

MAP-I

Joint doctoral programme in Computer Science of Universidade
do Minho, Universidade de Aveiro and Universidade do Porto

2008/09 Course Edition

System Software and Applications for Ambient Intelligence (UCT)

Teaching Team

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A. Course Description

1. Overview and Context

This document describes a course on “**System Software and Applications for Ambient Intelligence**” to be proposed as an instantiation of UCT (Unidade Curricular em Tecnologias) for the 2008/09 edition of the Joint doctoral programme in Computer Science of Universidade do Minho, Universidade de Aveiro and Universidade do Porto (MAP-I).

The course introduces students to the general topics of ubiquitous and pervasive computing and is particularly focused in systems and applications for Ambient Intelligence. At the end of this course, students should be able to create systems that explore the enormous innovation potential raised by the increasingly pervasive presence of information technologies in all aspects of our everyday life. This corresponds to an emerging need in the market for people that are skilled in designing, developing, deploying and evaluating Ambient Intelligence systems – as the new Fraunhofer centre for ambient intelligence in Porto illustrates.

The course is organised by researchers from University of Minho and University of Porto with a vast research experience in the field of Ubiquitous Computing and Ambient Intelligence. It also builds very strongly on previous teaching experience in this area such as the MSc on Mobile Systems of the Engineering School of University of Minho and the seminar on “Software Infrastructures for Smart Spaces” in the previous edition of MAP-I.

Ambient Intelligence

Research labs such as Fraunhofer and industrial manufacturers such as Philips have been promoting the Ambient Intelligence paradigm in which people interact with an environment that is personalized to people’s tastes, anticipates people’s behaviour, and is proactive in satisfying people’s needs. Ambient Intelligence builds on the paradigm of Ubiquitous Computing, where computation is embedded into everyday objects, where everything communicates with everything else, and where virtual and physical environments are closely interconnected. With computing devices becoming progressively smaller and more powerful, it is sensible to expect that almost any object, from clothing to coffee mugs, will be embedded with some sort of computational capability and able to connect to any other device. This enables Ambient Intelligence and will dramatically change our perception of what a computer system is, as the entire environment with all its integrated devices and associated services becomes indistinguishable from the computer. In such a scenario, the environment becomes the interface and computation devices, as we currently know them, fade into the background. Ambient Intelligence and Ubiquitous Computing systems are thus radically different from traditional distributed systems, and set many new research challenges that cut across various disciplines.

System Software and Applications for Ambient Intelligence

System software for Ambient Intelligence environments has become a particularly active topic of research, its ultimate goal being the creation of a meta-operating system for physical environments. Such software infrastructure should be able to transparently

manage the relevant resources and provide an integrated execution environment in which applications, seen here as orchestrated collections of services, could be executed in association with the corresponding physical environment. Many middleware architectures have been proposed that aim to provide the necessary glue to integrate an open, diverse and a priori unknown set of services into a functioning system. Examples include the Event Heap [1], One.World [2], Aura [3] and GAIA [4]. Typical issues include the architectural approach, the discovery, selection and spontaneous interaction between entities, naming, event notification, and the ability to enable cooperation between entities even if separated in time and space. These systems provide some type of programming model that application developers can use to create new applications without having to consider the details of the underlying infrastructure. Research in the area of middleware for Ambient Intelligence environments has been in progress for the last few years, both in academia and industry, and it is now possible to study and compare a diverse number of approaches and their accomplishments.

Driving the behaviour of the system, applications lie on top of the system software and have to deal with the complexity and diversity of an Ambient Intelligence environment. Issues such as the user experience, privacy, social and legal implications, business models, and user-led system and application innovation must be considered when designing these applications. For example, in ambient assisted living scenarios where the environment assists patients or elderly people in their daily tasks, reminding them for example to take prescribed medicine, application designers may need to find approaches that enable patient monitoring without clashing into their privacy. Ambient Intelligent scenarios are rich with such applications and challenges. Rather than simply evaluating the final system, interaction design techniques and evaluations are crucial from the beginning, as they play a central role in informing the evolution of the system design in a way that matches the expectations, opportunities and practices of the targeted environment.

- [1] B. Johanson and A. Fox, "The Event Heap: a coordination infrastructure for interactive workspaces," presented at Fourth IEEE Workshop on Mobile Computing Systems and Applications, 2002.
- [2] R. Grimm, J. Davis, E. Lemar, A. MacBeth, S. Swanson, T. Anderson, B. Bershad, G. Borriello, S. Gribble, and D. Wetherall., "System support for pervasive applications.," *ACM Transactions on Computer Systems*, vol. 22 No 4, pp. 421-486, 2004.
- [3] J. P. Sousa and D. Garlan, "Aura: an Architectural Framework for User Mobility in Ubiquitous Computing Environments," presented at Software Architecture: System Design, Development, and Maintenance (Proceedings of the 3rd Working IEEE/IFIP Conference on Software Architecture), 2002.
- [4] M. Román, C. K. Hess, R. Cerqueira, A. Ranganathan, R. H. Campbell, and K. Nahrstedt, "Gaia: A Middleware Infrastructure to Enable Active Spaces," *IEEE Pervasive Computing* No Oct-Dec., pp. 74-83, 2002.

