET one needs approximately 60 000 crystals and APD for 30cm FOV, the number of channels being somewhat reduced with position-sensitive avalanche photodiodes (PSAPD) [10].

In March 2008 two groups reported first successful tests of combined PET/MRI scanners for small animals [6, 11, 12]. These tests confirm in principle the possibility to construct such a device and its diagnostic advantages, however the remaining step to the human scanner is by far not trivial.

THE AIM OF THE PROJECT

Development of detectors for PET is an excellent example of translational research from physics to life sciences and medicine. It rests upon an adapted migration of technologies, originally developed for high energy physics experiments, into prototype PET detectors, scanner systems and finally - for a few of these - to commercial scanners. The importance of this diagnostic method and the objective physical and technological difficulties boost the research activities in this field. The problem is that there are

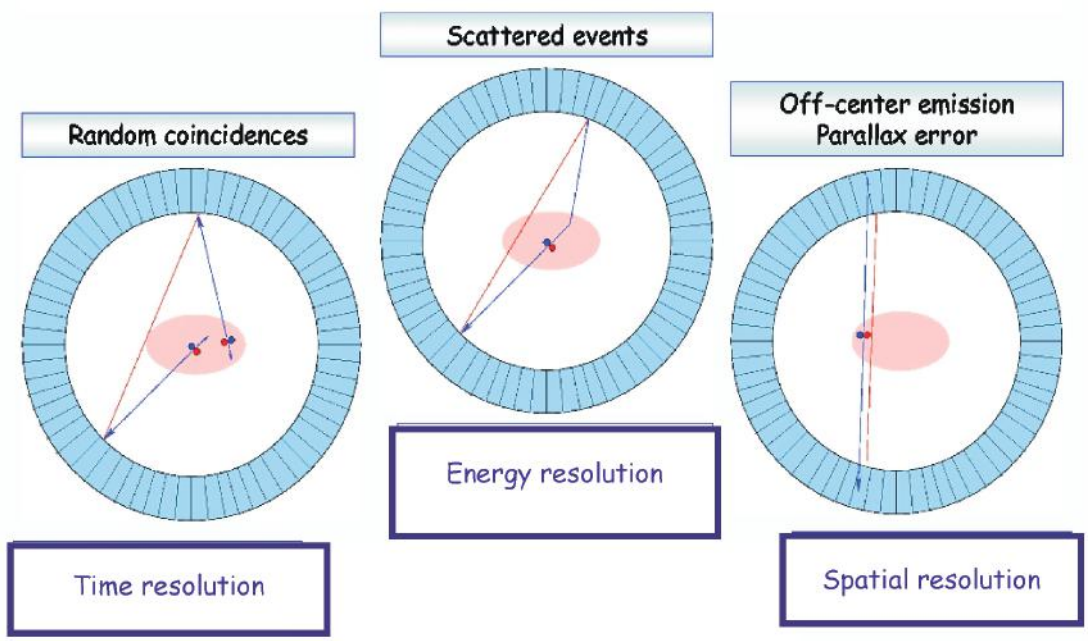

Fig. 2. Error sources in PET image reconstruction

physical limitations in the PET image reconstruction accuracy, Fig. 2. First, there are random coincidences, when two photons from different annihilation events are detected "simultaneously". The number of detected random photon coincidences is proportional to the detector time window (the time period in which two registered photons are considered originating from the same annihilation event), thus it is determined by the detector time resolution. Next, the photon scattering in the human body may cause a false determination of the line on which the annihilation takes place. This error is proportional to the detector sensitivity to photons with energies

lower than 511 *KeV*, therefore effective suppression of these photons is crucial. Finally, the so-called parallax error heavily depends on the detector space resolution as it accounts for the final size of the individual detector elements (the detector "point").

Most of the efforts in the development of PET detector technologies are focused on scintillator-based detectors, as described above; however various alternatives continue to be considered, among them wire chambers and - more recently - various solid-state devices in PET detector designs for very high spatial resolution applications.

The aim of the RPSPET project is the development of a PET scanner for human-body imaging, based on Resistive Plate Chambers (RPC) [13]. These are gaseous parallel plate detectors, at least one of the plates having a large specific resistivity (10^{10}-10^{11} Ωcm). The gap between the plates, of the order of millimetre, is filled with gas. The external surfaces of the plates are covered with conducting material, thus applying high voltage on them, a strong electric field (50-100 *kV/cm*) is created in the gas. The detector signal is formed by the ionization avalanche generated in the gas by the investigated charged particle. RPC's main advantages are high time and spatial resolution and the ability to work in strong magnetic fields. Nowadays these detectors are widely used in large-scale high energy physics experiments as fast trigger detectors for muon spectrometers. The project team includes groups from the "St. Kliment Ohridski" University of Sofia and two academic institutes with extensive experience and expertise in the design, construction, cosmic tests and installation of the RPC muon trigger system of the CMS experiment - one of the two general-purpose detectors at the LHC accelerator at CERN.

