AComIn Technology Transfer Seminar on Computational Vision Applied to Medical Diagnostics

Lecturer: **Prof. Petia Radeva – University of Barcelona, Spain**

Dr. Petia Radeva is a Senior Researcher and Associate Professor at the University of Barcelona. She is Head of Barcelona Perceptual Computing Laboratory and Head of MiLab of Computer Vision Center (www.cvc.uab.es). Her present research interests are in the development of learning-based approaches (in particular, statistical methods) for computer vision and image processing. She has led or leads more than 15 projects (European, international and national projects), and 19 technology transfer projects with Spanish, American and Israeli companies. She has 15 patents in the field of computer vision, image processing and medical imaging. Some of the projects she is currently heading are: Machine learning tools for large scale object recognition, Audience measurements by Computer Vision, Evaluation of Intestinal Motility by Endoluminal Image Analysis, Sponsored Research Agreement on Automatic Stent Detection in IVUS, Study for the development of a polyp detection algorithm under a Polyp Detection, etc.

The Seminar Programme:

July 24th: 14.00 – 18.00 h:
Introduction: Computer Vision in Barcelona University;
Segmentation Techniques:
· Snakes and Level Sets;
· Graph-cuts.
July 25th: 10.00 – 13.00 h:
Image Context Analysis:
· Shape Context;
· Active Shape Models and Active Appearance Models;
· Bayesian Context Modelling.
July 25th: 14.00 – 18.00 h:
Applications to Medical Diagnosis and Treatment – Two Real Clinical Projects:
· Introduction to Medical Imaging;
· Arteriosclerotic Plaque Analysis in Intravascular Ultrasound Images of Coronary Vessels;
· Stent Detection.
July 26th: 10.00 – 13.00 h:
Neuroimaging;
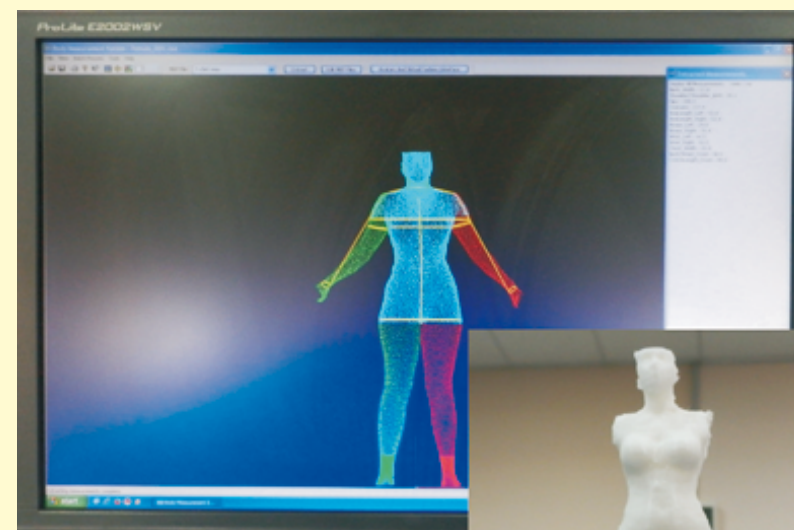Intestinal Motility Analysis in Wireless Endoscopic Images

The seminar was held from 24 to 26 July 2013 as a 14-hours course and brought together 33 participants from four private companies (MMSolutions AD, 3PS-SIMULIA, AVIQ Bulgaria Ltd., and Vitronic GmbH), two Bulgarian universities (Technical University of Sofia and Technical University of Veliko Tarnovo), seventeen participants from IICT-BAS, as well as representatives from six other institutes of the Bulgarian Academy of Sciences. The presentations of the lectures are freely accessible at the AComIn project site (http://iict.bas.bg/acomin/news.html).