Scientific areas

C. Computer Systems Organization/ C.2 COMPUTER-COMMUNICATION

NETWORKS/ C.2.1 Network Architecture and Design

C. Computer Systems Organization/C.2 COMPUTER-COMMUNICATION

NETWORKS/C.2.4 Distributed Systems

D. Software/D.1 PROGRAMMING TECHNIQUES/D.1.3 Concurrent Programming

D. Software/D.2 SOFTWARE ENGINEERING/ D.2.11 Software Architectures

D. Software/ D.2 SOFTWARE ENGINEERING / D.2.12 Interoperability

H. Information Systems/ H.5 INFORMATION INTERFACES AND PRESENTATION/

Similar courses

In recent years, Ubiquitous and Pervasive Computing has become a common topic for graduate courses in computing. For example, for some years, the CMU PhD Programme in Computer Science includes a course on Mobile and Pervasive Computing (<http://www.cs.cmu.edu/~15-821/>) and another on Research Topics in Ubiquitous Computing (<http://www.cs.cmu.edu/~jasonh/courses/ubicomp-sp2007/>).

However, and despite the emergence of multiple types of courses dedicated to Ubiquitous and Pervasive Computing, this is still a relatively recent topic for which there is no widely accepted view on the respective body of knowledge. This reality is exacerbated by the inherent multidisciplinary nature of Ubiquitous and Pervasive Computing, which means that different courses may approach the topic from very diverse perspectives.

In 2003, as multiple courses were spreading everywhere, multiple workshops and papers started addressing the topic of ubiquitous and pervasive computing teaching. One of the most influential in terms of defining the core body of knowledge associated with pervasive and ubiquitous computing was the *UbiComp Education: Current Status and Future Directions* [1]. Even though this is not a formal curriculum for ubiquitous and pervasive computing, it remains the most important reference for the structure of such courses and will also be used as the base structure for this course. Those interested in the details of the proposed structure are referred to the IEEE Pervasive Computing article where the workshop conclusions are presented[2].

[1] Abowd, G.D., G. Borriello, and G. Kortuem. UbiComp Education: Current Status and Future Directions: workshop at UbiComp 2003, Seattle, USA. 2003. Available from: <http://ubicomp.lancs.ac.uk/workshops/education03>.

[2] Abowd, G.D., G. Borriello, and G. Kortuem, Report from the UbiComp Education Workshop. IEEE Pervasive Computing, 2004. 3(1): p. 94-98.

2. Objectives and Learning Outcomes

This course aims to introduce students into the broad topics of Ubiquitous and Pervasive Computing, providing them with the key technological knowledge and methodological approaches for designing, developing, deploying and evaluating systems based on those paradigms. Within the broad set of topics associated with Ubiquitous and Pervasive Computing, this course has a particular focus on software infrastructures for Smart Spaces, working in more detail the challenges and reference approaches for enabling software infrastructures that become integral parts of their physical and social environments.

At the end of this course, students are expected to be able to:

- Explain the general principles of Ubiquitous Computing and the key technical and social factors driving the change towards post-desktop paradigms
- Explain the main implications of Ubiquitous Computing for system design, development and deployment.
- Explain reference approaches used in Ubiquitous Computing and evaluate their applicability in specific application scenarios

- Analyse an existing infrastructure for Ambient Intelligence from the perspective of the key design approaches.
- Realise simple Ambient Intelligence environments that combine virtual and physical, while showing a balanced attention to the relevant technical, social and economical factors involved.

3. Program

- A. Introduction to Ubiquitous and Pervasive Computing
 - a. General principles
 - b. Motivation and key driving factors
 - c. Main characteristics of post-desktop computing
 - d. The Ambient Intelligence vision
- B. Merging the virtual and physical worlds
 - a. General approaches
 - b. Techniques and Technologies
 - c. Sensing and modelling the physical environment
 - d. Machine learning and activity recognition
- C. Interaction Models
 - a. New interaction techniques
 - b. Situated and context-aware computing
 - c. Background interaction
 - d. Multi-modal interaction
 - e. Activity-driven computing
- D. Software Architectures for Ambient Intelligence
 - a. Key Challenges for software development
 - b. Design Principles for Smart Spaces: Volatility, Boundary, Self-configuration, Graceful degradation, and Maintainability
 - c. Key services for pervasive computing environments: Context, Location, Discovery, Events, Communication services, Bootstrapping, Security and Privacy.
 - d. Service discovery and collaboration patterns
 - e. Toolkits and middleware
 - f. Application frameworks
 - g. Case Studies: Event Heap, Gaia, Aura, Anywhere Places
- E. Designing and deploying systems for everyday life
 - a. Evaluation of the user experience
 - b. Interaction Design for everyday life
 - c. Open Innovation in Ubiquitous and Pervasive Computing
 - d. Privacy
 - e. Social implications
 - f. Business models
 - g. Main legal implications

F. Application Case Studies

- a. Scribe4Me: Evaluating a Mobile Sound Transcription Tool for the Deaf
- b. SenseCam: a Retrospective Memory Aid
- c. Coping with Uncertainty in a Location-Based Game
- d. Healthcare Systems and Other Applications
- e. Instant Places

4. Teaching Methodologies and Evaluation

This course corresponds to 5 ECTS involving a broad range of learning activities with a particular focus on active learning techniques. These will be favoured, not only for their ability in stimulating student engagement, but mainly because the learning outcomes proposed for this course include high-level objectives that can only be achieved through the execution, by the students, of analysis, development and discussion tasks. Furthermore, the high quality of the students involved, will contribute to maximise participation and therefore the benefits of the approach. The course also includes a practical component, which despite in this case being necessarily limited in scope, is repeatedly referred and recommended as a key enabler for learning in Ubiquitous Computing because of its role in structuring the relationship between the conceptual aspects of the field and the reality of deploying information technology for the mundane realities of everyday life.

Student activities will then be organized in approximately the same proportion among 3 main activities: Lectures, a State of the Art Report and a System Report.

Lectures will be used mainly at the beginning of each main section in the program to provide an initial background and quickly prepare everyone to the topic. The use of videos and the study of reference case studies will be used to complement the presentation of the topics and guide the study of the most commonly used approaches and issues.