A modification of the RPCs has been suggested in [14, 15], opening the way for their application in PET systems, that is - as gamma quanta detectors. The idea is to choose appropriate materials for one of the electrodes, thus transforming it into a gamma-quanta converter, as photon interactions cause electron ejection. In the single-gap detector design there is one converter-gas structure, in the multiple-gap design there are several converter-gas gaps. The schematic RPCPET design is shown on Fig. 3. Based on [16], a small PET system with timing RPC technology has been built and tested [17]. The tests confirmed the expectations from the simulations, the system revealing a space resolution of 0.6 mm FWHM without optimization of detector parameters.

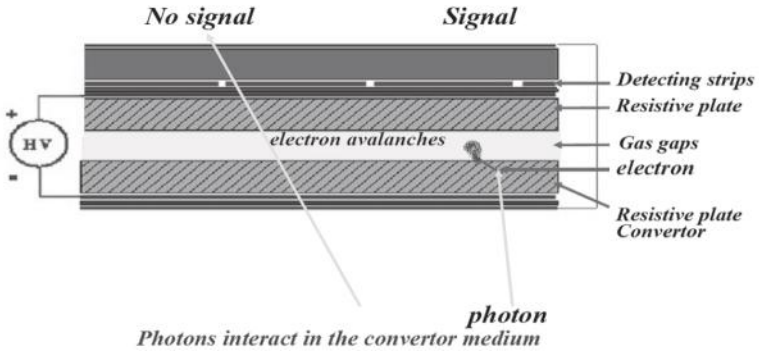

Fig. 3. Principle scheme of a photon-registrating RPC

To summarize, RPC-based PET detectors can compete favourably with the commercially available scanners which use different crystals and different light-collecting methods and whose parameters vary with the model and price:

• ***Random coincidences***

The RPC can easily reach sub-nanoseconds resolution (tens of picoseconds) and time coincidences within a few nanoseconds, against the best available so far time resolution from 650ps to few nanoseconds.

• ***Scattered photons***

In the RPC, the fraction of detected photons increases by a factor of 4, going from 200 *keV* to 500 *KeV*, while for scintillating crystals the efficiency constantly decreases with energy starting from 100 *keV*. This means that a crystal is "well" sensitive to low energy photons which in PET system are considered as a background. In the case of RPC based detector the efficiency for registration of low energy photons is considerably suppressed, ensuring in this way an effec-

tive background cut-off.

• ***Parallax error***

The best available scanners offer spatial resolution of about 4 *mm*; with the RPC based PET detectors the latter can easily be improved up to 1 *mm*. Actually, this is the absolute physical limitation: the emitted positrons have non-zero energy and momentum and travel some distance (called positron range) in the tissues before the annihilation. The positron range depends on the body tissue and the radionuclide but in general is of the order of 1 *mm*.

The above arguments apply already for a stand-alone PET scanner (In fact stand-alone PET scanners are no longer in use. The necessary complementary information is gained through a CT, the two scans being performed consecutively, with all disadvantages of such a procedure (long duration, unavoidable changes of the body position, high radiation exposure, impossibility for investigation of process dynamics and time correlations, etc.)). Consideration of the hybrid PET/MRI modality puts forward additional important advantages of the RPC-based PET scanners:

• As repeatedly emphasized, RPC are able to work in strong and gradient magnetic fields, characteristic for the MRI environment. This makes redundant the complicated optic-fibers system for transportation of the PET signal outside the magnetic field;

• The best available human PET scanners have FOV of about 15-25 cm, limited both by the complications in the construction and by the exploding cost. RPC can be easily implemented over large area, thus an increment of the field of view without divergent costs seems to be possible. In this way, one can significantly increase the counting rate that depends on the square of the FOV with a gain in the global sensitivity of the system.

• Last, but not least, are the expected costs. The price of such a hybrid scanner can only be estimated so far. According to [7], it should be above the price of a combined PET/CT scanner, that is - above 2 mln. USD. With the crystals-APD construction in mind, this esteem is even too low: to produce a human PET one needs approximately 60 000 crystals and APD for 30 cm FOV. According to recent publications on this research [10, 18] and on the present market prices of the APD-detectors, the device to be inserted in the standard MRI would exceed the 2 mln. Euros mark and still would be in the 2 mln. Euros range with PSAPD, for the PET system alone. With an RPC-based PET scanner, these costs might be reduced to 1 mln. Euro mark.

The first project objective is the construction of an RPC-based PET scanner with time resolution of about 30 *ps* and spatial resolution of about 1 mm. Being able to cover larger areas, it should provide an increase of the FOV up to 1 m, thus making possible a simultaneous whole-body scan, which essentially reduces the radiation dose for the patient and the duration of the examination procedure.

Our supreme goal is to design a detector, being able to work together with MRI, i.e. along with strong static and gradient magnetic fields and powerful radiofrequency pulses. This hostile environment imposes special requirements on the materials used for detector construction, gases, and on-detector electronics. A wide R&D program, including investigation of the detector properties inside the working MRI is envisaged.

