Name of the Institution:
University of Patras
Department of Medical Physics
Biomedical Technology Unit
Web: www.upatras.gr http://bme.med.upatras.gr/

Name of the TEMPUS CRH-BME representative: **Prof. Nicolas Pallikarakis**

BME GROUP/LABORATORY PRESENTATION

The Biomedical Technology Unit, one of the five groups in the Department of Medical Physics at the School of Health Sciences from the University of Patras, Greece is headed by Prof. N. Pallikarakis. The laboratory has a presence in frontline health related research of 20 years, in the broad domains of Medical Physics, Biomedical Engineering and Technology Deployment and focused in a number of key research areas including:

Medical Imaging, Diagnostic Tools and Methods

The laboratory is recognized as one of the pioneers and major contributors to the development of limited angle reconstruction techniques for clinical applications under spatially restricted conditions. During the period 1987-1995, the research has been directed towards the development, validation and implementation of a ***Digital Tomosynthesis*** (DTS) imaging prototype, based on the ***Multiple Projection Algorithm*** (MPA) which was patented in 1994. The second development phase (1995 – 2002) is characterized by an evolution of the MPA into a ***Cone Beam Computed Tomography*** (CBCT) formulation***.*** Concurrently, research was oriented towards motion correction methods, the objective being to obtain high-quality CBCT tomograms of moving organs, in particularly the case of the heart, resulting in a ***Dynamic DTS-CBCT*** imaging modality.
As the complexity and time and cost demands of testing and experimentation increased, new alternative, in silico testing methods were developed (see also Mathematical Simulation). In the end of 90s, the ***Radiographic Simulator*** was developed. Its further developing resulted in ***Mammographic Simulator*** and the ***Dual-Energy Simulator.***

Mathematical Modelling, Agent based Modelling

In the mid 90s a new direction of research emerged, in the Biomedical Technology Unit of the Medical Physics Laboratory as a new, self-contained research area of modelling and simulation for in silico design, testing and experimentation to support on going research in two main directions: (i) medical imaging and physiological systems modelling and (ii) emergent effects of healthcare processes.

Agent-based modelling techniques have been developed. Analytical, semi-analytical and Monte Carlo techniques are used in the simulators to model existing or novel systems and simulate property transport through them. Complex mathematical approaches are used to model the breast content, its compression and its two-dimensional projections. The ***Animal Simulator*** models imaging, diagnostic and monitoring applications and is used for training and research purposes. The ***Radiotherapy Simulator*** models absorbed dose under varying irradiation conditions and techniques and has been made feasible and operational in practice, following development of the GRID infrastructure in the laboratory, due to the excessive computation resources required.

Tools for simulation of health care processes and their emergent properties were first developed in the late 90's, in the specific area of *quality systems modelling*, using deterministic approaches. They are currently evolving into agent-based models and simulators, with applications in several areas, such as health care system response to epidemics specific patient's health care needs and impact of health care interventions - such as nocturnal haemodialysis - on quality, cost, efficiency and safety of care.

Cancer, Radiation therapy, Treatment Planning Simulations

New research fields include modelling of tumour growth using the breast and the animal models. Using the bulk of biological and relevant information, the computer simulation can be used to predict the cancer growth, in response to old and new drugs, as well different environment and gene factors like stress, café, tobacco smokes, age, race, social race, hormones, immune system, genetic factors that play a role in the breast cancer risk and other biological pathways. ***New technologies*** of irradiation treatment of neck and head cancers are also developed and tested; ***new optimized materials*** for healthy tissue protection are modelled and tested for their protection properties, both using the radiotherapy simulator.

Clinical Engineering, Process, Technology and Change Management

In the mid 90s, the Biomedical Technology Unit of the Medical Physics lab developed significant activity in the field of ***Biomedical Technology*** which was, at that time, developing fast in the directions of ***biomedical technology management***. The focus was placed on the effective management of medical equipment with significant expected benefits relating to cost, safety and proper use. A new integrated, Microsoft Windows oriented system, called PRAXIS, was developed, It addresses all tasks of Clinical Engineering Departments and offers a global approach to their management needs, including also vigilance. The main features of this system include: equipment acquisition and replacement management, inventory archiving and monitoring, follow up on scheduled maintenance, corrective maintenance, user training, data analysis and reports. It also incorporates vigilance monitoring, and information exchange module regarding adverse events, together with a specific application for quality control procedures. The system offers the clinical engineers the possibility to monitor and evaluate the quality and cost-effectiveness of the service provided, by means of quality and cost indicators. Particular emphasis has been given to the use of harmonized standards, concerning medical devices nomenclature and classification. The system is being installed and works in more than fifteen hospitals in Greece.
Another top area is the ***safe operation of medical devices***. Related to this, we have experience with the design, creation and the effective operation of the vigilance system for medical devices.