AComIn Technology Transfer Seminar on Applying Advanced 3D Technologies in the Textile Industry and Fashion

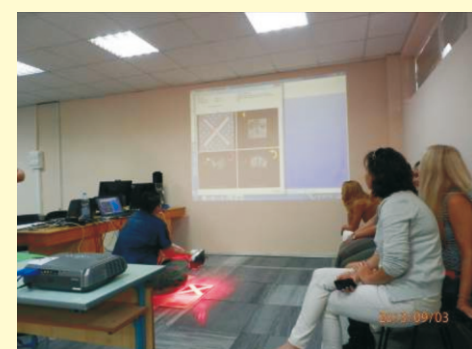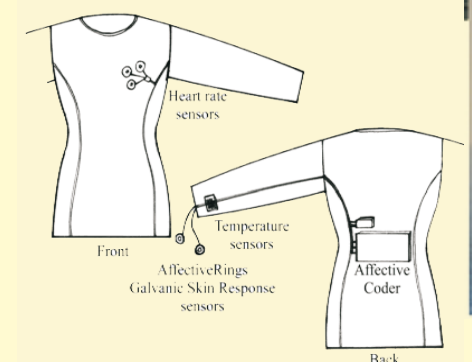Lecturer: **Dr. Petar Gulev - London School of Fashion, University of the Arts, London, UK**

Dr. Gulev is a computer scientist, who graduated from the Technical University in Sofia. He holds a PhD degree from Imperial College in London, UK and has gained scientific experience in London School of Fashion in the University of the Arts – London. The seminar took place in IICT-BAS in the period September 2 – 5, 2013. The event was organised with the help and support of:

· **The British Council**, which policy includes continuous wide-ranging support for carrying out lectures in Bulgaria by specialists, who have obtained scientific degrees in Great Britain, and

· **The Ministry of Education and Science** of the Republic of Bulgaria, which provides facilities and competent technical support for conducting cutting edge technology trainings in Bulgaria.

Dr. Petar Gulev made the participants familiar with the current scientific and technological advancements in the textile industry and fashion during a course, named: "Applying Advanced 3D Computer Technologies in the Textile Industry and Fashion". The focus fell on approaches for user opinion research, scanning and creating 3D models of the human body, 3D design of cloths and accessories, as well as using 3D models in electronic trade in the fashion industry. Dr. Gulev also presented an innovative concept, developed together with Lisa Stead - "Computer Aided Emotional fashion", a real time platform termed AfectiveWare, creating clothing that is personalised by the emotions of the individual. The list of attendees included company owners and managers from the textile industry, fashion designers, university professors and teachers in specialised secondary schools.

Leading Bulgarian companies in the field of 3D technologies were involved in the seminar upon the speaker's invitation: 3d Print – Bulgaria (http://www.3dprint-bg.com) demonstrated the creation of 3D objects in real time using MakerBotReplicator2 and environmentally clean corn pre-products, and Team Ltd (Теам ООД, http://www.team.bg) provided software for a manual 3D scanner ZScanner 800 for scanning textile objects and human shapes in real time. The seminar gathered 22 participants.

AComIn Newsletter №2

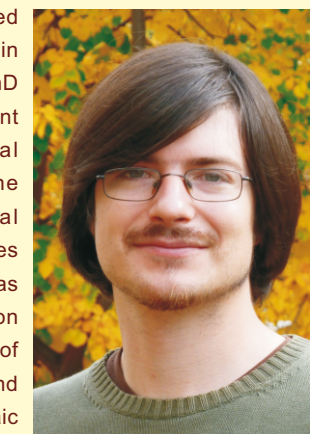*Advanced Computing for Innovation*

September 2013

AComIn Mission: to strengthen the research and innovation capacity of the Institute of Information and Communication Technologies – Bulgarian Academy of Sciences (IICT-BAS) by increasing the knowledge and skills of its researchers in emerging areas as well as by purchasing modern research infrastructure. AComIn should help the institute to successfully accomplish its strategic mission: by 2016, i.e. 5 years after its creation, IICT-BAS has to become a leading RTD Centre in Eastern Europe, providing facilities and working conditions comparable to the average standards of the EU Centres of Excellence in ICT. The institute will support the sustainable regional and national growth and employment by providing RTD results to advanced industrial organisations; it will be a focal point of high-quality research and training in advanced ICT topics.