MAIN PROBLEMS AND RESEARCH STAGES

The project objectives determine separation of the activities into three individual work packages:

Detector design work package is devoted to the design and construction of a gamma detector based on RPC optimized for the purposes of the positron emission tomography, and to the demonstration of its ability to work concurrently with a MRI system. The necessary steps for developing a successful prototype include the design of the detector construction, study of different materials for optimization of the detector photon efficiency; design of the complete detector and the prototype tests. Based on the outcome of these tests, modifications of the preliminary design might be needed. An important point is to build a two-prototype set to work as a single PET detector, in order to develop the event reconstruction algorithms. Tests will be done in close-to-real PET environment together with MRI at Tokuda hospital. Based on the obtained results the final technology for the RPC-PET will be chosen.

Software work package is dedicated to simu-

lation of the complete detector complex, including the investigated object, and to reconstruction, analysis and presentation of the events. The interactions of gammas inside the body will be studied and the corresponding corrections for scattering and absorption will be calculated. The entire detector will be described and its response will be investigated in the simulation.

Hospital work package comprises the work to be done at Tokuda Hospital. For the success of the project the availability of working PET and MRI facilities is of crucial importance, which makes the hospital participation in the project activities indispensable. The facilities will be initially used to verify the simulation of the gamma transportation through the body and then to test the constructed RPC-PET prototype. Some additional infrastructure necessary for the detector-operation will be built at the hospital as well.

The first stage of the project work comprises simulations directed on the detector design, the simulation of gamma transportation and the detector response with the use of a computer farm.

The read-out electronics for the prototypes, HV, LV and gas systems will be based on solutions and systems designed for the LHC experiments [19], but dedicated DAQ and Trigger systems will be developed.

Stand-alone RPC PET prototype will be constructed and thoroughly tested, also in concurrence with the MR system. The results will tune the final design technology and the Monte-Carlo simulations for the event-reconstruction studies, with the inclusion of the TOF information. Finally, a PET prototype, comprising two synchronously working detectors, will be built and tested with phantoms. The image spatial resolution and sensitivity of the detector complex will be determined.

EXPECTED IMPACT AND RESULTS

The suggested imaging technology, because of the novel RPC-based PET-detectors with extremely high resolution and large FOV, combines in a favourable way the advantages of the positron-emission tomography and the magnetic-resonance imaging towards a better accuracy of the imaging, including the soft-tissues examinations and functional and physiological implications, and the considerably lower radiation exposure (in contrast to PET/CT). The possibility for incorporation of both imaging modalities into a single scanner will not only contribute to improvement of the imaging accuracy, but will allow investigation of temporal correlations with enormous diagnostic and therapeutic value.

This provides better healing chances for the patients due to the:

• Very good anatomical framing;

• Reduction of the negative side-effects of this important diagnostic and therapeutic modality by diminishing of the radiation exposure;

• Identification of the tumour formations and the for-signs of functional disorders at an extremely early stage (a few mm^3 of affected tissues), long before any detectable anatomical structure changes, but also before any noticeable physiological deviations could have appeared;

• Better monitoring and evaluation of the therapy efficiency.

The quality assured non-invasive quantitative diagnostic and monitoring are not the sole applications of the proposed detecting system. Because of the accuracy and anatomical reference-framing of the imaging and of the low radiation doses, the minimally-invasive and invasive surgery, as well as the surgery training can be considered as important application possibilities and further impacts of the project foreground, that is:

• Image-guided surgical navigation;

• Exploitation of the image-output for the purposes of the "virtual surgery" for rehearsal or planning of surgical approaches and interventions.

The RPCPET imaging system with its competitive price is advantageous also from a cost point of view, as it allows halving the costs, as compared to the other investigated options for such a modality-combination, e.g. the scintillator/APD-based PET detectors. Thus, considerably lower production costs of the proposed imaging system will allow for more hospitals to be equipped with it, which will bring the results of the health research and the advantages of the innovative diagnostic and therapeutic techniques in the reach of larger number of patients. Originating from a non-health-policy driven research, the foreground of the project may well serve to

underpin informed policy decisions on the development of more effective strategies in health promotion, disease prevention, diagnosis and therapy.

About 50% of the participants in the RPCPET Collaboration are early-stage researchers - diploma students and young university assistants. Their involvement in a highest-level research will strengthen their motivation to remain on the scientific career-path and to conduct their investigations in Bulgaria. Most of the project-team members belong to the Atomic Physics Department of the University of Sofia. This department is responsible for the curriculum in medical physics. The research team can attract graduate students for participation in the project-related research, which can motivate them for a career choice in this fast-developing interdisciplinary field.

The RPCPET Project is an example of a highest level multidisciplinary research, based on the knowledge transfer from natural sciences to medicine, which demonstrates the impact that fundamental research may have on the quality of life of thousands and millions of people.

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EQUAL IN EUROPEAN RESEARCH AREA

BULGARIAN VIPs

Prof. NEDYU POPIVANOV, DSc

Department of Mathematics and Informatics, Sofia University "St. Kliment Ohridski"
Phone: +359 2 8161-532 (office FMI), +359 2 846-5039 (office Rectorat)
E-mail: nedyu@fmi.uni-sofia.bg, intprojects@vice-rector.uni-sofia.bg

Professor of Mathematics, Differential Equations, author and co-author of more than 90 papers in scientific journals and conference proceedings, vice-rector of Sofia University "St. Kliment Ohridski".

