

Carnegie Mellon | Portugal Program

2010 Expressions of Interest for Co-Supervision of ECE Dual Degree PhD Students

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Title**Supporting Sustainable Practices**

Ian Oakley, Mathematics and Engineering, University of Madeira
Anind K. Dey, HCII, SCS, CMU

Short Description of the Proposed Research

Environmental sustainability is an increasingly important global issue. People, particularly those in the western world, use resources faster than they can be reproduced. This behavior is arguably a consequence of the seductive vision of “wellbeing” afforded, enabled and encouraged by industrialization. This is intrinsically unsustainable and the research challenge addressed in this project is the creation and discovery of methods for people to achieve self-fulfillment sustainably. The work is situated in the fields of engineering and Human-Computer Interaction and has three major foci: (i) use of sensors and machine learning to monitor and make sense of human behavior; (ii) application of motivational theory to intentionally influence people’s behavior; and (iii) use of a design mode of inquiry to address “wicked problems,” such as sustainability. The practical work takes place in two key areas of human activity: resource use in the home and transportation. A major theme throughout the project is the use of social networking services as an enabling technology.

Keywords

sustainability, mobile, web, persuasive, sensors

Expected Student Profile

- mobile phone programming
- solid CS/CE background
- good communication (written/spoken English)

Research Methodology

- develop sensing systems to measure and report energy use
- develop web and mobile phone systems to provide feedback to energy consumers
- develop persuasive, social interfaces that support reduction in energy consumption

Useful Links

<http://www.labuse.org/sinais/>

Title**SINAIS - Home resource consumption**

Nuno Jardim Nunes, M-ITI, U. Madeira

Lucio Soibelman, CEE, Col. Engineering

Short Description of the Proposed Research

The objective of this research is to explore the use of multi-sensor systems in conjunction with contextual inquiry HCI techniques to detect and understand significant human activities related to resource consumption in a domestic environment. Through combining sensing systems with exploratory HCI techniques we aim to achieve a deeper understanding of the human behavior related to resource consumption in the home, thereby providing evidence that could be used to motivate sustainable practices or design innovative services.

Keywords

sustainability sensors hci machine learning

Expected Student Profile

We are seeking a student with background in electrical and computer engineering or CS with experience in sensor technology and machine learning.

Research Methodology:

The output of this research will be a robust and tested low-cost sensing infrastructure with associated machine learning systems informed through in-depth contextual inquiry that can be used to develop compelling applications of sensor-based statistical models.

Useful Links

www.m-iti.org

www.labuse.org/sinais

Other information

This research will happen in the context of the SINAIS (Sustainable Interaction with social Networks, context Awareness and Innovative Services) lead research project.

Title**Prevention of Blackouts in Electric Power System by the Application of Fast N-1 Solver**

Luis Miguel Silveira, Pedro Manuel Santos de Carvalho, Department of Electrical and Computer Engineering, IST, Technical University of Lisbon

Gabriela Hug-Glanzmann, Xin Li, Department of Electrical and Computer Engineering, Carnegie Institute of Technology, Carnegie Mellon University

Short Description of the Proposed Research

Electric power systems are the backbone of today's society. Outages in these systems affect everyday's life severely and may paralyze entire countries. The goal of this project is to develop a fast simulator for faults in power systems which can be used to guarantee that the system is in a secure state even if an element fails. This goal will be achieved by applying mathematical concepts to large-scale power systems to resolve the issue of the computational burden when trying to ensure N-1 security. In particular, a nonlinear relaxation algorithm and a low-rank update scheme for matrix operations will be used to solve power flow equations. The incorporation of this fast solver into an optimization problem used for the secure control of power systems and the decomposition of the resulting optimization problem is another mathematically challenging part of the project. This project is designed for a PhD thesis, where the student will be able to take advantage of the combined knowledge of the involved researchers. It is a multidisciplinary project that allows the student to obtain an understanding of the operation of a power system and apply mathematical principles to a system that is mathematically challenging.

Keywords

Power system, N-1 security, numerical solver

Expected Student Profile

This project is suitable for a student either with a background in numerical computation or in power systems. The student is expected to develop new numerical analysis and optimization algorithms and apply them to power flow analysis and control. These algorithms will be implemented and tested within a programming environment (e.g., MATLAB).

Research Methodology

Algorithm development and programming

Useful Links

The following is a list of the personal web sites of the faculties involved in this project:

<http://algos.inesc.pt/~lms/>

<http://energia.ist.utl.pt/pedro/>

<http://www.ece.cmu.edu/~ghug/>

<http://www.ece.cmu.edu/~xinli/>

Title**Geo-optimized and cross-layer transport communications**

Susana Sargento, Dept. Electronics, Telecommunications and Informatics, University of Aveiro, Portugal, Institute of Telecommunications
Peter Steenkiste, ECE, CMU

Short Description of the Proposed Research

So far, in most vehicular applications, navigation and communication are viewed as separate capabilities with little or no relationship between each other. Although much work has already been done related to the enhancement of vehicular communication protocols, they do not consider the leveraging of rich data sets provided by GPS receivers, such as position information, roadmap geometry, and traffic conditions, which would improve the utilization of the wireless medium and provide higher quality of service for a wide range of applications. With this goal in mind, we shall seek for opportunities to use GPS data at every layer of the communications protocol stack. The work to be performed in this Thesis aims to improve transport layer communications with geographic information in a cross-layer approach, studying the influence of lower layer characteristics and enhancements, mainly related to the MAC layer, in the transport layer.

Keywords

vanets, transport protocols, MAC, geographic information

Expected Student Profile

The student should have MSc on the area of telecommunications, data networks, IP communications, wireless communications.

Research Methodology

The type of work will consider analysis of existent mechanisms, possibly through simulation, and then proposal of new mechanisms, through theory, functional, communication and evaluation strategies.

Useful Links

<http://www.av.it.pt/ssargento>
<http://www-2.cs.cmu.edu/~prs/>
<http://drive-in.cmuportugal.org/>

Title**Optimizing Vehicular Communications through Hybrid Networks**

Susana Sargento, Dept. Electronics, Telecommunications and Informatics, University of Aveiro,
Institute of Telecommunications

Ozan Tonguz, ECE, CMU

Short Description of the Proposed Research

In most vehicular applications, navigation and communication are viewed as separate capabilities with little relationship between each other. The reliability of vehicle-to-vehicle communication depends on several factors: vehicles density, location, mobility models and radio propagation. In this sense, the support of infrastructure points, denoted as Road Side Units (RSU), may be used to increase reliability in vehicular communications. However, the number of RSUs needs to be minimized to decrease the communications cost; this requires an unusual optimization process, which needs to operate in this extremely dynamic environment. The choice of the optimal number, location and characteristics of RSUs to significantly optimize communication, dependent on the vehicular network and road characteristics, aided by GPS traffic information and dynamic trends on traffic loads, are problems that will be subject of the work in this Thesis. The research of network protocols and extended network applications in these optimized networks will be also addressed.