In the **State of the Art Report**, students will have to select one of the topics in the program and investigate in more detail the existing work to produce a report where they briefly describe and analyse previous research. This will be an opportunity for students to develop their research skills in searching and analysing previous work, while studying in more detail a particular topic that they find motivating. A presentation of the results to the class will also part of the activity.

In the **System Report**, students will be asked to propose a particular system for Ambient Intelligence and a set of associated research questions. This will be an opportunity to build small but challenging systems that will help students master ambient intelligent technologies and best practices. While implementation is not required, practical evaluation of key technologies may be important in gaining some insight into some of the key issues involved and will be strongly recommended. Simulation using virtual worlds may also be used not only to reduce hardware requirements for class but, most importantly, enable students to develop more interesting Ambient Intelligence systems and applications. The need to indicate research questions associated with the proposed system aims to stimulate students to go beyond the merely technical specification and exercise their analysis skills by identifying and describing the broad issues involved in creating ambient intelligence systems.

Assessment will be based on the evaluation of both reports. The State of the Art Report will be evaluated based on its scope and on the ability to analyze, compare, relate and judge the relevance of previous research. The System Report will be evaluated on the innovation of the proposed system, on the coherence of the specification and on the broadness of the issues considered.

5. Main Bibliography

Within the topics of this course, and particularly at this level, there are no text books that can significantly cover the proposed program. Therefore, the key bibliography for the course will be mainly based on research papers. In this section, we indicate only the key bibliography that can be considered more generic and mandatory reading for all participants in the course.

Mark Weiser, "Some Computer Science Problems in Ubiquitous Computing," Communications of the ACM, July 1993. (reprinted as "Ubiquitous Computing". Nikkei Electronics; December 6, 1993; pp. 137-143.)

M. Satyanarayanan, "Pervasive Computing: Vision and Challenges," IEEE Personal Communications, vol. 8, pp. 10-17, 2001.

G. Banavar and A. Bernstein, "Software infrastructure and design challenges for ubiquitous computing applications," Communications of the ACM, vol. 45, pp. 92 - 96, 2002.

Bell, G. and P. Dourish (2007). "Yesterday's tomorrows: notes on ubiquitous computing's dominant vision." Personal and Ubiquitous Computing 11(2): 133 - 143.

Rogers, Y. (2006). Moving on from Weiser's vision of of calm computing: engaging UbiComp experiences. Ubicomp 2006, Orange County, California, USA, Springer-Verlag.

Alex, S. T., H. Richard, et al. (2007). "Homes that make us smart." Personal Ubiquitous Comput. 11(5): 383-393.

Kindberg, T.; Fox, A., "System software for ubiquitous computing", IEEE Pervasive Computing Magazine, vol.1, no.1, pp. 70- 81, Jan-Mar 2002

N. Davies and H.-W. Gellersen, "Beyond prototypes: challenges in deploying ubiquitous systems," IEEE Pervasive Computing, vol. 1 No 1, pp. 26- 35, 2002.

R. Sharp and K. Rehman, "The 2005 UbiApp Workshop:What Makes Good Application-Led Research?," IEEE Pervasive Computing, vol. 4 No 3, pp. 80-82, 2005.

W. K. Edwards and R. E. Grinter, "At home with ubiquitous computing: seven challenges," presented at UBICOMP 2001: Ubiquitous Computing International Conference, Atlanta, GA, 2001.

B. Teaching Team

1. Coordinator

Rui José (University of Minho)
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2. Overview of the research team

The course will be conducted in collaboration between Rui José (University of Minho), Ricardo Morla (University of Porto) and José Campos (University of Minho).

These three researchers are all actively involved in ubiquitous computing and ambient intelligence research and together provide a valuable mix of complementary competences for the topics of this course.

Rui José is a member of the Ubicomp@UMinho team, a research group at Algoritmi, an ICT research centre of the Engineering School of University of Minho. This group has been actively engaged in ubiquitous computing research for some years, and has organised the first conference in this area in Portugal, CSMU'06, where Rui José was the Program Chair. In addition to the publication record, Rui José research experience in this area also includes the participation in several research projects and the regular contribution as a reviewer for the main conferences and journals in the field, including the Ubicomp and Pervasive conferences and the IEEE Pervasive Computing journal. Additionally, Rui José also has an extensive experience in teaching Ubiquitous and Pervasive Computing. He was the first Director of the MSc in Mobile Systems where he was responsible for the course on Ubiquitous Computing.

Ricardo Morla is actively conducting research in the field of Ubiquitous Computing and Ambient Intelligence. He is currently looking into immersive virtual worlds such as Second Life™ as a tool for simulation and prototyping of Ubiquitous Computing systems, as a middleware for Ubicomp applications, and as a tool particularly suited for teaching ubiquitous computing classes. Ricardo has a funded research project on this subject in collaboration with the University of California, Irvine, where he has lectured on distributed systems and mobility issues that are core to Ubiquitous Computing and Ambient Intelligence. Ricardo is also involved in other projects related to this field and is trying to create a research group on intelligent environments at his home institution; some of these projects he focus e.g. on the co-location of devices, on intermittent interaction, and on overlays for intelligent transportation systems, in addition to other projects that leverage on virtual worlds.

José Creissac Campos is a member of the Foundations and Applications of Software Technology research group at CCTC (Sciences and Computing Technologies Centre), a research centre from the Engineering School of the University of Minho. His research interests lie in the intersection of Software Engineering and Human-Computer

Interaction (HCI). In recent years he has developed a strong interest in mobile and ubiquitous computing. He is particularly interested in the problems faced when trying to design, analyse and develop the human interaction for such heterogeneous contexts as those present in mobile and ubiquitous computing settings. He serves as Programme Committee member in a number of conferences, including IFIP TC13 INTERACT, and DSV-IS. He his programme co-chair of Interacção 2008, the third Portuguese HCI conference. He has led and participated in a number of funded research projects. For the last 6 years he has tough and been responsible for a number of HCI courses at the postgraduate level, including a course on the MSc in Mobile Systems.