Education and Career

Professor Dr. Nedyu Popivanov was born in 1948 in Veliko Tarnovo. He graduated from Sofia University "St. Kliment Ohridski", Faculty of Mathematics and Informatics in 1971. In 1974 he defended his PhD thesis and in 1980 became an Associate Professor at the Department of Mathematics and Informatics, Sofia University "St. Kliment Ohridski". His Doctor Habil. thesis "Local and Nonlocal Boundary Value Problems" was defended in 1987. In 1989, at the age of 40, Nedyu Popivanov became a full professor in mathematics in the field of differential equations. Over the period 1986-1989 he served as a Vice Dean of the Department of Mathematics and Informatics at Sofia University "St. Kliment Ohridski". In 1987, Nedyu Popivanov and some other colleagues from Veliko Tarnovo and Sofia Universities, and the Bulgarian Academy of Sciences created the „Mathematics and Informatics" program of study at Veliko Tarnovo University. In parallel to his duties at Sofia University "St. Kliment Ohridski", Nedyu Popivanov had been teaching "Calculus" at Veliko Tarnovo University from its launching at the university up to 2000. 1991 witnessed the opening of the Department of Mathematics and Informatics at Veliko Tarnovo University and Nedyu Popivanov was elected his first Dean. Since 2007 Professor Nedyu Popivanov has been a vice-rector of Sofia University "St. Kliment Ohridski" responsible for the university scientific and international projects.

Research Activity

Professor Nedyu Popivanov has been invited to work with a number of world reputed academicians in the field of partial differential equations such as Andrey Bitsadze, Vladimir Il'in, Alexander Samarsky (Moscow), Vladimir Vragov (Novosibirsk, Russia), Manfred Schneider and Rudolf Scherer (Karlsruhe, Germany), Sigfried Proessdorf (Berlin), David Edmunds (University of Sussex, the UK), Myron Grammatikopoulos (Greece), Daniela Lupo and Kevin Payne (Italy), Barbara Keyfitz (USA), colleagues from Norway, France and Morocco.

Professor Nedyu Popivanov's international scientific career began in 1974 at the famous "Steklov Mathematical Institute" in the Academy of Sciences of USSR. Let us also mention University of Karlsruhe, where Professor Nedyu Popivanov has important connections and where since 1987 he was invited for long periods at

least 15 times. As a result of his international invitations he has achieved numerous joint research results published in over 90 articles in international scientific journals and conference proceedings. Nedyu Popivanov has won many international scientific grants for research activities, including from the Royal Society (UK), DFG and DAAD (Germany) - three times, the Commission of European Communities for Cooperation in Science and Technology, NATO Science Fellowship Program. This international activity leads to new invitations for collaborative research projects abroad, which Nedyu Popivanov manages to balance with his teaching activity at Sofia University "St. Kliment Ohridski" and his other obligations. Under his supervision there have been elaborated and defended seven PhD dissertations (one of which in Morocco). Presently, Professor Nedyu Popivanov works with three young PhD scholars.

Participation in International and National Projects, Boards and Committees

Professor Nedyu Popivanov has taken part in international collaborative research teams since 1985. Presently, he is a Coordinator of a National Science Fund (NSF) project for establishment of the SimPro Centre - Simulation and Business Processes Centre of Competence. He is further a manager of a work package under another NSF project for establishment of Center of Competence "Super Computing Applications". Finally, he is responsible for a work package in a 7-th Framework Program project.

Professor Nedyu Popivanov took part in many international and national editorial boards, program and organizing committees of scientific congresses as well as many conferences.

Publications

Professor Nedyu Popivanov is the author and co-author of over 90 papers published in scientific journals and conference proceedings in the field of partial differential equations.

Other Activities

• Since 1990 to present Professor Nedyu Popivanov has been a member of specialized research councils in the field of Mathematics, Applied Mathematics and Mechanics, their Chairman or Co-Chairman.

• For more than ten years Professor Nedyu Popivanov had been a Chairman of the Mathematics, Applied Mathematics and Informatics Committees at the NSF.

Assoc. Prof. ILIANA MARINOVA, PhD

Department of Electrical Apparatus, Faculty of Electrical Engineering,
Technical University of Sofia
Phone: +359 2 965 3873, E-mail: Iliana@tu-sofia.bg

Associate Professor at the Department of Electrical Apparatus in Technical University of Sofia. Author and co-author of more than 120 papers in scientific journals and conference proceedings. Project leader or participant of more than 25 scientific and industrial projects.

Mrs. Iliana Marinova graduated from Technical University of Sofia, Faculty of Electrical Engineering finishing the MSc course in Electrical Power Supply and Electrical Equipment in 1982. Immediately after that she took up a Postgraduate Courses in Applied Mathematics - Block B and Block C delivered by the Centre of Applied Mathematics at the Technical University of Sofia, and in 1983 Iliana Marinova received MSc. Degree in Applied Mathematics. In 1989 she successfully defended her PhD thesis titled "Electromagnetic Calculation of a Driving AC Electromagnet". Practical results of the thesis have been successively implemented in industry.

From 1988 to 1994 Iliana Marinova was an Assistant Professor at the Department of Electrical Apparatus of the Technical University. Since 1995 she has been working as an Associate Professor at the same Department.