Keywords

Vanets, RSUs, Optimize connectivity, GPS traffic information

Expected Student Profile

The student should have MSc on the area of telecommunications, data networks, IP communications, wireless communications.

Research Methodology

The type of work will consider analysis of delays in Vanet communications, analytical work to optimize the connectivity, followed by proposal of new protocols and applications, through theory, functional, communication and evaluation strategies.

Useful Links

<http://www.av.it.pt/ssargento>

<http://www.ece.cmu.edu/~tonguz/main/>

<http://drive-in.cmuportugal.org/>

Title**A virtual machine for distributed, resource-constrained environments**

Ricardo Rocha, Department of Computer Science, Faculty of Sciences, University of Porto

Todd Mowry, Computer Science/Electrical and Computer Engineering, Carnegie Mellon University

Short Description of the Proposed Research

Claytronics is a project combining modular robotics, systems nanotechnology and computer science to create the dynamic, 3-Dimensional display of electronic information known as claytronics. The goal is to give tangible, interactive forms to information so that a user's senses will experience digital environments as though they are indistinguishable from reality. Claytronics is taking place across a rapidly advancing frontier. This technology will help to drive breathtaking advances in the design and engineering of computing and hardware systems.

Within this project, a key challenge is designing and writing robust and reliable software programs that will manage the shaping of ensembles of millions of atoms into dynamic, 3-Dimensional forms. The Meld logic programming language was proposed towards this goal: it allows an ensemble to be viewed as a single computing system. Examples of such ensembles, include programmable sensor networks (where the network topology can change due to failures in the nodes or links) and modular robotics systems (whose physical configuration can be rearranged under program control). A first compiler for Meld showed that we can write efficient and complex programs for ensembles containing over one million nodes.

The actual deployment of Meld will require going one step further and designing a virtual machine based environment for Meld. The challenge we propose is therefore to design and implement a virtual machine that will run well in distributed, resource-constrained environments. The design must scale well up to environments with millions of nodes. It must perform well on very small machines, with limited memory footprint, and limited computational power. Orchestration issues between millions of nodes or in simulation will need to be investigated. The student will work with the Claytronics team at CMU, and with the Logic Programming group at Porto. The first group is the original developer of Meld and is highly interested in the language. The Porto group has long expertise in parallel logic programming, and is highly motivated to participate in this collaboration.

Keywords

singing biofeedback acoustic perceptual parameters

Expected Student Profile

The student is expected to have a strong motivation for and a consistent background on signal processing, pattern recognition, real-time voice and audio signal analysis, coding and identification.

The student is expected to combine good programming skills concerning efficient signal processing algorithm design and optimization (C/C++) for real-time operation, and innovative solutions for signal analysis, perceptually relevant feature extraction, acoustic-perceptual identification and recognition, and interactive operation.

Title**Stream Analysis Techniques for Real-Time Process Mining**

Prof. Diogo R. Ferreira, Dept. of Computer Science and Engineering, IST, Technical University of Lisbon

Prof. Christos Faloutsos, Dept. of Computer Science, Carnegie Mellon University

Short Description of the Proposed Research

Process mining deals with discovering process models and behavior from event logs recorded at run-time. However, current process mining techniques are able to handle run-time data in offline mode only. The goal of this work is to adapt existing techniques and/or to create new techniques to facilitate the analysis of event logs in real-time. These techniques should be able to build and update process models - in their graph, logic, or probabilistic representations - as event data becomes available in real-time. The same techniques should also be able to distinguish between different versions of the same process as its run-time footprint changes over time. To address these challenges, it will be necessary to combine and extend process mining techniques and stream mining techniques developed at the Technical University of Lisbon and at Carnegie Mellon University, respectively.

Keywords

Process Mining, Stream Mining

Expected Student Profile

Background or interest in Business Process Management (BPM) and Data Mining (DM) is highly recommended. Good writing skills and ability to work proactively are expected.

Research Methodology

The candidate is expected to begin by a general review of the challenges and of existing literature, tools and approaches to address those challenges. The first contributions will take the form of incremental improvements over existing techniques. The main contributions will comprise new techniques specifically developed for real-time processing. The techniques will be implemented as standalone tools or as plug-ins for other frameworks. The proposed approaches will have to be validated in lab experiments or in real-world case studies. Results are to be published in relevant scientific conferences and journals.

Useful Links

<http://www.processmining.org/>

<http://web.tagus.ist.utl.pt/~diogo.ferreira/>

<http://www.cs.cmu.edu/~christos/>

Title**Enterprise Network Fault Location Using Probabilistic Graphical Models**

Ricardo Morla, DEEC/FEUP

Hyong Kim, ECE

Short Description of the Proposed Research

Enterprise networks (EN) are rich and complex systems with network infrastructure, application servers, databases, and clients running web, multimedia, and business applications. A critical aspect in managing EN is fault location, i.e. the problem of determining the origin of a fault in the network. Existing literature takes heuristic approaches at this problem. The aim of the proposed research is to develop a systematic approach at enterprise network fault location based on the framework of probabilistic graphical models (PGM). PGM can be used to encode a factorization of the joint probability distribution function of the random variables observed in the enterprise network, on top of which an inference process is used to determine fault location. As the number of observed variables increases, domain-specific knowledge such as network topology, network control plane information, network multimedia service architecture, and application-server dependencies can drastically reduce the complexity of the PGM and speed up the inference process. Network model abstraction using control plane data is proposed. This research will address how different domain-specific knowledge can be used to improve fault location in enterprise networks.

Keywords

Fault location, Network Control Plane, Enterprise Network, Probabilistic Graphical Models

Expected Student Profile

Networking, Routing, Multimedia, Programming, and basic notions of Probability.

Research Methodology

Start with a basic example of simulated network enterprise data and faults; this will allow familiarization with PGM and fault location inference mechanisms based on PGM. Follow to enterprise network data collection (from public repositories, project partner data sources, or test-bed), definition and implementation of different PGM, and offline evaluation of their fault location performance. Deployment and fine-tuning of one PGM-based fault location mechanism in a live network, including adapting the mechanism to run decentralized.