3. CV Rui José

Name	Rui João Peixoto José
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Academic Degrees, fields of study, award institutions, dates

in reverse chronological order

- 1997-2001: PhD in Computing (Distributed Systems) from Lancaster University (UK). Thesis title “An Open Architecture for Location-Based Services in Heterogeneous Mobile Environments”. Supervisors: Professors Nigel Davies and Geoff Coulson.
- 1993–1995: MSc in Computing, University of Minho, Portugal. Subject: Distributed Systems, Computer Communications and Computer Architectures. Dissertation title: “Adaptive access to Internet Information Services”
- 1988–1993: Five years degree in Software and Computer Engineering, University of Minho, Portugal

Synopsis of current research interests:

Rui José is the principal investigator of the Research Program on Situated Displays for Smart Places, a multi-disciplinary long-term initiative that is part of the efforts of the Algoritmi Research Centre in the area of Smart Places and aims to develop and evaluate a new concept of situated display that can serve as a general purpose and strongly situated information artefact. This work is based upon a vision of situated displays as shared, networked, and pro-active devices that are embodied into their environment and provide an execution environment for situated applications. Key research challenges include software design issues associated with this concept of situated displays, the exploration of the concept in various real world applications and domain-specific scenarios, the use of displays as enablers for embodied interaction in situated computing, and the understanding of how displays can provide an execution environment for situated applications.

Additional Information:

Rui José has been actively involved in Ubiquitous and Pervasive Computing for some years. He has been the Program Chair for first Portuguese Conference on Mobile and Ubiquitous Computing (CSMU2006) and he is regularly invited as reviewer for the main conferences and journals in the area of pervasive and ubiquitous computing, including:

- International Conference on Pervasive Computing (PERVASIVE)
- International Conference on Ubiquitous Computing (UBICOMP)
- IEEE Transactions on Mobile Computing,
- IEEE Pervasive Computing
- Mobile Computing and Communications Review (MC2R)

Rui José has also participated in the several Scientific Program Committees in this area, including (most recent):

- Membro da Comissão de Programa da *Interação 2008 – 3ª Conferência Interação Pessoa-Máquina* – Universidade de Évora, 15 a 17 de Outubro de 2008
<http://interacao2008.xdi.uevora.pt/>
- Membro da Comissão de Programa do 13o Encontro Português de Inteligência Artificial - EPIA 2007 no âmbito do “*AmITA'2007 – Workshop on Ambient Intelligence Techniques and Applications*”, 3-7 Dezembro. Guimarães, Portugal.
<http://epia2007.appia.pt/>
- 7th International Workshop on Smart Appliances and Wearable Computing (IWSAWC 2007) within ICDCS 2007, 29 de June 2007, Toronto, Canada
- Workshop on Location Based Services for Health Care (LOCARE '06) within PervasiveHealth, Innsbruck, Austria. 29 November, 1 December 2006.
<http://www.pervasivehealth.org/>
- Artech 2006 – Third International Conference on Digital and Electronic Art, Pontevedra, Galiza, Spain, 17-18 November 2006
<http://artec2006.ccg.pt/>
- Interacao'2006 – 2ª Conferência Nacional em Interação Pessoa-Máquina, Braga, de 16 a 18 de October 2006.
<http://interacao2006.di.uminho.pt/>
- Conferência sobre Sistemas Móveis e Ubíquos (CSMU 2006), Guimarães, 29-30 June 2006. (Program Chair)
<http://ubicomp.algoritmi.uminho.pt/csmu>
- Workshop on Pervasive Display Infrastructures, Interfaces and Applications, within Pervasive 2006, Dublin, Ireland, 7-10 May, 2006.
<http://ubicomp.algoritmi.uminho.pt/perdisplay>

He has also has a very extensive teaching experience in the area of ubiquitous and pervasive computing, at both graduate and undergraduate levels, including 3 editions of a course on Ubiquitous Computing in the MSc in Mobile Systems of the University of Minho (since 2004), and a similar one in the MSc in Communications Engineering. He has also been Director of the MSc in Mobile Systems (Since January 2004) of the Engineering School of University of Minho.

Projects (last 5 years)

Situated web portal for local awareness and transient interaction

→ Principal Investigator (May 2005/April 2007)

Funding: Fundação para a Ciência e Tecnologia (POS-C/EIA/58832/2004), 75000€(Global) 69003€(UMinho).

Main partners: Associação Centro de Computação Gráfica - CCG/ZGDV.

<http://ubicomp.algoritmi.uminho.pt/situaction/>

USE-ME.GOV - USability-drivEn open platform for MobilE GOVernment

→ Senior Researcher (Jan.2004/ Mar. 2006)

Funding: European Commission-6FP Information Societies Technology (IST) Programme (IST-002294): Global budget: 1.350.250 € UMinho: 134.160 €

Main partners: Edisoft, S.A., Portugal (coordinator); Retevisión Móvil, S.A., Spain; Universidade do Minho, Portugal; Câmara de Vila Nova de Cerveira, Portugal; Indra Sistemas, S.A., Spain; Asociación Extremeña de Formación Tecnológica, Spain; The Poznan University of Economics, Poland; City Hall of Gdynia, Poland; Fraunhofer Institute for Applied Information Technology, Germany; Arakne S.r.l., Italy; City Hall of Bologna, Italy; IntuiLab S.A., France.