Progress Report (April - September 2013)

WP1: Strengthening the IICT-BAS Human Potential
Employed incoming post-docs

Dr. Clemens Hofreither was appointed to a post-doc position in IICT-BAS in August 2013. He defended his PhD thesis "A Non-standard Finite Element Method using Boundary Integral Operators" with distinction at the Doctoral College "Computational Mathematics" hosted at the Johannes Kepler University in Linz, Austria. He has developed a particular discretisation scheme for boundary value problems of elliptic partial differential equations and received interesting results on algebraic reconstruction methods for objects with non-homogeneous density by Radon projections. While working in IICT-BAS he will conduct research on advanced computing as well as on signal and image processing.

Dr. Ivan Georgiev was appointed to a post-doc position in IICT-BAS in September 2013. He came to Bulgaria from Johann Radon Institute of Computational and Applied Mathematics (RICAM) at the Austrian Academy of Sciences. His research interests are mostly related to efficient numerical solution methods for partial differential equations, solvers for systems resulting from non-standard finite element discretisations, robust with respect to anisotropy and coefficient heterogeneity. In the framework of the AComIn project he is going to work on the development and parallel implementation of the efficient multilevel preconditioning methods for problems with heterogeneous coefficients. Testing these methods with particular problems using the Smart Lab equipment is foreseen as well.

of preconditioners for systems arising in FEM approximation of second order elliptic problems, describing processes in highly heterogeneous media. The developed approach uses the recently proposed preconditioning technique based on additive Schur complement approximation (ASCA). The theoretical study includes both mixed and least-squares finite element methods for self-adjoin second order problems. The robustness is achieved through special overlapping Schwarz procedure that also utilises some newly developed estimates for the Raviart-Thomas projection in weighted norms.

Prof. Lazarov also delivered an intensive course of lectures on Advanced Numerical Methods for partial differential equations, based on the contemporary concept of the infsup condition. The first part of the course consisted of lectures presenting the basic tools for the analysis and the finite element constructions. The second part addressed advanced topics related to Stokes equations and relevant spaces that satisfy the infsup condition. The third part of the lectures covered some of the latest developments in the theory and practice of FEMs, namely, the discontinuous Galerkin method.

Prof. Lazarov took part in the organisation of a Special Session on "Modelling and Numerical Simulation of Processes in Highly Heterogeneous Media" at the 9th Conference on Large Scale Scientific Computing (LSSC'13), Sozopol, 3–7 June, 2013. The Session is aimed at bringing together researchers working in the area of large scale simulations and computations of various processes in highly heterogeneous media. During the session 10 talks were presented.

Prof. Darina Dicheva and Prof. Christo Dichev came to IICT-BAS from Winston Salem State University, USA. The aim of their visit was to conduct joint research with their local hosts – Prof. Gennady Agre and Prof. Galia Angelova, in the area of applying semantic techniques for supporting educational systems and on the IT challenges in developing and using educational digital repositories. During their stay at the Institute (June 2013), a comprehensive review of the state of the art and the trends in K12 e-learning developments and practices around the world has been

Short employments of incoming experienced researchers

Prof. Raytcho Lazarov came to IICT-BAS from Texas A&M University, College Station, USA. During his stay at the Institute (April 10 – May 10 2013) he conducted joint research with his local host, Prof. Svetozar Margenov, in the area of development, study, analysis and implementation

done. Special attention was given to the presentation of the main policies, supportive tools and research activities driving the steady progress in online learning in the US. State online learning practices and trends have been examined for a number of other countries including Mexico, Canada, Australia, New Zealand, India, Hong Kong, South Korea, China, and Singapore. E-learning in the European Union and its place in the Digital Agenda for Europe was considered as well as the current status of the introduction of K12 e-learning in Bulgaria. The trends in the next generation of e-learning and virtual learning environments laid the groundwork for outlining the research areas and technologies that need further development and advancing. The review was used as a basis for preparing the joint journal publication C. Dichev, D. Dicheva; G. Agre, G. Angelova "*Current Practices, Trends and Challenges in K-12 Online Learning*".

Prof. Dicheva and Prof. Dichev proposed jointly with the IICT seniors a methodological and evaluation framework for studying, analysing, and assessing the needs and readiness for online learning in the Bulgarian K-12 education system. Based on the suggested methodology a survey questionnaire has been developed, covering questions about the knowledge and skills of potential teachers, perceived barriers and facilitators, training needs, as well as questions on the current status of the information and communication technologies in schools and their real use. The content of the questionnaire was discussed with stakeholders and aimed at collecting information from a diverse and representative audience. The survey results are intended to guide the design and implementation of online K-12 school platforms in Bulgaria by selecting implementation strategies designed to deal with the identified barriers and exploit facilitators.