Useful Links

"S. Lee, T. Wong, and H.S. Kim, "NetPiler: Detection of ineffective router configurations", in IEEE Journal of Selected Areas in Communications, special issue on network infrastructure configuration, Vol. 27, no. 3, pp. 291-301, April 2009.

S. Lee and H.S. Kim, "Correlation, visualization, and usability analysis of routing policy configurations", in IEEE Transactions on Network and Service Management, to appear in 2010.

F. Le, S. Lee, T. Wong, H.S. Kim, and D. Newcomb, "Detecting Network-wide and router-specific misconfigurations through data mining", IEEE Trans. On Networking, vol. 17, No. 1, pp. 66-79, January 2009.

M. Steinder, and A.S. Sethi. 2004. Probabilistic fault localization in communication systems using belief networks. IEEE/ACM Trans. Netw. 12, 5 (Oct. 2004), 809-822

M. Natu and A.S. Sethi, ""Using Temporal Correlation for Fault Localization in Dynamically Changing Networks."" International Journal of Network Management, Vol. 18 No. 4 (July-Aug. 2008), pp. 303-316.

S. Kandula, R. Mahajan, P. Verkaik (UCSD), S. Agarwal, J. Padhye, P. Bahl, Detailed Diagnosis in Computer Networks, SIGCOMM 2009, Barcelona, Spain (August 2009)

Other information

This proposed research is within the context of ongoing collaboration between Hyong Kim and Ricardo Morla involving Portugal Telecom, Portugal's largest telecom operator. Ricardo Morla is spending the 2010 Spring term at CMU to take this collaboration a step further.

Title**Learning Probabilistic Models of Enterprise Networks**

Ricardo Morla, DEEC/FEUP

Hyong Kim, ECE

Short Description of the Proposed Research

Enterprise networks (EN) are rich and complex systems with network infrastructure, application servers, databases, and clients running web, multimedia, and business applications. These networks can be modeled using the probabilistic graphical model (PGM) framework which employs a graph to encode a factorization of the joint probability distribution function of the random variables observed in the enterprise network. In network modeling this graph is typically obtained from domain-specific knowledge such as the network topology. The aim of this research is to develop an approach to obtain this graph directly from the data. This research will explore an approach based on kernel-based methods, likelihood-based model selection, and standard (Fourier, Wavelet) signal processing techniques. An example of a Kernel-based method is the kernel-generalized variance used to speed up the calculation of mutual information, whereas model selection assigns a likelihood value to each model given the observed data that can be used to choose a model. The performance of PGM with different graphs will be assessed through its impact on network management functions such as fault detection.

Keywords

Kernel-based Methods, Signal Processing, Probabilistic Graphical Models, Enterprise Networks

Expected Student Profile

Signal Processing, Machine Learning, Statistics, and Probability.

Research Methodology

Start with toy example of simulated network enterprise data and faults; this will allow familiarization with PGM and failure detection. Choose and implement different kernel-based data processing tools to extract graph factorization and variable independence information from the data and for subsequent model selection. Compare the performance of different graphs (and consequently of different approaches to extract graph factorization) in failure detection. Follow to enterprise network data collection (from public repositories, project partner data sources, or test-bed) and fine-tune model selection algorithm. Finally rethink model selection algorithm for running in a live network.

Useful Links

F. R. Bach and M. I. Jordan. Learning graphical models with Mercer kernels. In Advances in Neural Information Processing Systems 15. MIT Press, 2003

Kline, Jeff; Nam, Sangnam; Barford, Paul; Plonka, David; Ron, Amos. Traffic Anomaly Detection at Fine Time Scales with Bayes Nets, In Proceedings of the International Conference on Internet Monitoring and Protection (ICIMP '08), June, 2008

D. Koller and N. Friedman. 2009. Probabilistic Graphical Models, Principles and Techniques. MIT Press.

Other information

This proposed research is within the context of ongoing collaboration between Hyong Kim and Ricardo Morla involving Portugal Telecom, Portugal's largest telecom operator. Ricardo Morla is spending the 2010 Spring term at CMU to take this collaboration a step further.

Title**Embedding adaptation in distributed model predictive control**

João M. L. de Miranda Lemos, Electrical and Computer Engineering Department, Instituto Superior Técnico (IST), Universidade Técnica de Lisboa (UTL), INESC-ID

Bruce H. Krogh, Department of Electrical and Computer Engineering, Carnegie Institute of Technology (CIT), Carnegie Mellon University, and Center for Sensed Critical Infrastructure Research (CenSCIR), Institute for Complex Engineered Systems (ICES)

Short Description of the Proposed Research

The central subject of the proposed work consists in embedding adaptation in distributed model predictive control (D-MPC). The aim consists in developing innovative algorithms for adaptive D-MPC, to establish their properties, and to demonstrate them in simulation and, if possible, in a large scale pilot plant. MPC is a very powerful technique that allows the control of “difficult” plants, in particular incorporating constraints. When considering its application to large plants, such as water delivery canals, distributed thermo-chemical processes and interacting robot groups, the underlying optimization problem may become so large that a central solution is not possible. It may also happen that the control of different plant subsystems is managed by different agents that each measure only part of the complete system. This leads to D-MPC, a suboptimal solution that aims at approaching the performance that can be achieved by centralized MPC by implementing distributed optimization using limited exchanges of information between local agents. D-MPC is currently a significant research topic. An important issue that has received limited attention to date is how to deal with the inevitable uncertainty in plant dynamics. The mismatch between the models used by the agents and the actual system dynamics will compromise performance. This project will develop methods for embedding adaptation in D-MPC, making it possible to improve the models based on information obtained as the process is running. Adaptation mechanisms may be included in several ways, including parameter estimation and supervised switched multiple models, among others. The work will consider different possibilities and evaluate them, considering both stability and performance.

Keywords

Control, adaptation, distributed optimization, predictive control

Expected Student Profile

It is mandatory to have basic training in Mathematic Analysis, Linear Algebra, introduction to Differential Equations, Linear Systems Theory, introduction to feedback control of linear systems, introduction to programming and basic programming in MATLAB and Simulink. This is included in the typical training of the first 3 years of a degree in Electrical and Computer Engineering or in Mechanical Engineering. It is preferred that the student also has a course on Optimization and additional courses on Control covering state-space techniques, linear quadratic optimal control, introduction to nonlinear systems and control, computer controlled systems and system identification. Candidates without at least part of this additional background should compensate this deficiency with exceptional grades and motivation..

Candidates should be highly motivated to do research in control and to have an interest in pursuing applications from a solid theoretic perspective.