Prof. Marinova prepared and delivered lec-

tures on the following university courses: Electrical apparatus, Computer-aided design of electrical apparatus, Electromagnetic systems, Numerical methods and modeling of circuits and fields at Faculty of Electrical Engineering; Electrical Engineering-II, Industrial power supply systems and switchgear at English Language Faculty of Engineering; Electromechanical Systems, Electrical machines and apparatus, Transients and modeling of electromechanical systems at French Language Faculty of Electrical Engineering.

From 1993 to 1994 she was a visiting researcher at Hosei University in Japan. She studied thin film transformers and inverse problems in electromagnetism and bioelectromagnetism. After that the collaboration with Japanese Society of Applied Electromagnetics has been extended and she was invited to organize and chair a joint Japanese-Bulgarian-Macedonian seminar on Applied Electromagnetics held in Sofia (1998), Bulgaria; Sapporo, Japan (1999) and Ohrid, Macedonia (2000).

Prof. Marinova was invited as a visiting professor in LGEP, Paris, France (2002); ESIEE, Paris, France (2004); LEG, Grenoble, France, 2007. She presented invited lectures in University of Ashikaga, Japan, 2000; Cedzyna, Poland, 2000; LGEP, SupElec, Paris, France, 2002; 31-st Symposium on Visualization, Tokyo, Japan, 2003; Tohoku University, Sendai, Japan, July 25, 2003; ESIEE, Paris, October, 2004.

Current research interests of Prof. Marinova are in the field of inverse problems in electromagnetism and bioelectromagnetism, electromagnetic fields calculations by finite element method and boundary integral equation method, computer-aided design and optimization, image processing, signal processing and visualization of electromagnetic fields and processes of electromagnetic devices.

She has taken part in more than 25 research projects solving industrial and scientific problems. Her publications include more than 120 papers in peer-reviewed journals and conference proceedings and one book. She is an editor of three books. The publications contain the results and conclusions of her investigations. The paper titled "Image reconstruction for electromagnetic filed visualization by inverse approach" published in International Journal of Applied Electromagnetics and Mechanics, Vol. 15, IOS Press, 2001/ 2002, pp. 403-408, was awarded. The paper titled "Inverse electromagnetic problems by field visualization" published in IEEE Transactions on Magnetics, Vol. 40, No. 2, 2004, pp. 1088-1093 was invited.

Prof. Marinova is a reviewer of the IEEE Transactions on Magnetics, IEEE Sensors Journal, International Journal of Applied Electromagnetics and Mechanics, International Journal of Wavelets, Multiresolution and Information Processing, International Journal on Smart Sensing and Intelligent Systems.

Prof. Marinova is a member of the Editorial Board and reviewer of the International Conference on Computation of Electromagnetic Fields COMPUMAG'Sapporo (Japan, 1999), COMPUMAG' Evian (France, 2001), COMPUMAG' Saratoga Springs, New York (USA, 2003), COMPUMAG (China, 2005), COMPUMAG' Aachen (Germany, 2007), COPMUMAG' Florianopolis (Brazil, 2009); IEEE Conference of Electromagnetic Field Computation CEFC 2000 (Milwaukee, USA), CEFC 2002 (Italy), CEFC 2004 (Seoul, Korea), CEFC 2006 (Miami, Florida, USA), CEFC 2008 (Athens, Greece). Prof. Marinova is a member of the organizing committee of Symposium on Electrical Apparatus and Technologies, SIELA'97, SIELA'99, SIELA 2001, SIELA 2003, SIELA 2005, SIELA 2007 (Plovdiv, Bulgaria) and SIELA 2009 (Burgas, Bulgaria) as well as of the Organizing Committee of Symposium on Electrical Machines, ELMA 2008 (Sofia, Bulgaria).

Prof. Marinova is a member of the IEEE Magnetics Society, International Compumag Society, Bulgarian Scientists Union, Union of Electronics, Electrical Engineering and Communications and Polish Association of Applied Electromagnetics.

Currently Iliana Marinova serves as an independent expert of European Commission for the Seventh Frame Program - 7FP.

AWARDS

JOHN ATANASOFF AWARDS BESTOWED

At a ceremony in the beginning of October 2009 President Georgi Parvanov bestowed **John Atanasoff Award**, which is adjudged for the seventh time to a young Bulgarian with considerable contribution to the development of computer and information technologies.

The award was adjudged to **Martin Vechev**. He is an alumnus of Sofia High School of Mathematics. He graduated in mathematics and informatics from Simon Frazer University, Canada. In 2007 he defended his doctor's degree at University of Cambridge, England. In the same year he starts work as a researcher at IBM Center in New York. His work is connected with application and creation of new formal methods for synthesizing and proving of complex concurrent algorithms. The results of his work are used for the next generation of American military ships. He is the author of 23 scientific publications and proceedings and has prestigious awards for contribution to the development of information society. He is the founder of the first conference on applied methods of synthesis for concurrent programs.

Awards for contribution to the sphere of information technologies were handed to **Galya Ivanova**, PhD and **Rosen Kirilov**, PhD.

For the second year in succession the head of state bestowed **John Atanasoff award – for high school students** for high achievements in the field of informatics and information technologies. The award was bestowed to **Rumen Hristov**, a 10-grade student from High School of Natural Sciences and Mathematics from the town of Shumen.