Prof. Darina Dicheva and Prof. Christo Dichev delivered a set of lectures on improving content identification and search in educational digital repositories with a focus on using language and semantic technologies. They also discussed critical aspects for the successful start of K-12 online learning and the role of a community of active supporters in the initial stage for advocating, promoting, sharing common experiences, and providing feedback.

Prof. Milena Dobreva came to IICT-BAS from the University of Malta. She did joint research together with her local hosts – Prof. Galia Angelova and Prof. Gennady Agre, on Language and Semantic Technologies with an emphasis on applications within digitalisation of, access to, and preservation of cultural heritage; application of 3D models in this domain, and finally, synergies between access methods to digitalised cultural content and educational resources. During her stay at the Institute (June 18 – July 17 2013) Prof. Dobreva started preparing a state-of-the-art review on using linked data technologies in digital cultural heritage repositories. Such a review would outline the advantages of linked data in the cultural heritage domain, scope current use with good practice examples, analyse the spread of development of current linked data applications, and identify gaps in provision. The results of Prof. Dobreva's research on improving the user experiences in digital cultural heritage environments were presented at lectures entitled "Methods of Studying Users of Digital Libraries" and "End Users and Digital Preservation: Challenges and Perspectives". In order to establish an initial AComIn end-user community dealing with 3D cultural heritage objects, Prof. Dobreva had several meetings with the Director of Bansko Museum Complex and PhD students from the Department of Library and Information Studies of the Philosophical Faculty of Sofia University working on wider outreach for museum information, the use of mobile applications and QR codes.

WP2: Purchasing Smart Lab and Building User Communities

In August 2013 a public tender for purchasing the AComIn equipment was completed. Providing companies are selected for nine of the twelve specified devices. The equipment will be delivered by the end of November 2013. The following items are available in September 2013:

Laser Particle Sizer ANALYSETTE 22 Nano Tec plus - with a total measuring range of 0.01 – 2000 μm in a single measurement, the ANALYSETTE 22 NanoTec plus is the ideal, universally applicable Laser Particle Sizer for the effective and reliable determination of particle size distributions. The Sizer consists of 3 units – Measuring unit, Dry dispersion unit and Wet dispersion unit. Dry dispersion is ideal for dry, free-flowing and non-sticking materials. Especially coarse material can be measured with it very well and easily. The wet dispersion is suitable for almost all materials which do not dissolve in liquid. The advantage compared to the dry dispersion is the higher efficiency and greater flexibility of the dispersion process as well as the very simple and comfortable handling.

Thermo Camera FLIR P640 - this thermal imaging camera has an uncooled microbolometer detector that produces thermal images of 640 x 480 pixels. The model FLIR P640 has some very useful built-in features that make it ideal for predictive maintenance, such as a laser pointer, Picture in Picture and FLIR Thermal Fusion to merge the visual and the thermal image.

EDEM® Software for modelling and simulation - a computer-aided engineering platform powered by state-of-the-art Discrete Element Modelling technology, capable of generating the powerful simulations and analysis required to solve complex problems in the design, prototyping, and optimisation of bulk material handling and process equipment.

WP3: Networking with Leading EU Partners
Secondments

In March – April 2013, **Dr. Yavor Vutov** visited the Fraunhofer Institute for Industrial Mathematics (ITWM), Department of Flow and Material Simulation, Kaiserslautern, Germany for collaborative work on finite element and finite volume simulations. During his stay in ITWM he developed a surface reaction module added to a finite volume filter simulation, an adaptive timestepping scheme added to an unstructured 3D FEM solver and a numerical homogenisation tool for anisotropic linear elastic materials.

In the period May 13 – June 12 2013 **Prof. Dimo Dimov** visited the Computer Vision and Multimedia Lab (CVML) at the University of Pavia, Italy, which is a partner in the AComIn project. During his visit he was working with the Italian colleagues in the field of Proteomics (information approaches in proteins analysis). He has also discussed future joint research between the two groups in the area of application of the MV3R (Multi View Based 3D Recognition) method developed in IICT-BAS to a set of problems in Biometrics and/or Cultural heritage preservation. He gave 4 talks at seminars of the CVM Lab. The presentations are available at http://vision.unipv.it/events.