Research Methodology

The type of work the PhD student is expected to do is mainly theoretic (algorithm development; study of control algorithm properties like stability, convergence, bounds of performance), complemented with development of a simulation framework in MATLAB and possibly Simulink. If logistic conditions make it possible, field work will be done by conducting tests of the control algorithms developed in a large scale pilot water delivery canal with multiple pools. Skills of programming are limited to MATLAB, SIMULINK and possibly some simple C code sections for field work testing. The bulk of the work is thus made with “brain, pencil, paper and MATLAB”.

The student will start by reviewing a number of D-MPC algorithms and then study how to embed them with selected adaptation mechanisms.. The properties of the resulting Adaptive D-MPC algorithms will then be studied and demonstrated.

Useful Links

Home page of J. M. Lemos: <http://ramses.inesc.pt/People/jlml>

Home page of Bruce H. Krogh: <http://www.ece.cmu.edu/~krogh/>

Other information

J. M. Lemos is the coordinator of project AQUANET – Decentralised and Reconfigurable Control for Water delivery Multipurpose Canal Systems, starting on January 2010 and lasting 3 years. It is expected that the PhD. student will benefit from interaction with the research team of this project.

D. Jia and B. H. Krogh, Distributed Model Predictive Control, Proc. 2001 American Control Conference, pp. 2767-2772, June 2001.

E. Camponogara, D. Jia, B. H. Krogh, S. Talukdar (2002). Distributed model predictive control. IEEE Control Systems Magazine, February 2002.

D. Jia and B. H. Krogh, Min-max feedback model predictive control for distributed control with communication, Proc. 2002 American Control Conference, May 2002, pp. 4507-4512.

D. Jia, B. H. Krogh, Min-max feedback model predictive control with state estimation Source: Proceedings of the 2005 American Control Conference, 2005, pt. 1, p 262-7 vol. 1.

D. Jia, B. H. Krogh, and O. Stursberg, An LMI approach to robust model predictive control, Journal of Optimization Theory and Applications, Vol. 127, No. 2, November, 2005.

S. Talukdar, . D. Jia, P. Hines, and B. H. Krogh, Distributed Model Predictive Control for the Mitigation of Cascading Failures, 44th IEEE Conference on Decision and Control, Dec. 2005, pp. 4440 – 4445.

Y. Zhang and S. Li (2007). Networked model predictive control based on neighborhood optimization for serially connected large-scale processes. Journal of Process Control 17:37–50.

Title**Vital Responder – Monitoring stress among first responder professionals**

Miguel Tavares Coimbra, Instituto de Telecomunicacoes, Dept. Computer Science, Faculty of Sciences, University of Porto

Vijayakumar Bhagavatula, Electrical & Computer Engineering, Carnegie Mellon University

Short Description of the Proposed Research

Research will be integrated into the CMU|Portugal project “Vital Responder” and will involve using signal processing and pattern recognition methodologies to determine stress and fatigue levels of first responder professionals in action, namely firemen. The student is expected to focus in one or more of the areas explained in the research methodology, and to integrate a multi-disciplinary research team of around 30 people.

Keywords

Biomedical Signal Processing, Pattern Recognition, Physiology

Expected Student Profile

Strong signal processing background.

Reasonable understanding of pattern recognition methodologies.

Interested in applied research and in field experimentation and testing.

Research Methodology

The student is expected to focus in one or more of these areas:

- Understand the physiological manifestation of stress and fatigue on humans.
- Study adequate wearable sensors and their signal and noise characteristics.
- Extract relevant physiological parameters from raw captured signals.
- Detect and predict stress and fatigue related events.

Useful Links

www.vitalresponder.org

www.dcc.fc.up.pt/~mcoimbra

Title**Learning Visual Representations**

Alexandre Bernardino, Instituto Superior Tecnico

Fernando De la Torre, Robotics Institute

Short Description of the Proposed Research

For decades researchers have been working in Computer Vision to extract from images and videos meaningful information for a multitude of applications: surveillance, control, diagnosis, interfaces, entertainment, etc. However, despite being a very rich source of information vision is also very computationally demanding due not only to the massive amount of data to process but also because of the immense amount of possible objects, activities, motions, color, textures, present in the visual signals. It is very difficult, and a tenuous work, to manually create models of visual entities from physical principles due to the complexity of the process. Machine learning concepts can help on addressing these issues because representation can be extracted directly from the input data. Both in a surveillance system or in an autonomous robot, the required models are very dependent, and can be learned specifically, and mostly in an unsupervised way, from the data stream. This research proposal aims at developing theory and algorithms to address the broad goal of autonomously learning efficient representations of visual entities in artificial systems. The focus will be on automating the process as much as possible so that the systems can continuously adapt (open-ended learning) and control its own learning process (self-learning systems). As a side-effect, this research can also help us better understand the principles whereby humans are so efficient in visual learning and processing.

Keywords

Computer Vision, Machine Learning, Dimensionality Reduction, Self-Learning Systems, Open-Ended Learning.

Expected Student Profile

Strong mathematical background.

Research Methodology

The student is expected to conduct basic research in learning theory and optimization with applications to signal processing and computer vision.

Useful Links

www.humansensing.cs.cmu.edu

www.ca.cs.cmu.edu

www.cs.cmu.edu/~ftorre

<http://users.isr.ist.utl.pt/~alex/pmwiki/index.php>

Other information

If interested contact Fernando De la Torre (ftorre@cs.cmu.edu) or Alexandre Bernardino (alex@isr.ist.utl.pt) for more detailed information.

Title

Large scale systems: analysis design and control

Carlos Silvestre, ISR, IST Lisbon

Bruno Sinopoli, ECE

Short Description of the Proposed Research

The candidate will develop novel methodologies to address the analysis and design of large scale distributed networked control systems, with applications to robotics, power systems, transportation systems.

Keywords

control, robotics, complex systems

Expected Student Profile

The student is expected to have a solid theoretical background (having a master is a plus) in theory as well experience in the design and evaluation of prototype systems. Enthusiasm and creativity is a plus.

Research Methodology

Develop analytical, computational tools for design and analysis of complex systems as well realize prototypes

Title**Secure and Real-Time Coordination of Distributed Network Operations Centers**

Paulo Sousa, Dept. Informatics, Faculty of Sciences, Univ. Lisbon, LaSIGE

Hyong Kim, Electrical and Computer Engineering, College of Engineering, CMU

Short Description of the Proposed Research

Network operations centers (NOCs) have a fundamental role on telecommunication networks given that they have the responsibility of monitoring, managing and troubleshooting various kinds of problems (e.g., power failures, circuits' problems). In order to ensure 24x7 availability, they are often geographically distributed. For instance, AT&T, Sprint Nextel, and Verizon have distributed NOCs. This distribution implies the need for coordination protocols, which should be able to maintain effective, reliable, and secure coordination in the presence of network problems of various types, either provoked by accidental faults (e.g., equipment malfunction, natural disasters) or attacks. The goal of this PhD is to devise innovative network operation center modes of operation, whose improvement will lie on dependable coordination of multiple decentralized and distributed centers, as opposed to the fairly centralized trend today. Devising fault-tolerant architectures and protocols for secure and real-time coordination of such distributed centers will be a key aspect. We envisage that the PhD work will include the design and implementation of secure & real-time fault-tolerant communication protocols for WANs, wired and/or wireless, optimized for different levels of reliability, latency and security.