Honorary diplomas were handed to students **Stefan Avramov** and **Ivan Georgiev**.

The President backed up the idea of creation of a joint center with IBM in Bulgaria for developing projects in the field of nanotechnologies.

CENTER FOR EXCELLENCE IN EDUCATION BESTOWS ACHIEVEMENT MEDAL

In September 2009 on the occasion of the 25-th anniversary of the International Research institute at the Center for Excellence in Education **Acad. Petar Kenderov** was decorated with a medal for merit - Achievement Medal for Leadership and Commitment to Excellence in Education, which is an acknowledgement of his exceptional achievements in searching and promoting young talents in the field of mathematics and informatics.

The award was handed by a Nobel laureate in physics Dr. John Mather.

In a special press-release of the Centre on the occasion of the anniversary the role of Acad. Kenderov as a missioner of education of worldwide importance is noted.

„Dr. Kenderov, President of the Sts. Cyril and Methodius International Foundation in Sofia, Bulgaria is a Professor at the Institute of Mathematics and Informatics of the Bulgarian Academy of Sciences where he tirelessly searches for and promotes young students who are highly talented in mathematics and informatics. He also supports the professional development of teachers for gifted and talented students. Dr. Kenderov recently served as President of the World Federation of National Mathematics Competition (WFNMC)."

PRESIDENT PARVANOV HANDED TOP STATE AWARDS TO FIGURES IN SCIENCE AND CULTURE

On September 29, 2009 President Parvanov handed the highest state awards and Honorary Badge of the President of the Republic of Bulgaria to figures in Bulgarian science and culture.

Awards in the field of science were delivered as follows:

Sts. Cyril and Methodius Order of Merit – necklace was bestowed on **Prof. Margarita Deyanova–Vaklinova**, Director of the National Archeological Museum, for her exceptional contribution to the development of Bulgarian archeology. Prof. Vaklinova is the author of over 100 publications, documentary films, projects, and a participant in many Bulgarian and international scientific forums. She has a considerable contribution to supporting "Preserve the Bulgarian" movement and "Bulgarian Heritage".

Sts. Cyril and Methodius Order of Merit – first degree was handed in to **Acad. Matey Mateev** for his services in the field of education and science. Acad. Mateev is the President of the Union of Physicists in Bulgaria and one of the brightest representatives of Bulgarian physics.

Sts. Cyril and Methodius Order of Merit – first degree was bestowed on **eng. Vladimir Genevski** for his many years of activity in creation and development of non-ferrous metallurgy in Bulgaria and on international level. The decoration is an expression of high assessment of his over 30 inventions, over 50 publications and many patents with economic effect both in Bulgaria and abroad.

Bulgarian President's Honorary Badge was delivered to **Prof. Anna Manolova Nedyalkova**, DSc, Rector of Varna Open University, for considerable contribution to reformation and modernization of Bulgarian higher education and science.

ARTICLES

RECENT PUBLICATIONS OF BULGARIAN SCIENTISTS

Title: **Amateur observations of solar eclipses and derivation of scientific data**
Authors: Stoev, A. D.[1], stoev52@abv.bg, Stoeva, P. V.[2], penm@abv.bg
Source: Advances in Space Research, Vol. 42, 11, (Dec. 2008), 1806-1813
Author Affiliations: [1]Yuri Gagarin Public Astronomical Observatory, 62, Tsar Ivan Shishman, 6000 Stara Zagora, Bulgaria;
[2]Solar-Terrestrial Influences Laboratory, "Acad. D. Mishev" - Bulgarian Academy of Sciences, Stara Zagora Department, 47, Gurko Str., Ap. 6, 6000 Stara Zagora, Bulgaria.
ISSN: 0273-1177

Title: **Large–Scale Mass Table Calculations**
Authors: Stoitsov, M.[1,3], Nazarewicz, W.[1,4], Schunck, N.[1,2]
Source: International Journal of Modern Physics, E: Nuclear Physics, Vol. 18, 4, (Apr. 2009), 816-822, 3 charts
Author Affiliations: [1]Department of Physics & Astronomy, University of Tennessee, Knoxville, Tennessee 37996, USA;
[2]Physics Division, Oak Ridge National Laboratory, P.O.Box 2008, Oak Ridge, Tennessee 37831, USA;
[3]Institute of Nuclear Research and Nuclear Energy, Bulgarian Academy of Sciences, 1784 Sofia, Bulgaria;
[4]Institute of Theoretical Physics, Warsaw University, ul. Hoza 69, 00-681, Warsaw, Poland.
ISSN: 0218-3013

Title: **Women in Physics in Bulgaria–Statistics and Challenges**
Authors: Proykova, Ana
Source: AIP Conference Proceedings, Vol. 1119, 1, (Apr. 2009), 89-90
Author Affiliations: St. Kliment Ohridski University of Sofia, 15, Tsar Osvoboditel Blvd., 1504 Sofia, Bulgaria
ISSN: 0094-243X