<http://ubicomp.algoritmi.uminho.pt/usemegov/>

▪ **LOCAL - Location contexts for location-based services and applications**

→ Senior Reseracher (Fev. 2004/ Jan. 2006)

Funding: Fundação para a Ciência e Tecnologia (POSI/CHS/44971/2002), 46.092 €

<http://ubicomp.algoritmi.uminho.pt/local/>

▪ **VADE - Value Added Environments for Dynamic Support to Location-Based Services in UMTS Networks**

→ Principal Investigator (Feb. 2002/Oct. 2004)

Funding: Fundação para a Ciência e Tecnologia (POSI/CHS/38475/2001), 68.595 €(global) 49.420 €(UMinho)

Main partners: Associação Centro de Computação Gráfica - CCG/ZGDV

PhD Students

- **Fernando Reinaldo Silva Garcia Ribeiro.** “Software Platforms for context-aware interactive spaces” July 2005.
- **Hélder Manuel da Silva Pinto.** “System support to localised activities in ubiquitous computing”. June 2003.

Publications (last 5 years)

- Richard Harper, Tom Rodden, Yvonne Rogers, Abigail Sellen (Eds). HCI 2020. A report on the future of HCI. Microsoft Research. March 2008. Contributor.
- The Mediterranean Journal of Computers and Networks (MEDJCN). Special Issue On Mobile and Ubiquitous Systems. Guest Editors: Adriano Moreira, Rui José and Carlos Bento. Volume 3, No. 1, January 2007. ISSN: 1744-2397
- Rui José and Carlos Baquero (Eds), Proceedings of the Conference on Mobile and Ubiquitous Systems. Universidade do Minho. ISBN 972-8692-29-3. July 2006.
- Helder Pinto, Rui José. “An Activity-Centered Ubiquitous Computing

Framework for Public Spaces". The Mediterranean Journal of Computers and Networks. Special Issue on Mobile and Ubiquitous Computing. 2007

- Helder Pinto and Rui José. "ActivitySpot: activity-centered ubiquitous computing support to localized activities". Proceedings of the Conference on Mobile and Ubiquitous Systems (CSMU 2006). Guimarães, Portugal, 29-30 June, 2006.
- Helder Pinto, Rui José. "Pervasive location-based systems: the fundamental challenges between vision and reality". International Journal of Pervasive Computing and Communications. Special issue on Ubiquitous Computing. Vol.1, N°1, pp. 7-12, ISSN 1742-7371.Troubador Publishing Ltd, Março 2005
- Arouca, David; Figueiredo, Carlos; José, Rui; Machado, Ricardo J.; Monteiro, Paula; Moreira, Adriano; Pascoe, Jason; Pinheiro, Luís; Rodrigues, Helena; Santos, Leonel; Santos, Maribel; Silva, Abílio; Tilsner, Dirk, Os Sistemas de Informação Geográfica no suporte a Serviços Móveis para o Cidadão, Actas do Encontro Português de Utilizadores de Sistemas de Informação Geografica, 2 - 4 Junho, 2004, Lisboa, Portugal.
<http://hdl.handle.net/1822/2356>
- Alexandre Oliveira, Pedro M. Figueiredo, Adérito Marcos, Rui José, "Aplicações Móveis de Valor Acrescentado: um caso Prático". Workshop de Sistemas de Informação Multimedia, Cooperativos e Distribuídos, COOPMEDIA 2003, Porto, 8 de Outubro de 2003.
<http://hdl.handle.net/1822/2831>
<http://www.coopmedia2003.ccg.pt>
- Helder Pinto, Noé Vilas Boas, Rui José, "Utilização do UDDI no suporte à descoberta de serviços baseados na localização", Workshop "XML: Aplicações e Tecnologias Associadas" (XATA 2003), 13 e 14 de Fevereiro, Braga, 2003.
<http://hdl.handle.net/1822/711>.
- Rui José, Adriano Moreira, Helena Rodrigues, and Nigel Davies, The AROUND architecture for dynamic location-based services, Mobile Networks and Applications (MONET), the Journal of Special Issues on Mobility of Systems, Users, Data and Computing. ISSN 1383-469X. Kluwer Academic Publishers, Special issue on Mobile & Wireless Data Management., Aug. 2003.
<http://hdl.handle.net/1822/2674>
- Rui José, Helder Pinto "Display-centred applications in Ubiquitous Computing". Workshop on System Support for Ubiquitous Computing at the 8th Annual Conference on Ubiquitous Computing (UbiComp 2006), Orange County California, USA. September 17-21, 2006
- Rui José. "Beyond Application-Led Research in Pervasive Display Systems", Proceedings of the Workshop on pervasive display infrastructures, interfaces and applications at the 4th International Conference on Pervasive Computing (Pervasive 2006). Dublin, Ireland, 7 May, 2006.
- Helder Pinto and Rui José. "ActivitySpot: engaging, activity-centered experiences for occasional visitors". Proceedings of the Workshop on User Experience Design for Pervasive Computing at the 3rd International Conference on Pervasive Computing (Pervasive 2005). Munich, Germany, May, 2005.
<http://hdl.handle.net/1822/2240>
- Rui José, Filipe Meneses, Adriano Moreira, "Integrated Context Management for Multi-domain Pervasive Environments", First International Workshop on Managing Context Information in Mobile and Pervasive Environments (MCMP-05). In conjunction with 6th International Conference on Mobile Data

Management (MDM'05), May 9, 2005, Ayia Napa, CYPRUS.
<http://hdl.handle.net/1822/2878>.
Published on-line at <http://ceur-ws.org/Vol-165/>