Keywords

Network operations centers, dependable coordination, fault-tolerant communication, real-time, security

Expected Student Profile

The student should have a good background on electrical and computer engineering, namely on computer networking and on wired/wireless communication protocols.

Research Methodology

The PhD work will be a balanced mix of theory and practice. On the theory side, the student will devise fault-tolerant architectures and protocols for secure and real-time coordination of distributed network operations centers (NOCs), and new NOC functionalities that take advantage thereof, like decentralization. On the practice side, the student will implement these coordination protocols on top of secure & real-time fault-tolerant communication protocols for WANs. This may include building network cards (wireless and/or wired).

Useful Links

http://www.navigators.di.fc.ul.pt/?Research_Lines:FIT

http://www.navigators.di.fc.ul.pt/?Research_Lines:TADS

http://lasige.di.fc.ul.pt/Main_Page

<http://en.di.fc.ul.pt/Informatica/Welcome!>

http://en.wikipedia.org/wiki/Network_operations_center

<http://www.ece.cmu.edu/directory/details/81>

<http://homepages.di.fc.ul.pt/~pjsousa/>

Title**Adaptive and Automatic Security and Dependability of Client Machines**

Paulo Verissimo, pjv@di.fc.ul.pt, Dept. Informatics, Faculty of Sciences, Univ. Lisbon, LaSIGE

Virgil Gligor, gligor@cmu.edu, Electrical and Computer Engineering Dpt., College of Engineering, CMU

Short Description of the Proposed Research

Threats to computer systems have been increasing over the past few years. Given the dependence of society and businesses on computers, we have been spending every day more to make computer systems and networks secure enough. While attention has been devoted to infrastructures (servers, data centers) the client machine trustworthiness remains a great challenge. It has been pointed out recently that a possible key to client-side trustworthiness is the development of models and technologies allowing the automatic and secure operation of coexisting realms with different degrees of trustworthiness, from totally untrusted (may be compromised) to totally trusted (tamperproof), in a same physical client machine. These would allow the metaphore of there existing, on a same PC, the "office work", the "web-browsing", the "e-banking" computers, etc., each protected in incrementally demanding ways as seen fit. To fulfill this ambitious vision, we intend to study combinations of prevention and tolerance techniques applied to PC architectures, since current practice and technology are largely based on intrusion prevention, but have been know to be insufficient, albeit very necessary. We plan to combine the natural existence of preventive mechanisms with effective tolerance mechanisms and protocols, to devise hybrid distributed system models representing virtual client machines exhibiting hybrid and adaptive security and dependability characteristics.

Keywords

Client security and dependability, trusted components, automatic security, hybrid distributed systems

Expected Student Profile

The student should have a good background on electrical and computer engineering, namely on computer networking and O.S. and on distributed systems and security.

Research Methodology

The PhD work will be a balanced mix of theory and practice. On the theory side, the student will devise the fundamental work leading to the hybrid distributed system models representing virtual client machines exhibiting hybrid and adaptive security and dependability characteristics, in a transparent and automatic way. As a means to achieve our goals, we plan on investigating with: innovative local cryptographic techniques leveraging trusted trustworthy components such as smart cards or the TCG/TPM attestation mechanisms; isolation between virtual machines residing on a same hardware machine (hypervisors); Byzantine fault-tolerant protocols amongst diverse replicas; self-healing of individual components that may have been compromised, even as new attacks take place. On the practice side, the student will devise proof-of-concept experiments implementing these protocols and mechanisms. This may include building small prototypes.

Useful Links

http://www.navigators.di.fc.ul.pt/?Research_Lines:FIT

http://lasige.di.fc.ul.pt/Main_Page

<http://en.di.fc.ul.pt/Informatica/Welcome!>

<http://www.ece.umd.edu/~gligor/>

<http://homepages.di.fc.ul.pt/~pju/>

Title**Design of Highly Optimized Multiprocessor Systems on Chip for Image and Video Processing Applications**

Valeri Skliarov, Department of Electronics, Telecommunications and Informatics, University of Aveiro
Radu Marculescu, Dept. of Electrical and Computer Engineering, Carnegie Mellon University

Short Description of the Proposed Research

The basic idea of this research is to develop design methodologies, software tools, and hardware prototypes for future multiprocessor systems-on-chip that are highly optimized for image and video processing applications. This is important area of research which has a large spectrum of real-life application domains. The nature of the work is interdisciplinary and so the anticipated impact quite significant.

Keywords

Multiprocessor systems-on-chip, Networks-on-chip, low-power design, FPGA

Expected Student Profile

Strong background in algorithms and programming, low power design, hardware specification and prototyping. Basic understanding of systems-on-chip design, multicore and parallel systems, image and video processing.

Research Methodology

This research work will involve algorithms, simulation, and FPGA prototyping. In the first part of this research work, the student will explore various algorithms and optimization techniques that are well suited for this type of multiprocessor platforms. This will involve mostly software and simulations tools. During the second part of this project, the student will evaluate the proposed methodology using hardware specification languages and FPGA prototypes. Final results will be demonstrated using real image and video processing applications.

Useful Links

<http://www.ece.cmu.edu/~sld/wiki/doku.php>

<http://www.ieeta.pt/~skl/index.html>

Title**Layered architecture for dependable and intrusion-tolerant wireless networks**

Hans Peter Reiser, Dept. Informatics, Faculty of Sciences, Univ. Lisbon, LaSIGE

Peter Steenkiste, Departments of Computer Science and Electrical and Computer Engineering, CMU

Short Description of the Proposed Research

In the near future, a large part of the communication infrastructure will be wireless. Highly heterogeneous, mobile nodes will expect the infrastructure to provide similar dependability and security properties as found in traditional communication networks. It is to be expected that malicious users will be the most severe threat of a wireless infrastructure. Traditional protection mechanisms such as physical isolation and firewalls are hardly feasible in dynamic, ad-hoc networks. The objective of this proposal is to elaborate a layered architecture that protects the ad-hoc wireless against malicious attacks. At the low-level link layer, recent smart antenna and software defined radio technology (e.g., beamforming) shall be applied to mitigate low-level attacks such as radio jamming. At the routing layer, algorithms need to cope with malicious participants. Traditional BFT algorithms that cope with this kind of faults need to be evolved towards the dynamic characteristics and energy constraints of the nodes. At the highest level, self-optimizing network services need to be aware of malicious entities. The goal needs to be optimizing the dependability given a number of malicious nodes.