Title: **Object–oriented programming in Bulgarian universities' informatics and computer science curricula**
Authors: Donchev, I., i.donchev@abv.bg, Todorova, E., emilia_todorova@yahoo.co.uk
Source: Informatics in Education, Vol. 7, 2, (2008), 159-172
Author Affiliations: Department of Information Technologies, Veliko Tarnovo University, 3, G. Kozarev Str., 5000 Veliko Tarnovo, Bulgaria
ISSN: 1648-5831

Title: **Application of Genetic Algorithms for Determining the Parameters of Induction Motors**
Authors: Kostov, Ivan[1], Spasov, Vasil[2], Rangelova, Vania[2]
Source: Tehnicki Vjesnik - Technical Gazette, Vol. 16, 2, (Apr.-Jun. 2009), 49-53

Author Affiliations: [1]Technical University of Sofia, Control Systems Department, Branch Plovdiv, Sofia, Bulgaria;
[2]Technical University of Sofia, Department of Electrical Engineering, Branch Plovdiv, Sofia, Bulgaria.
ISSN: 1330-3651

Title: **On the Cauchy problem for the periodic b–family of equations and of the non–uniform continuity of Degasperis–Procesi equation**
Authors: Christov, Ognyan[2], Hakkaev, Sevdzhan[1]
Source: Journal of Mathematical Analysis and Applications, Vol. 360, 1, (Dec. 2009), 47-56
Author Affiliations: [1]University of Shumen, Faculty of Mathematics and Informatics, 9712 Shumen, Bulgaria;
[2]St. Kliment Ohridski University of Sofia, Faculty of Mathematics and Informatics, 1164 Sofia, Bulgaria.
ISSN: 0022-247X

Title: **Spherical motion burnishing implemented on lathes**
Authors: Maximov, J. T.[1], Kuzmanov, T. V.[2], Duncheva, G. V.[1], Ganev, N.[3]
Source: International Journal of Machine Tools & Manufacture, Vol. 49, 11, (Sep. 2009), 824-831
Author Affiliations: [1]Technical University of Gabrovo, 5300 Gabrovo, Bulgaria;
[2]Technical University of Sofia, Sofia, Bulgaria;
[3]Czech. Tech. Univ., CR-16635 Prague, Czech Republic.
ISSN: 0890-6955

Title: **Catalytic activity of NiW electrodeposits**
Authors: Mitov, Mario[1,3], Hristova, Elitsa[1], Hristov, Georgi[1], Rashkov, Rashko[2], Arnaudova, Marina[2], Popov, Alexander[3]
Source: Environmental Chemistry Letters, Vol. 7, 3, (Sep. 2009), 249-253
Author Affiliations: [1]South West University, Department of Chemistry, 2700 Blagoevgrad, Bulgaria;
[2]Bulgarian Academy of Sciences, Institute of Physical Chemistry, BU-1113 Sofia, Bulgaria;
[3]Bulgarian Academy of Sciences, Institute of Electrochemistry and Energy Systems, BU-1113 Sofia, Bulgaria.
ISSN: 1610-3653

Title: **Global neo–liberalism, global ecological modernization, and a swine CAFO in rural Bulgaria**
Authors: Glenna, Leland L.[1], Mitev, Georgi V.[2]
Source: Journal of Rural Studies, Vol. 25, 3, (Jul. 2009), 289-298
Author Affiliations: [1]Penn State University, AERS, University Pk, PA 16803, USA;
[2]University of Rousse, Rousse, Bulgaria.
ISSN: 0743-0167

Title: **Investigation of flux under ultrafiltration and diafiltration of whey from Kashkaval**
Authors: Dinkov, K., Dushkova, M.

Source: Milchwissenschaft - Milk Science International, Vol. 64, 3, (2009), 312-315
Author Affiliations: University of Food Technology, Department Proc. Engn., 4000 Plovdiv, Bulgaria
ISSN: 0026-3788

Title: **The upper spatial limit for perception of displacement is affected by preceding motion**

Authors: Miroslava Stefanova[1], Stefan Mateeff[1,2], Joachim Hohnsbein[3]

Source: Vision Research, Vol. 49, 5, (Mar. 2009), 499-504

Author Affiliations: [1]Institute of Neurobiology, Bulgarian Academy of Sciences, Acad. G. Bonchev Str., bl. 23, 1113 Sofia, Bulgaria;
[2]New Bulgarian University, 21, Montevideo Str., 1618 Sofia, Bulgaria;
[3]Leibniz Research Centre for Working Environment and Human Factors (IfADo), Ardeystr. 67, 44139 Dormund, Germany.

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EVENTS

ESTABLISHMENT OF A MEDAL AND AWARD FUND IN THE NAME OF JOHN ATANASOFF

Representatives of International Foundation of the Institute of Electrical and Electronics Engineers (IEEE) - the most famous international non-governmental professional organization in the field of engineering sciences were on a visit to Bulgarian Academy of Sciences (BAS) in October.

The visit was connected with the establishment of a medal and award fund in the name of John Atanasoff jointly by IEEE and BAS.

John Atanasoff-Jr., Carl Chang - Professor and Chair of Department of Computer Science at Iowa State University (USA) and Matthew Lob - a senior official at IEEE were present at the meeting.