In the period September 14-29, 2013 **Prof. Dimitar Karastoyanov, Prof. Vladimir Monov, and Prof. Lyubka Doukovska** visited the University of Örebro, Sweden - one of the IICT-BAS partners in the AComIn project. They gave talks in a seminar with the attendance of scientists from the School of Science and Technology and the Centre for Applied Autonomous Sensor Systems (AASS), where they presented current results in the project AComIn, as well as results and research activities of the IICT-BAS departments "Embedded Intelligent Technologies", "Modeling and Optimisation", and "Intelligent Systems". Working meetings and discussions about future joint tasks were also carried out with Prof. Ivan Kalaykov, contact person in the partnership with the Örebro University, Prof. D. Driankov, Director of the Centre AASS, Prof. Franziska Kluegl, and Prof. Anani Ananiev.

Incoming short visits

Prof. Franziska Kluegl from the University of Örebro, Sweden visited IICT-BAS in the period May 20-23, 2013. During her stay she had meetings and discussions with leading scientists from the "Modelling and Optimisation" and "Intelligent Systems" Departments. Prof. Kluegl presented a lecture "Use of Multiagent Systems for Simulation" (May 21, 2013).

In the period June 26 – July 4 2013 IICT was visited by **Prof. Virginio Cantoni** from the Computer Vision and Multimedia Lab of the University of Pavia, Italy. During his stay at IICT he had professional discussions with leading IICT seniors from the Department of Signal Processing and Pattern Recognition. Possible directions for future co-operative work have also been outlined. Prof. Cantoni gave a talk "*A Few Applications of Pattern Recognition Techniques to Proteomics*" (July 2, 2013). The presentation is available at http://iict.bas.bg/acomin/news.html.

Participations at scientific events

During the last 6 months 29 scientists from IICT-BAS presented 52 talks at their research results that were partially funded by the AComIn project at 28 International Conferences and Workshops held in 13 European countries.

WP4: Development of Innovation Policy and Knowledge Transfer Plan and Innovation Capacity Building

On April 18, 2013 IICT-BAS and the Joint Innovation Centre of BAS organised a **Seminar on Intellectual Property Issues** with presentations on Protection of IP (*Dr. Georgi Dimitrov*) and Authorship and Patents (**Mrs. Plamena Georgieva**).

In the period July 9-12, 2013 IICT-BAS was visited by **Dr. Frank Heemskerk** from the Research and Innovation Management Services, Belgium, an external AComIn consultant on Innovation capacity development. Dr. Heemskerk had several meetings with IICT key staff, during which the draft IICT Innovation strategy was discussed. Dr. Heemskerk also visited the Head-quarters of BAS and had a meeting with the BAS Vice-President Corr. Mem. Nikolay Miloshev in order to discuss the IP Policy of BAS. During his stay in Bulgaria Dr. Heemskerk presented a cycle of lectures on different IP issues:

• *Exploitation of Research Results: European Practices, Expectations and Trends* (10.07.2013),
• *Exploitation of Research Results: How to Create Impact, Project Examples and Cases* (10.07.2013),
• *Developing Innovation Capacity in a Globalised World: How to Bring Competences Together* (11.07.2013),
• *Developing Innovation Capacity in a Globalised World: Examples of Organisational Structures to Support Innovation* (11.07.2013),
• *Innovation in Horizon 2020 – Towards a Seamless Link Between Research, Innovation and Society Challenges* (12.07.2013).

On June 25, 2013 IICT-BAS received from the Bulgarian Patent Office *registration of industrial design of night viewing devices* (№ 7 8 2 6 / 2 5 . 0 6 . 2 0 1 3 and №7827/25.06.2013) with authors: B. Bantutova, D. Borissova, E. Bantutov, I. Mustakerov. The night viewing devices are designed for security reasons and early warning of natural disasters and emergency. They can be used in research as well.