Keywords

dependability, security, wireless networks

Expected Student Profile

The student should have a good background on electrical and computer engineering, namely on distributed systems, computer networking and wireless communication protocols.

Research Methodology

The work will be a balanced mix of theory and practice. On the theory side, the PhD student will design and specify the layered architecture and the respective algorithms. On the practice side, the student will develop a prototype implementation of the architecture and evaluate the design using an emulator testbed.

Useful Links

http://www.navigators.di.fc.ul.pt/?Research_Lines:FIT

http://www.navigators.di.fc.ul.pt/?Research_Lines:TADS

http://lasige.di.fc.ul.pt/Main_Page

<http://en.di.fc.ul.pt/Informatica/Welcome!>

<http://www.cs.cmu.edu/~prs/>

<http://homepages.di.fc.ul.pt/~hans/>

Title**Bio-inspired Neuromorphic Systems for Computational Vision**

Miguel Velhote Correia, University of Porto, School of Engineering, ECE, INESCPorto

Xin Li, Carnegie Mellon University, ECE, Center for Circuit & System Solutions

Short Description of the Proposed Research

This proposed research consists of the investigation, development and implementation of an artificial vision system which fits, by its level of integration, in what is usually called Vision Chip. The work involves the following tasks 1) study and develop algorithms which perform the same processing of the human retina, like the detection of movement, contours, contrast, etc. and 2) develop an electronic mixed-signal circuit with both analog and digital components that are responsible for image acquisition and its pre-processing. The system must have biological inspiration with neurophysiologic and psychophysics relevance for the human vision, and hence it could constitute or integrate a device of support, substitution or rehabilitation of the vision functions for some quotidian tasks.

Keywords

Neuromorphic, Vision Chips, Silicon Retina

Expected Student Profile

The candidate must hold a graduate degree in Electrical and Computer Engineering, Electronics Engineering, Computer Science or equivalent.

Research Methodology

The PhD student is expected to:

- study the biologic system of human vision in the relevant literature for the subject of this investigation, in the domains of engineering, neurophysiology and psycho-physics
 - analyze and develop models and algorithms for visual information processing with biologic inspiration;
 - optimize the chosen algorithms for implementation in dedicated hardware;
 - conceive, project and develop the electronic system;
 - test and acquire results with the developed system;
- and finally
- validate the study and development accomplished against available psycho-physical and neurological data.

Useful Links

<http://spectrum.ieee.org/biomedical/imaging/neuromorphic-vision-chips>

http://www.fe.up.pt/si_uk/FUNCAONARIOS_GERAL.FORMVIEW?P_CODIGO=240172

<http://www.ece.cmu.edu/~xinli/>

Title**Foundations of Future Communications Networks**

Prof. Miguel Rodrigues, Instituto de Telecomunicações, Department of Computer Science, University of Porto

Prof. Rohit Negi, Department of Electrical and Computer Engineering, Carnegie Mellon University

Short Description of the Proposed Research

The objective of the research work is to establish the foundations of future communications networks. In particular, the work will consider key aspects of future networks such as the provision of reliability and security. To address these challenging problems, we shall use the principles and methodologies of the discipline of information theory.

Keywords

Communications Networks, Information Theory, Communications Theory, Reliability, Security

Expected Student Profile

The PhD student is expected to have a strong mathematical and engineering background. Prior knowledge of information theory, communications theory, signal processing and networks is also highly desirable.

Research Methodology

The PhD student will be able to concentrate on the theory and practice of communications networks, which in addition to leading to important contributions in the field would also allow him to acquire a deep understanding of many areas revolving around the area.

Useful Links

Prof. Miguel Rodrigues webpage: www.dcc.fc.up.pt/~mrodrigues

Prof. Rohit Negi webpage: <http://www.ece.cmu.edu/~negi/>

Title**Automatic speech recognition facilitated by auditory modeling**

Isabel M. Trancoso, Department of Electrical and Computer Engineering of Instituto Superior Técnico and INESC-ID Lisboa

Richard M. Stern, Department of Electrical and Computer Engineering and Language Technologies Institute

Short Description of the Proposed Research

As applications of speech technologies such as automatic speech recognition and speaker identification are now becoming commonplace, it is becoming increasingly apparent that speech systems which are designed to achieve good performance in optimal acoustical environments typically fail catastrophically when deployed in locations in which substantial noise and/or reverberation is present. Nevertheless, the ability of the human auditory system to interpret speech sounds reliably under the same conditions serves both as an existence proof that much better recognition accuracy is possible, and as an inspiration for how to achieve that better performance.

The proposed research will be directed toward the development of speech recognition and speaker identification systems which develop statistical features that are motivated by knowledge of how the auditory system processes sounds. While this approach is not new, we are presently at a point in which current understanding of auditory processing and speech technology combined with the continuing advances in computational power provides an opportunity to achieve dramatically greater advances than before.

Our work will develop processing that incorporates auditory knowledge both at the level of the auditory nerve (peripheral processing) and at the level of the brainstem (which mediates sound localization and other types of speech enhancement based on spatial diversity). While this work will build on current efforts at CMU that have produced simple but effective models that exploit the most important elements of auditory physiology in a pragmatic fashion, the proposed work will produce processing that is based on a more detailed and a more literal model of the human auditory system."

Keywords

recognition, acoustical robustness, auditory processing, signal processing

Expected Student Profile

We are looking for a talented student with a good mathematical background and a basic knowledge of signal processing and (if possible) pattern recognition, at least at the undergraduate level. Knowledge of speech technology and auditory processing is desirable but not necessary.

Research Methodology

We will develop algorithms for speech feature extraction based on auditory principles, primarily using MATLAB and C for algorithm development and system integration, respectively. Performance of the signal processing algorithms will be evaluated and validated by measuring their impact on the recognition accuracy of the open source CMU speech recognition system, Sphinx. These evaluations will be conducted both using standard speech databases that are artificially degraded and using speech recorded in natural environments of interest.