Details of the agreement which will be signed between BAS and the foundation after the Governmental decree on establishment of the joint award fund for the **John Atanasoff Medal of IEEE** were discussed.

SECOND PRACTICAL SCHOOL ON SPECTROSCOPY – ROZHEN 2009

Second practical school on spectroscopy was opened on October 5, 2009 at the Rozhen National Astronomical Observatory. The school is sponsored by UNESCO-BRESCE and Institute of Astronomy at BAS through a project financed by the National Research Foundation at the Ministry of Education, Youth and Science.

Participants in the School were students from South-Eastern Europe: Bulgaria, Greece, Romania, Serbia, Macedonia, Turkey and Russia. Lecturers were prominent spectroscopists from Bulgaria and guest lecturers from France and Russia.

The main goal of the School was to give the participants basic knowledge of astrospectroscopy by means of spectral observations, processing and analysis of the obtained data as well as to acquaint them with basic spectral characteristics of different types of stars. The program included lectures, night observations with Coude-focus of the 2m RRC telescope and practical exercises with IRAF code.

Astronomical Observatory is the largest astronomical infrastructure in SEE and provides excellent conditions and opportunities for education and research for the regional astronomical community. This School is also a part of the activities of the SREAC - Sub-Regional European Astronomical Committee.

COOPERATION AGREEMENT BETWEEN STEINBEIS UNIVERSITY IN BERLIN AND BULGARIAN ACADEMY OF SCIENCES

In September 2009 a Cooperation Agreement was signed between Steinbeis University in Berlin and Bulgarian Academy of Sciences (BAS).

The Agreement envisages cooperation between the two countries for joint education in Bulgaria. The main object of activities is the "Business and Engineering" educational program resulting in master's degree of Steinbeis University - "Master of business and engineering". The program for training is intellectual property of the university. It is expected to start in Bulgaria in September 2010, and for the purpose establishment of a joint institute in Bulgaria is planned.

The agreement was signed by the President of the Bulgarian Academy of Sciences Acad. Nikola Sabotinov, Rector of Steinbeis University Prof. Dr. h.c. Johann Lohn, Executive Director of Steinbeis University Mr. Walter Beck, representative of Steinbeis University and Steinbeis Foundation for Eastern Europe Prof. Dr. h.c. Florin Ionescu, Corresponding Member Prof. Angel Baltov, Rector of BAS Training and Development Center, and by Senior Research Associate Dr. Kostadin Kostadinov, BAS Scientific Secretary.

120 YEARS FROM ESTABLISHMENT OF THE NATIONAL MUSEUM OF NATURAL HISTORY AT BAS

On October 27, 2009 celebration of the 120-th anniversary from establishment of the National Museum of Natural History (NMNHS) at BAS took place. The event started in the building of the Museum with opening of a new hall - Fish, and unveiling of a bas-relief of the creators of the museum - Tsar Ferdinand and Acad. Ivan Buresh, as well as of a plaque of donators.

Among the guests of the event were: Prime Minister Mr. Boyko Borisov, Minister of Education, Youth and Science (MEYS) Mrs. Yordanka Fandakova, Vice President of the National Assembly Mr. Atanas Semov, Vice Minister of MEYS Assoc. Prof. Sergey Ignatov, President of BAS Acad. Nikola Sabotinov and the former Prime Minister Mr. Simeon Saxe-Coburg-Gotha.

At the special meeting in BAS the museum got a "Marin Drinov" Honorary Plaque of BAS. "Acad. Ivan Buresh" Honorary Plaque of the museum was handed to Senior Research Assoc. Dr. Svyatoslav Petrusenko for his merits in the development of the museum collections and mineralogy in Bulgaria, to Prof. Denis Geraads from the National Research Center (CNRS) in Paris for his merits in the development of paleontology in Bulgaria and his contribution to the development of the museum, and to Senior Research Assoc. Dr. Nikolay Spasov for his merits in the development of zoology and paleontology in Bulgaria and his contribution to the museum.

The National Museum of Natural History in Bulgaria is the oldest and the richest museum of national history on the Balkan Peninsula. It was founded by Royal Prince Ferdinand in 1889 under the name Royal Prince's Natural Museum. Priority development of zoology and botany in Bulgaria in comparison with other Balkan countries was due to its early foundation and growth. During 60 years the museum is a basic center of research work in these two sciences in Bulgaria.

The mission of the NMNHS incorporates the following areas: fundamental and applied studies, management and preservation of collections, promotion of natural scientific knowledge through exposition and popular literature, training of doctorate degree candidates and young experts, expert activities. The research work is mainly in the field of zoology and paleontology, but also in botany and mineralogy. For already 120 years the museum has been playing its role of a national unit in the field of natural sciences.

INTERNATIONAL CONFERENCE "CHALLENGES OF CONTEMPORARY ASTROPHYSICS"

In October 2009 an international conference "Challenges of Contemporary Astrophysics" was held in Sofia. The conference was financed by European network of optical and infrared telescopes for astronomy (OPTICON, http://www.astro-opticon.org/) and was organized by OPTICON and Institute of Astronomy at BAS. During the conference prominent astronomers from Europe and the USA presented the most challengeable fields of research in astronomy as well as the existing and future technologies connected with astronomy.