WP5: Dissemination
Scientific events supported by AComIn

The 9th International Conference "Large-Scale Scientific Computations" (LSSC 2013) was held on June 3-7, 2013 in Sozopol, Bulgaria. The Conference gathered 154 researchers (44 of them from Bulgaria) working on large scale computer simulations and high performance computer architectures and algorithms. A wide range of recent achievements in the field of scalable numerical methods, algorithms and their applications have been addressed during the conference. The meeting provided a forum for exchange of ideas between scientists, who develop and study numerical methods and algorithms, and researchers, who apply them for solving real life problems. The following major scientific topics, all related to the AComIn project activities, have been included: Hierarchical, adaptive, domain decomposition and local refinement methods; Robust preconditioning algorithms; Monte Carlo methods and algorithms; Numerical linear algebra; Control systems; Large-scale computations of environmental biomedical and engineering problems; High-performance algorithms for engineering problems; Parallel algorithms and performance analysis. The event's Scientific Programme included 5 Plenary Invited talks, 11 Special Sessions and Sessions of Contributed Talks. Six of the Special Sessions were directly related to the AComIn project activities. The Conference Proceedings will be published as a special volume of Springer Lecture Notes in Computer Science (LNCS) and will contain 10 AComIn related papers.

Four papers presented at the Workshop have been published in the "Bulgarian Journal of Agricultural Science" and another four papers will appear in the journal "Cybernetics and Information Technology" published by IICT-BAS.

The 9th International Conference "Recent Advances in Natural Language Processing" (RANLP 2013) was held on September 7-13, 2013 in Hissar, Bulgaria. The RANLP events, organised biennially in Bulgaria, consist of two days of tutorials, main conference of three days and post-conference workshops held in two days. In 2013 the focus fell on large scale technologies, which adjusted the event to the AComIn perspective. Four tutorials were given on 7-8 September, discussing automatic processing of Wikipedia and scalable approaches for discovering phrasal expressions and semantic relations. The main conference (9-11 September) included 6 invited talks, 60 oral presentations, 39 poster presentations, and a parallel Student Research Workshop with 4 oral presentations and 21 posters. The Workshops held on 12-13 September included 4 invited talks and 21 oral presentations. The event gathered 159 participants, 18 of them from Bulgaria (5 from IICT-BAS). The invited lecturers, supported by AComIn, gave keynote lectures on large scale word sense disambiguation, automatic assessment of the Wikipedia content, policy issues for language resources in the data era, automatic text simplification, and automatic collocation extraction. The conference and workshop Proceedings are uploaded as usual in the Digital repository of the Association for Computational Linguistics (*ACL Anthology*). They contain 5 AComIn related papers.

Upcoming events supported by AComIn

International Workshop "Autonomic Computing and Automatic Control in Computer Systems" (ACACCS), a co-event of the International Conference "Automatics and Informatics 2013", October 3-7, 2013, Sofia, Bulgaria. The Workshop aims at demonstrating the potential of AComIn project results for developing autonomic computing and automatic control in computer systems. Selected papers will be published in a special issue of the "Cybernetics and Information Technologies" journal.

The 1st National Workshop "Information and Communication Technologies for Human Health and Quality of Life" (ICT-HuHeQuL2013) was held on May 15-17 2013 in Stara Zagora, Bulgaria. The discussed topics ranged from theoretical considerations of modelling and simulation approaches to demonstration of application prototypes that can be used in healthcare decision making, ambient assisted living, orthopaedic surgery, quality preservation of foods, etc. The workshop was attended by 42 participants (14 from IICT-BAS, 5 invited lecturers, 5 participants from companies, 8 from various academic organisations, and 10 local experts leading or working in regional institutions). 22 talks were given in the following topics: ICT for Human Health – 6 presentations, ICT for Quality of Life – 6 presentations, ICT in Medical Robotics – 5 presentations and ICT for Healthy Food – 5 presentations.

Workshop "ICT for New Materials and Nanotechnologies" is a co-event of the Int. Conference "Robotics, Automation and Mechatronics" RAM 2013, October 8-10, Bankya, Bulgaria. The Workshop aims at demonstrating advances in applications of ICT for new materials and nanotechnologies. Selected papers will be published in a special issue of the "Cybernetics and Information Technologies" journal.