Useful Links

The CMU robust speech group's website:

<http://www.cs.cmu.edu/~robust>

Sample papers which provide some background for the proposed work:

<http://www.cs.cmu.edu/~robust/Papers/is2009KimStern.pdf>

<http://www.cs.cmu.edu/~robust/Papers/polyaural.pdf>

The website of the Spoken Language Systems Lab (L2F) of INESC-ID:

<http://www.l2f.inesc-id.pt>

Other information

The work will be performed in the CMU Robust Speech Recognition Group, working in close collaboration with L2F INESC ID, and other colleagues at LTI. The CMU Robust Group has maintained robust speech recognition as its primary focus for almost two decades and is one of the best known groups in the world in the field. Over the years the Robust Group has developed well known and widely used algorithms to improve speech recognition accuracy in difficult environments in the areas of statistically-based compensation for the effects of noise and filtering, missing-feature compensation, multi-stream information fusion, microphone array processing, and signal processing motivated by auditory physiology and perception.

The CMU speech group is known for the development of the Sphinx speech recognition system, the Festival and FLITE text-to-speech synthesis systems, the CMU-Cambridge language modeling toolkit, and the Olympus spoken dialog architecture, among many other successful projects.

The L2F group has specialized in all speech technologies for Portuguese. One of the major outcomes of this R&D has been the automatic subtitling of TV news, live at RTP since March 2008.

Title**Representation Learning for Medical Applications**

Jaime S. Cardoso, ECE Department, Faculty of Engineering, University of Porto, INESC Porto
Fernando de la Torre, Computer Science Department, Robotics Institute

Short Description of the Proposed Research

This proposal will focus on the effective and efficient retrieval of medical images. Clinical decision support techniques such as case-based reasoning or evidence-based medicine can produce a strong need to retrieve images valuable for supporting certain diagnoses. For the clinical decision-making process, it can be beneficial or even important to find other images of the same modality, the same anatomic region, or the same disease. However, medical images are not amenable to a direct process of knowledge extraction. Several problems are still unsolved, both at the representation level and at the gap between the extracted visual features and the semantic concepts a user searches for.

While feature vectors are typically used to represent the perceived environment, shape, relational and structural descriptions are deemed to be of crucial importance to capture the relevant information on medical images. Since relations are not easily represented by feature vectors, researchers have resorted to richer representations such as graphs to capture the structure. Moreover, the integration of such representations with learning methods is still a challenge. A second difficulty is that the diagnostically most important information in medical images is rarely deduced from the whole image but is restricted to specific regions of interest (ROIs), e.g. the detection of fractures or tumors, while the rest of the image is mainly important for orientation. The restriction of the query to a certain ROI in the image is still unsolved. A third challenge involves the learning algorithms. While many medical diagnostics require the prediction of the intensity or ranking of a phenomena (such as the degree of the disease), conventional algorithms do not use such ranking information to improve prediction.

The project aims at researching new representations and learning formulations for image retrieval in medical applications.

Keywords

Machine vision, Pattern recognition, Machine learning, medical image retrieval

Expected Student Profile

Prior contact with image analysis and machine learning concepts. Strong mathematical background.

Research Methodology

We will conduct basic research in computer vision and machine learning, done mostly in Matlab. The PhD Student will be integrated in ongoing research projects at INESC Porto in collaboration with the Medical School at Porto, and at CMU.

Useful Links

<http://www.fe.up.pt/~jsc/>

<http://www.cs.cmu.edu/~ftorre/>

Human sensing lab:

<http://www.humansensing.cs.cmu.edu/>

Component Analysis Lab:

<http://www.ca.cs.cmu.edu/>

Title**Other information** **Design and Implementation of FPGA-based Systems and Networks on Chip for Solving Computationally Intensive Problems**

Valeri Skliarov, Iouliia Skliarova, Department of Electronics, Telecommunications and Informatics/ IEETA, University of Aveiro

Radu Marculescu, Electrical and Computer Engineering Department

Short Description of the Proposed Research

The research is dedicated to FPGA-based implementation and optimization of computationally intensive algorithms applying alternative techniques (e.g. recursive vs. iterative algorithms), reconfiguration and paradigms of SoC (Systems On Chip) and NoC (Networks On Chip). Examples of such algorithms are image processing (e.g. compression, decompression, conversion between formats), combinatorial optimization (e.g. Boolean satisfiability, set covering, graph coloring), data processing (e.g. sorting, priority selection). The emphasis will be done on analysis and comparison of: 1) alternative and competitive techniques (e.g. SoC vs. NoC); 2) models (e.g. processor-based, advanced FSM based); 3) architectures; and 4) parallel implementations. Theoretical results will be confirmed by profound experiments and comparisons. As an example, let us consider fast sorting algorithms. They can be executed using different data structures, such as binary trees, linked lists, etc. In many cases data structures can be processed applying either recursive or iterative algorithms. Different potential ways of parallel processing (such as simultaneous traversing of different subtrees) can be used. The research is dedicated to analysis, comparison and selection of the best algorithms that can be implemented in reconfigurable FPGA-based SoC and NoC.

Keywords

Reconfigurable computing, FPGA, Systems on Chip, Networks on Chip, Multi-core systems

Expected Student Profile

The PhD student is expected to have a good basic education in the areas of digital design and hardware description languages. Knowledge of general-purpose programming languages, reconfigurable FPGA-based digital systems, SoC and NoC paradigms, and discrete mathematics is welcome.

Research Methodology

1. Review of state of the art in the scope of Ph.D. work.
2. Analysis and comparison of algorithms from one of the proposed areas, that are: image processing; combinatorial optimization; data processing; processing of matrices and vectors.
3. Design, implementation and test of hardware (FPGA-based systems) communicating with general purpose computers (e.g. through PCI express, USB).
4. Profound experiments with the designed systems.
5. Dissemination of the results through presentations and discussions at top-level conferences, such as FPL, FCCM, DATE, DAC.

Useful Links

<http://www.ece.cmu.edu/~radum/index2.html>

<http://www.ieeta.pt/~skl>

<http://www.ieeta.pt/~iouliia>

Other information

At the end of scholarship the student will acquire profound knowledge in the following areas. Design, implementation and test of complex dynamically reconfigurable FPGA-based systems. The use of industrial computer-aided design systems. Fluent knowledge in general-purpose (such as C/C++) and hardware description (such as VHDL) languages. SoC and NoC paradigms and their use in practice. Alternative implementations of computationally intensive algorithms with emphasis on parallelism and dynamic reconfiguration. Methodology of experiments with FPGA-based systems. Advanced models of finite state machines.