- Rui José, “A Web portal for situated Interaction”, Workshop on Ubiquitous Display Environments. In association with UbiComp 2004, the Sixth International Conference on Ubiquitous Computing, Nottingham, England. 7 September, 2004.
<http://hdl.handle.net/1822/2871>
- Rui José, Pedro Coutinho "Situated web portal for local awareness and transient interaction", 2nd International Workshop on Ubiquitous Systems for Supporting Social Interaction and Face-to-Face Communication in Public Spaces. In association with UbiComp 2004, the Sixth International Conference on Ubiquitous Computing, Nottingham, England. 7 September 2004.
<http://hdl.handle.net/1822/2796>
- Helder Pinto and Rui José. “User-centered support to localized activities in ubiquitous computing environments.” Workshop Computer Support for Human Tasks and Activities, Tuesday, April 20, Radisson SAS Palais Hotel. In association with Pervasive 2004, the Second International Conference on Pervasive Computing, April 18-23, Linz/Viena, Áustria. <http://hdl.handle.net/1822/698>
- Helder Pinto and Rui José, "Integrating local services and applications into external user home environments". International Workshop on Ubiquitous Computing (IWUC 2004) in association with 6th International Conference on Enterprise Information Systems (ICEIS2004), April 13-14, 2004 - Porto, Portugal.
<http://hdl.handle.net/1822/2209>
- Rui José, Helder Pinto, Filipe Meneses, Noé Vilas Boas, Helena Rodrigues and Adriano Moreira, "System Support for Integrated Ubiquitous Computing Environments". First Workshop on System Support for Ubiquitous Computing (Ubisys 2003) in association with Fifth International Conference on Ubiquitous Computing, 12-15 October, Seattle, Washington, U.S., 2003.
<http://hdl.handle.net/1822/2847>
- Helder Pinto, Rui José and Noé Vilas Boas, “Using a Private Uddi for Publishing Location-Based Information to Mobile Users”, Proceedings of the 7th ICCC/IFIP International Conference on Electronic Publishing (ELPUB2003), June 25-28, Guimarães, Portugal, 2003.
<http://hdl.handle.net/1822/712>
- Helena Rodrigues, Rui José, Adriano Moreira, Hélder Pinto, “Hypergeo: context-aware access to geographic information for mobile users”, 12th IST Mobile & Wireless communications Summit, 15-18 June, Aveiro, Portugal, 2003.
<http://hdl.handle.net/1822/1487>
- Adriano Moreira, Rui José, Helder Pinto, Noé Vilas Boas, “An expandable location-based portal for mobile users”, Proceedings of the IADIS International Conference e-Society 2003, Lisboa, Portugal, June, 2003.
<http://hdl.handle.net/1822/1702>

4. CV Ricardo Morla

PERSONAL INFORMATION

NAME	RICARDO SANTOS MORLA
DATE OF BIRTH	July 1st 1975
CURRENT POSITION	Assistant Professor Department of Electrical and Computer Engineering Faculty of Engineering and INESC Porto University of Porto 4200-625 Porto
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EDUCATION

DATE	2006-2007
TÍTULO	Post-doc in Computer Science
MAIN SUBJECTS	Support for the rapid simulation and prototyping of ubiquitous computing applications using immersive virtual reality environments such as Second Life™.
NAME OF INSTITUTION PROVIDING EDUCATION	Bren School of Information and Computer Science, Univ. California Irvine, USA
DATES	2002-2006
TITLE OF QUALIFICATION	Ph.D. in Computing
MAIN SUBJECTS	Mobile and Distributed Systems, Ubiquitous Computing, Deployment issues in future ubicomp systems.
NAME OF ORGANISATION PROVIDING EDUCATION	Computing Department, University of Lancaster, UK.
DATES	1998-2000
TITLE OF QUALIFICATION	M.Sc. in Optoelectronics and Lasers
PRINCIPAL SUBJECTS	Physics, Optoelectronics and Lasers, propagation and switching in fibre optics.
NAME OF ORGANISATION PROVIDING EDUCATION	Faculty of Sciences, University of Porto, Portugal.

DATES	1993-1998
TITLE OF QUALIFICATION	Diploma in Electrical and Computer Engineering
PRINCIPAL SUBJECTS	Electrical and Computer Engineering, Telecommunications, Data communications and networks.
NAME OF ORGANISATION PROVIDING EDUCATION	Faculty of Engineering, University of Porto, Portugal.

PROFESSIONAL EXPERIENCE

DATE	2007 – to date
POSITION	Assistant Professor Department of Electrical and Computer Engineering Faculty of Engineering
MAIN ACTIVITIES	First year classes including Assembly Programming and Math and final year classes including Network Services and Optical Communications. In charge of the Department's Networking Lab.
EMPLOYER	University of Porto.
DATE	2007
POSITION	Lecturer
MAIN ACTIVITIES	Responsible for the "Software Architectures and Distributed Systems" class in UCI's Informatics degree. Distributed systems paradigms, distributed architectures, and mobility.
EMPLOYER	Univ. California Irvine, USA
DATE	1998-2006
POSITION	Programmer, Researcher, and Project Manager
MAIN ACTIVITIES	Research, development, project management, and project proposal.
EMPLOYER	INESC Porto

PROJECTS, STUDENTS, AND PUBLICATIONS

FUNDED PROJECTS	- FLAD/NSF Portugal-USA: Partnerships and Networks for Research 2008, "Fast Prototyping Intelligent Environment Applications using Virtual Worlds".
PHD STUDENTS	Saravan Kandasamy. "Enhancing Wireless Communications and Networking Systems for Pervasive Communication Scenarios". 2007-to date. Co-supervised.
PUBLICATIONS	- "Blurring the Line Between Simulation and Real-World

Prototypes Using Second Life", R.Morla and C.V.Lopes. Int. Conf. Ubiquitous Computing LBR, Innsbruck, September 2007.