Biomedical Instrumentation and Measurements

The laboratory has also significant experience in the area of ***Biomedical Instrumentation and Measurements***. This includes design and implementation of new sensors, biopotential ***electrodes***, laser and electrical ***biostimulators*** for stimulation of acupuncture points, ***clinical audiometer*** and ***system for weaning from mechanical ventilation***. The latter is used to minimize the duration of the weaning process in patients under mechanical ventilation.

BME EDUCATION

European Postgraduate Programme on Biomedical Engineering

COURSES AVAILABLE IN ENGLISH? (IF YES, ON WHICH LEVEL?)

- BSc: No
- MSc: Yes
- PhD: Yes

ECTS: Total number

- BSc:
- MSc: 90
- PhD:

BILATERAL AGREEMENTS WITH OTHER UNIVERSITIES? (LIST THOSE UNIVERSITIES)

- http://bme.med.upatras.gr/collabor_universities.htm

MAIN BME INTERESTS

- Medical Imaging, Diagnostic Tools and Methods
- Mathematical Modeling, Agent based Modeling
- Biomedical Instrumentation and Measurements
- Cancer, Radiation Therapy, Treatment Planning Simulations
- Clinical Engineering, Process, Technology and Change Management

RECENT SELECTED PUBLICATIONS

[A1]. Kolitsi Z, Panayiotakis G, Anastassopoulos V, Scodras A, Pallikarakis N
A multiple projection method for digital tomosynthesis
Med Phys 19 (4): 1045-1050 1992

[A2]. Kolitsi Z, Messaris G, Panayiotakis G, Pallikarakis N
A modular phantom for digital tomosynthesis X ray units
Rad Prot Dosim 49 (1-3): 277-280 1993

[A3]. Kolitsi Z, Yoldassis N, Siozos T, et al.
Volume imaging in fluoroscopy - A clinical prototype system based on a generalized digital tomosynthesis technique
Acta Radiol 37 (5): 741-748 1996

[A4]. Badea C, Kolitsi Z, Pallikarakis N
A 3D imaging system for in-theatre orthopedic applications based on Digital Tomosynthesis, CARS 2001 Computer Assisted Radiology and Surgery. Berlin, Germany: Elsevier Science B.V. International Congress Series, 2001:376-378

[A5]. Badea C, Kolitsi Z, Pallikarakis N
A wavelet-based method for removal of out-of-plane structures in digital tomosynthesis
Comput Med Imag Grap 22 (4): 309-315 1998

[A6]. Kosta M, Kolitsi Z, Pallikarakis N
Can DTS benefit stereotactic radiotherapy of arteriovenous malformations? A feasibility report
Physica Medica 14 (3): 101-109 1998

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Three-dimensional localisation based on projectional and tomographic image correlation: an application for digital tomosynthesis
Med Eng Phys 21 (2): 101-109 1999

[A8]. Badea C, Kolitsi Z, Pallikarakis N
Image quality in extended arc filtered digital tomosynthesis
Acta Radiologica 42 (2): 244-248 2001

[A9]. Soimu D, Kolitsi Z, Pallikarakis N
A multiple projection algorithm with noise removal of out-of-plane structures for digital tomosynthesis using a stationary detector
4th European Symposium in Biomedical Engineering and Medical Physics, Patras, 25th – 27th June 2004

[A10]. Pallikarakis N
Comment on "Tomosynthesis-based localization of radioactive seeds in prostate brachytherapy"
Med Phys 32 (1): 300-300 2005

[B1]. Soimu D, Buliev I and Pallikarakis N
Circular isocentric cone-beam trajectories for 3D image reconstruction
accepted in *Computer Methods and Programs in Biomedicine* 2006

[B2]. Buliev I, Badea C, Pallikarakis N
A logarithmic amplifier for computed tomography tasks using fluoroscopic projections
JMET, vol.26, 247-252 2002

[B3]. Badea C, Kolitisi Z, Pallikarakis N
A 3D Imaging system for dental imaging based on digital tomosynthesis and cone-beam CT
MEDICON Pula, Croatia 739-742 2001

[B4]. Chlewicki W, Badea C, Pallikarakis N
Performances of fast SART implementation for reconstruction using Cone-Beam projections
UEES '01 Szczecin and Miedzyzdroje, Poland 963-966 2001

[B5]. Soimu D and Pallikarakis N
Circular Isocentric Cone-Beam Trajectories for 3D Image Reconstructions using FDK Algorithm
MEDICON, Italy, 31 July-5 August, 2004

[B6]. Buliev IG, Badea CT, Kolitsi Z, Pallikarakis N
Estimation of the heart respiratory motion with applications for cone beam computed tomography imaging: A simulation study
IEEE Trans on Information Technology in biomedicine 7 (4): 404-411 2003