Title**Real-time Scheduling on Multicores**

Bjorn Andersson, CISTER Research Unit at the Engineering School of Polytechnic Institute of Porto
Raj Rajkumar, Department of Electrical and Computer Engineering at Carnegie Mellon University

Short Description of the Proposed Research

Multicore processors were originally designed for high-end computer systems but their use has spread. They are today the norm in desktop computers. And the next step is that they will be standard building blocks in embedded computer systems. (Embedded computer systems are embedded in products, for example cars, pace makers or robots, and these computers typically take sensor readings and control the physical environment.) Multicore processors is a good match for embedded computer systems because of their power-efficiency and because software engineers in embedded system are already accustomed to writing threaded applications so the extra burden of designing software for multicore as compared to single-cores is reduced.

The use of multicore processors in embedded computer systems is complicated however by the fact that many embedded computer systems have real-time requirements. Typically, the time from sensing to actuation must be bounded. Therefore, researchers at CMU and ISEP are addressing the problem of scheduling a set of threads on a multicores so that timing requirements are fulfilled. Prospective Ph.D. students are invited to join these efforts.

Keywords

Real-time systems, real-time scheduling, multiprocessor, multicores.

Expected Student Profile

The student is expected to have taken an undergraduate course in operating systems. The student must have a strong background in mathematics; for example knowledge in linear programming, integer-linear programming, optimization in general and discrete mathematics.

Research Methodology

Theory (proving that a given scheduling algorithm will meet all deadlines) and systems (implementing and testing a scheduling algorithm in an operating system).

Useful Links

<http://www.ece.cmu.edu/~raj/>

<http://www.cister.isep.ipp.pt/~bandersson>

<http://www.cister.isep.ipp.pt/research/multicore+systems/>

Title**CAGE - Computer Assisted Gastroenterology Examination**

Miguel Tavares Coimbra, Instituto de Telecomunicacoes, Dept. Computer Science, Faculty of Sciences, University of Porto.

Jelena Kovačević, Depts. of Biomedical Engineering & Electrical and Computer Engineering Carnegie Mellon University

Short Description of the Proposed Research

Research will be integrated into the CAGE (Computer Assisted Gastroenterology examination) research line of the University of Porto and will involve researching novel texture descriptors that are adequate for in-body imaging scenarios such as Chromoendoscopy, Narrow-Band Imaging and High-Definition endoscopy. The student is expected to integrate a multi-disciplinary research team of computer scientists and Gastroenterologists.

Keywords

Medical Imaging, Texture Descriptors, Pattern Recognition

Expected Student Profile

Strong image processing background.

Reasonable understanding of pattern recognition methodologies.

Interested in applied research and in field experimentation and testing.

Research Methodology

The student is expected to:

- Review the state-of-the art in texture descriptors.
- Study the specific texture characteristics of in-body imaging scenarios.
- Research novel texture descriptors that are adequate for in-body imaging scenarios.
- Perform classification experiments using pattern recognition methodologies.

Useful Links

www.dcc.fc.up.pt/~mcoimbra

www.andrew.cmu.edu/user/jelenak/index.html

Other information

Cooperating institutions include the Universities of Porto - Faculty of Sciences, Faculty of Medicine (Portugal), Carnegie Mellon University (US), Portuguese Institute of Oncology - Porto (Portugal), Portuguese Institute of Oncology - Coimbra (Portugal), Karolinska Universitessjukhuse (Sweden)

Title**Decentralized estimation of diffusive sources and fields using mobile sensors**

Joao Pedro Gomes, Department of Electrical and Computer Engineering, Instituto Superior Tecnico, Technical University of Lisbon, Institute for Systems and Robotics

Bruno Sinopoli, Department of Electrical and Computer Engineering, College of Engineering - Carnegie Institute of Technology

Short Description of the Proposed Research

This research addresses problems of information processing on sensor networks, i.e., ad-hoc networks with hundreds or thousands of low-cost nodes that can sense, compute, and communicate via wireless radio. The potential of these sensor networks to carry out complex and useful tasks through collaboration of simple nodes has sparked an intense research effort at various levels to develop hardware prototypes, networking protocols, and effective methods to fuse the collected data and extract useful information. Applications include tracking and surveillance, social networking, or monitoring of large-scale infrastructures. The proposed work aims to develop theoretical tools for estimation of the spatial and temporal concentration of pollution gases or other diffusive fields at large scales from measurements taken by a set of both static and mobile sensors. Unlike classical estimation scenarios, where (possibly compressed) measurements are conveyed to a central station for processing, the emphasis here is on developing decentralized methods where field estimates emerge from local interaction between neighbouring nodes. Mobility of nodes adds to the problem complexity, as optimal sampling strategies intersect with control theory for trajectory planning. Criteria for selecting subsets of sensors that can be used to effectively localize diffusive sources while conserving energy resources in the network are also of interest.

Keywords

Sensor networks, diffusive field estimation, mobile sensors, decentralized estimation, optimal control

Expected Student Profile

The student is expected to have a solid background in mathematics and statistics, and a keen interest in signal processing methods, control theory, and optimization. Proficiency in Matlab programming is also valued.

Research Methodology

Development of theory and algorithms (estimation, control). Testing and validation of algorithms through simulation.

Useful Links

<http://www.isr.ist.utl.pt/~jpg/>

Title**Vital Responder – Monitoring stress among first responder professionals**

Miguel Tavares Coimbra, Instituto de Telecomunicacoes, Dept. Computer Science, Faculty of Sciences, University of Porto.

Anind D. Key, Computer Science Carnegie Mellon University

Short Description of the Proposed Research

Research will be integrated into the CMU|Portugal project “Vital Responder” and will involve using human computer interaction methodologies to provide real-time information on biosignals, stress and fatigue levels of first responder professionals in action, namely firemen, to their respective team leaders. The student is expected to integrate a multi-disciplinary research team of around 30 people.

Keywords

Human Computer Interaction

First Responders

Biosignals

Expected Student Profile

Strong human computer interaction background.

Interested in applied research and in field experimentation and testing.

Research Methodology

The student is expected to:

- Prepare, perform and analyze relevant user studies.
- Design and evaluate interactive solutions for the target scenario.
- Support adequate prototyping needs.

Useful Links

www.vitalresponder.org

www.dcc.fc.up.pt/~mcoimbra

<http://www.cs.cmu.edu/~anind/>

Other information

The project involves a multi-disciplinary team of around 30 people involving computer scientists, engineers, cardiologists and psychologists. Cooperating institutions include the Universities of Porto and Aveiro (Portugal), BioDevices S.A (Portugal), Carnegie Mellon University (US), Voluntary Firemen of Amarante (Portugal), V.N.Gaia Civil Protection (Portugal), Portuguese Royal Hospital (Brazil).