- "CodeGenie: using test-cases to search and reuse source code", O.Lemos, S.Bajracharya, J.Ossher, R.Morla, P.Masiero, P.Baldi, and C.V.Lopes. IEEE/ACM Int. Conf. Automated Software Engineering Demo, Atlanta, Nov. 2007.
- "Informing the Design of User Studies on Conceptual Interference Frameworks", R.Morla and N.Davies. IEEE Ubiquitous Computing and Intelligence Symposium, Niagara Falls, May 2007.
- "A New Approach for Slideshow Presentations at Working Meetings", B.Gaspar, C.Pinho, R.Campos, and R.Morla. ConfTele 2007, Peniche, May 2007.
- "A Framework for Describing Interference in Ubiquitous Computing Environments", R.Morla and N.Davies. IEEE PerCom Conference, Pisa, March 2006.
- "Sentient Future Competition: Vision of Congestion-Free Road Traffic and Cooperating Objects", R.Morla. EWSN, Zurich, February 2006.
- "Evaluating a Location-based Application: A Hybrid Test and Simulation Environment", R.Morla and N.Davies. IEEE Pervasive Computing Magazine, 3(3):48-56, July 2004.

5. CV José Creissac Campos

Name	José Francisco Creissac Freitas de Campos
Date of Birth	31st July, 1967
Nationality	Portuguese
Current position	Assistant Professor Informatics Department Engineering School University of Minho Gualtar 4710-057 Braga Portugal
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Academic Degrees

- Doctor of Philosophy – University of York, Computer Science, 2000.
- MSc – University of Minho, Computer Science, 1993.
- Licentiate – University of Minho, Computer Science and Systems Engineering, 1991.

Research Interests

- Main topic: Human-Computer Interaction
- Other topics: Software Engineering, Formal Methods, Automated reasoning

Professional experience

- [08/2000-] Assistant Professor, Departamento de Informática, Universidade do Minho.
- [12/1993-07/2000] Teaching Assistant, Departamento de Informática, Universidade do Minho.
- [10/1991-11/1993] Junior Teaching Assistant, Departamento de Informática, Universidade do Minho.
- [06/1991-09/1991] Software Designer & Programmer, F3M - Engenharia de Sistemas e Informática Lda., Braga, Portugal.

Fellowships and Honours

- 04/2007- EPSRC Visiting Research Fellow, Informatics Research Institute / School of Computing Science, Newcastle University, UK.
- 01/2006- Member of the Scientific Committee of APROJE (Portuguese Association of Electronic Games Producers).
- 09/2005 Socrates/Erasmus Visiting Scholar, Escola Superior de Enxeñaría Informática, University of Vigo, Spain.

Teaching Experience

- [2007/08] Taught lectures on Model Driven Software Engineering course of the MAP-I doctoral programme.
- [2000/01-] Several courses in Computer Science topics (different programming paradigms, software engineering, and human-computer interaction) at the University of Minho, both at undergraduate and post-graduate levels.
- [2002/03] Short course (8h) on Usability Engineering given to undergraduate students at FEUP (Faculty of Engineering of the Universidade of Porto).
- [2001/02-2002/03] Intensive course (20h) on UML for Information Systems Development lectured to Enabler employees. (Enabler is a leading provider of retail solutions in Europe)
- [2000/01] Intensive course (20h) on Object Oriented Programming lectured to software industry professionals.
- [1997/98] Practicals on Pascal Programming (MSc in Information Technology Business Management and Language), and Mathematics for Computer Science (BSc in Computer Science/Mathematics) at the University of York, UK.

Projects

- REVVIS – Network of Experts in Software Verification and Validation (507AC0326)
Position: University of Minho's group coordinator; Funding (2007): e34.615,00 (CYTED); Start/Duration: 01/2007 / 4 years; Partners: 18 partners from 8 ibero-american countries; lead by University of Coimbra.
- IVY – A model based usability analysis tool (POSC/EIA/56646/2004)
Position: Principal investigator; Funding: e74.000,00 (FCT/FEDER); Start/Duration: 07/2005 / 3 years; Partners: DI/CCTC (University of Minho), FEUP (University of Porto), and INESC Porto.
- SCAPS – Safety Control of Automated Production Systems (POCTI/EME/61425/2004)
Position: Researcher; Funding: e33.600,00 (FCT/FEDER); Start/Duration: 07/2005 / 2 years; Partners: DEM (Principal researcher: José Mendes) and DI/CCTC of the University of Minho.
- AudioBrowser – A web accessibility tool for blind and visual ly impaired users (POSI/SRI/41952/2001)
Position: Researcher; Funding: e29.000,00 (FCT); Start/Duration: 05/2003 / 1 year; Partners: DI/CCTC (University of Minho); FEUP (University of Porto).
- XtrmSWING – Reverse Engineering of Java/Swing code
Position: Principal investigator; Funding: e12.220,55 (Algoritmi Center, University of Minho); Start/Duration: 01/2002 / 1 year
- Sistema Integrado de Acesso à Internet para Pessoas com Deficiências Visuais (Proc. 22/1/sub prog 1)
Position: Researcher; Funding: e15.762.00 (SNRIPD-CITE 2001); Start/Duration: 09/2001 / 1 year

Supervising Experience (PhD)

- João Carlos Silva. Métodos Formais e Engenharia Reversa Aplicados à Manutenção e Usabilidade de Sistemas Interactivos. Departamento de Informática, Universidade do Minho (Started March 2005). Co-supervision with Alexandre Saraiva (DI/UM).

- José Luís Silva. An infrastructure for experience centred agile prototyping of ambient intelligence. Departamento de Informática, Universidade do Minho (started April/2008). Co-supervision with Michael Harrison (Newcastle University).