[C1]. Lazos D, Kolitsi Z, Pallikarakis N
A software data generator for radiographic imaging investigations
IEEE Trans on Information Technology in biomedicine 4 (1): 76-79 2000

[C2]. Lazos D, Bliznakova K, Kolitsi Z, Pallikarakis N
An integrated research tool for X-ray imaging simulation
Computer Methods and Programs in Biomedicine 70 (3): 241-251 2003

[C3]. Bliznakova K, Kolitsi Z, Pallikarakis N
A Monte Carlo based radiotherapy simulator

Nuclear Instruments & Methods in Physics Research Section B-Beam Interactions with materials and atoms 222 (3-4): 445-461 2004

[C4].Bliznakova K, Bliznakov Z and Buliev I
Monte Carlo radiotherapy simulator implemented on a distributed system
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A three-dimensional breast software phantom for mammography simulation
Phys Med Biol 48 (22): 3699-3719 2003

[C6]. Bliznakova K, Kolitsi Z, Pallikarakis N
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Phys Med Biol. 51(18):4497-515 2006

[C7]. Soimu D
Preliminary studies for development of a 3D animal phantom for CT imaging.
5th European symposium on BME, Patras, Greece, 7-9 July, 2006

[C8]. Ivanova T, Bliznakova K and Pallikarakis N
Simulation studies of field shaping in rotational radiation therapy
Med Phys. 33 (11): 4289–4298 2006

[C9]. Ivanova T, Bliznakova K and Pallikarakis N
Simulation studies on the effect of protectors on dose distribution in rotational radiotherapy 5th *European Symposium in Biomedical Engineering and Medical Physics,* Greece, 7th – 9th July 2006

[D1]. Kolitsi Z, Bliznakov J, Gueorguieva-Bliznakova K, Theodorakos Y, Pallikarakis N
Q-Pro: a quality control management system for medical equipment
Journal of Medical Engineering & Technology 24 (3): 117-122 2000

[D2]. Theodorakos Y., Gueorguieva K., Bliznakov J., Kolitsi Z., Pallikarakis N
A protocol building software tool for medical device quality control tests.
Stud Health Technol Inform. 1999; 68: 759 – 63

[D3]. Bliznakov Z, Gueorguieva K, Theodorakos Y, Kolitsi Z and Pallikarakis N
A QS-Pro management tool for Quality Assurance.
VI International Conference on Medical Physics, 1st – 4th September, Patras, Greece 1999

[D4]. Stavrianou K, Pallikarakis N
Technology Assessment of Nocturnal Home Hemodialysis and Quality of Life in End Stage Renal Disease Patients in Greece
3rd European Medical and Biological Engineering Conference EMBEC, Prague 20-25 November, IFMBE Proceedings 2005

[D5]. Bliznakov Z, Pappous G, Bliznakova K, Pallikarakis N
Integrated software system for improving medical equipment management
Biomed Instrum Technol. 37 (1):25-33 2003

[D6]. Bliznakov Z, Pappous G and Pallikarakis N
Implementation of a web based medical device vigilance and user reporting system in Greece
MEDICON 2004 – X Mediterranean Conference on Medical and Biological Engineering and Computing, Naples, Italy 31 July - 5 August, in Proceedings 2004

[D7]. Pappous G, Bliznakov Z, Mitalas G, Pallikarakis N
Medical Device Software and Patient Safety
3rd International Conference on Information Communication Technologies in Health, 7th – 9th July, Samos Island, Greece 2005

[D8]. Bliznakov Z, Mitalas G, Pallikarakis N
Analysis and Classification of Medical Device Recalls
World Congress on Medical Physics and Biomedical Engineering 2006, 27 Aug – 1 Sept 2006, Seoul, Korea

[E1]. Valchinov E, Pallikarakis N
An active electrode for biopotential recording from small localized bio-sources
Biomed Eng Online 3(1):25 2004

[E2]. Valchinov E, Pallikarakis N
Design and testing of low intensity laser biostimulator
Biomed Eng Online 4(1):5 2005

[E3]. Valchinov E and Pallikarakis N
A low cost PC based system for high quality multichannel recording and analysis of bioelectric events
2nd European symposium on MP/BME, Patras, 6-8 October, 2000

[E4]. Buliev I, Pallikarakis N, and Kolev J
DSP-based audiometer
2nd European symposium on MP/BME, Patras, Greece, 6-8 Oct, 2000

[E5]. Buliev I, Filos K and Pallikarakis N
Computer-based System for weaning of conscious Patients from mechanical ventilation
5th International Symposium of Communication Systems, Networks and Digital Signal Processing 19-21 July, 2006, Patras, Greece