Program Committees

- [Interacção 2004-] Conferência Nacional de Interacção Pessoa-Máquina.
- [DSV-IS 2005-] International Workshop on Design, Specification and Verification of Interactive Systems.
- [Interact 2005-] IFIP TC13 International Conference on Human-Computer Interaction.
- [FMIS 2006-] International Workshop on Formal Methods for Interactive Systems.
- [HCSE 2007-] IFIP WG 13.2 Conference on Human Centred Software Engineering.
- [EPCG 2007] 15o Encontro Português de Computação Gráfica. Porto Salvo, Portugal, Outubro de 2007.
- HCI Educators 2007 International conference of Human-Computer Interaction Educators. Aveiro, Portugal, Março de 2007.
- iDig 2006 International Digital Games Conference. Portalegre, Setembro de 2006.

Other reviewing work

- *Journals* – Human Technology; Innovations in System and Software Engineering; ACM Crossroads; Cognition Technology and Work; IEEE Software; ACM Transactions in Human-Computer Interaction.
- *Conferences* – CHI 2008/2007/2005/2003 (ACM Conference on Human Factors in Computing Systems); IDC 2007/2006 (Interaction Design and Children); IBM CASCON 2006 Dublin symposium; CSMU 2006 (Conference on Mobile and Ubiquitous Systems); ICTAC 2004 (First International Colloquium on Theoretical Aspects of Computing); CLIHC 2003 (Congresso Latino-americano de Interacção Humano-Computador).

Organizing Committees

- Co-chair and editor for Interacção 2006 – 2nd Portuguese Human-Computer Interaction Conference. Braga, Portugal, October 2006.
- Organizing co-chair for the 6th Eurographics Workshop on Design, Specification and Verification of Interactive Systems, DSV-IS'99. Braga, Portugal, June 1999.
- Member of the local organizing committee for the Portuguese Informatics Meeting '96. Braga, Portugal, September 1996.
- Member of the organizing committee for the 6th Portuguese Conference on Computer Graphics. Braga, Portugal, February 1994.

Selected Recent Publications

- J. Doherty, J. C. Campos, and M. D. Harrison. Resources for situated actions. In XVth International Workshop on the Design, Verification and Specification of Interactive Systems, July 2008. (accepted)

- J. C. Campos and M. D. Harrison. Systematic analysis of control panel interfaces using formal tools. In XVth International Workshop on the Design, Verification and Specification of Interactive Systems, July 2008. (accepted)
- J. C. Campos, J. Machado, and E. Seabra. Property patterns for the formal verification of automated production systems. In 17th IFAC World Congress 2008, 2008. (accepted).
- J. C. Campos and M. D. Harrison. Considering context and users in interactive systems analysis. In Engineering Interactive System, Lecture Notes in Computer Science. Springer, 2008. (in press)
- M. D. Harrison, J. C. Campos, and K. Loer. Formal analysis of interactive systems: opportunities and weaknesses. In P. Cairns and A. Cox, editors, Research Methods in Human Computer Interaction, chapter 5. Cambridge University Press, 2008.
- M. D. Harrison, J. C. Campos, G. Doherty, and K. Loer. Connecting rigorous system analysis to experience centred design. In E. Law, E. Hvannberg, and G. Cockton, editors, Maturing Usability: Quality in Software, Interaction and Value, Human-Computer Interaction Series, chapter 3, pages 56. Springer, 2007.
- M. Harrison, C. Kray, and J. C. Campos. Exploring an option space to engineer a ubiquitous computing system. In Paul Curzon and Antonio Cerone, editors, The Pre-proceedings of the 2nd International Workshop on Formal Methods for Interactive Systems (FMIS 2007), pages 67{82, 2007. (to appear in ENTCS).
- J. L. Silva, J. C. Campos, and A. Paiva. Model-based user interface testing with Spec Explorer and ConcurTaskTrees. In Paul Curzon and Antonio Cerone, editors, The Pre-proceedings of the 2nd International Workshop on Formal Methods for Interactive Systems (FMIS 2007), p 116. 2007. (to app. in ENTCS)
- H. Pinto, R. José, and J. C. Campos. An interaction model and infrastructure for localized activities in pervasive computing environments. In IEEE International Conference on Pervasive Services 2007 (ICPS'07), pages 232{241. IEEE Computer Society Press, 2007.
- J. C. Silva, J. C. Campos, and J. Saraiva. Combining formal methods and functional strategies regarding the reverse engineering of interactive applications. In Interactive Systems, volume 4323 of Lecture Notes in Computer Science, pages 137{150. Springer-Verlag, 2007.
- M. A. Barbosa, L. S. Barbosa, and J. C. Campos. Towards a coordination model for interactive systems. In A. Cerone and P. Curzon, editors, Proc. of the First Int. Workshop in Formal Methods for Interactive Systems (FMIS 2006), n. 183 in Electronic Notes in Theoretical Computer Science, p.73. Elsevier, 2007.
- J. Machado, E. Seabra, F. Soares, and J. Campos. A new plant modelling approach for formal verification purposes. In Proc.11th IFAC/IFORS/IMACS/IFIP Symposium on Large Scale Systems - Theory and Applications (LSS 2007)
- T. Chambel, N. J. Nunes, T. Rom~ao, and J. C. Campos, editors. Interação 2006 { Actas da 2a. Conferência Nacional em Interação Pessoa-Máquina. Grupo Português de Computação Gráfica, Outubro 2006.
- R. Fernandes, J. R. Pereira, and J. C. Campos. Accessibility and visually impaired users. In I. Seruca et al., editor, Enterprise Information Systems VI. Springer, March 2006.
- J. C. Campos and G. J. Doherty. Supporting resource-based analysis of task information needs. In Interactive Systems, volume 3941 of Lecture Notes in Computer Science, pages 188{200. Springer-Verlag, 2006.