

MAP Doctoral Program in Computer Science

Intelligent Robotics – 2017/2018

A. Program

1. Subject, justification and Motivation

Research in robotics has traditionally emphasized low-level sensing and control tasks, path planning, and actuator design and control. In contrast, several Artificial Intelligence researchers are more concerned with providing real/simulated robots with higher-level cognitive functions that enable them to reason, act and perceive in an autonomous way in dynamic, inaccessible, continuous and non deterministic environments. Combining results from traditional robotics with those from AI and cognitive science will be thus essential for the future of intelligent robotics, showing the increased importance of informatics and computer science research on this area.

The purpose of Intelligent Robotics in MAP-I is to prepare researchers in the application of Artificial Intelligence (AI) techniques in real/simulated robotics. The discipline will also promote discussion on several other specific topics:

- **Intelligent Systems and Devices:** What are the differences on applying intelligent systems to computer systems and robotic systems;
- **The Internet of Things and the Future Internet of Robotic Things;**
- **Simulated vs. Real Robotics:** How to bridge the gap between simulation and real robots and machines?
- **Robotics and Computer Science Competitions** as a mean to promote scientific progress;
- **Social Robots:** Will machines be our partners in the future and how?
- **Machine Learning for Robotics:** Are current machine learning approaches adequate for the future physical systems (robots)?
- **Why is Google taking over robotics research in the last two years?**

These topics will be the subject of invited talks by known researchers with vast experience in organizing/participating in national/international real or simulated robotic competitions and on migrating approaches tested on simulators to real robotic platforms.

The discipline will also emphasize cooperative robotics and application in a domain where the proponents are known as lead world researchers: RoboCup – Robotic Soccer. In the last fifteen years RoboCup has increasingly become as a testbed for research in cooperative/intelligent robotics and multi-agent systems. Teams from the best companies and universities in the world compete in nine major leagues, including seven cooperative leagues. The research developed during the development of FC Portugal robosoccer teams, that regularly compete in four of these leagues (2D Simulation, 3D Simulation, Rescue and Legged League), conducted the Universities of Aveiro, Porto and Minho to win three RoboCup world championships and eight European championships in different leagues. The research focus was on the development of a formal model for the concept of strategy, for a team of heterogeneous agents, in a competition and generic coordination and communication mechanisms, general enough for other cooperative tasks. These are research topics that are still unexplored in intelligent/cooperative robotics and may easily lead to worldwide recognized PhD thesis as the number of PhD students supervised by this proposal proponents, including several international students, clearly indicates.

There are several similar teaching projects in other universities. However, the focus, teaching methods and learning outcomes are different. The proposed teaching project, compared with other competitors,

benefits from the availability of robotic platforms, internationally recognized base codes and simulators, previously developed by the proponents, very useful for fulfilling the goals of the teaching project.

Briefly mentioning similar projects, the course “CSCI 854 - Control and Learning in Mobile Robots and Multi-Robot Systems” from the University of Southern California, which gives credits the PhD program (IS track), follows a similar approach emphasizing the robotic agent architectures (reactive, hybrid, behavior-based), Navigation and Cooperation between Robots, it also includes Human-Robot Interaction issues, which are not included in this proposal. The course “82778 CIS 6930 - Introduction to AI Robotics” taught by Prof. Robin Murphy at the University of South Florida, includes a graduation section, and is focused on the relation between AI and Robotics, the Biological Inspirations of robotics, Sensing, Navigation, Planning and Multi-Agent Systems, the approach is similar to the current proposal, only the focus as been changed in some aspects from the biological inspirations issue to the development of robotic teams, while this proposal follows different high-level approaches to the development of this type of teams. There is also a course at the University of Lund, Department of Computer Science, Postgraduate Studies named “DAT125/EDA135 - Artificial Intelligence for Robots” with a very similar approach as the one proposed in this document but, again limited by the unavailability of the above-mentioned platforms, base codes and simulators.

2. Objectives

Intelligent robotics course main objectives are:

- To understand the basic concepts of Robotics and the context of Artificial Intelligence in Robotics.
- To study methods of perception and sensorial interpretation (emphasizing computer vision), which allow to create precise world models and mobile robots’ control methods.
- To study the methods which allow mobile robots to navigate in familiar or unfamiliar environments using Planning and Navigation algorithms.
- To study the fundamentals of cooperative robotics and of the robots teams construction.
- To analyze the main national and international robotic competitions, the more realistic robot simulators and the more advanced robotic platforms available in the market (emphasizing the robots NAO and KUKA LWR)

3. Learning Outcomes

A successful learner from this discipline will be able to:

- Acquire knowledge of current state and trends in intelligent robotics and practical knowledge from programming real/simulated robots;
- Demonstrate an understanding of main challenges of the discipline and be enabled to select appropriate techniques to solve them;
- Have a broad critical understanding of how Artificial Intelligence may be applied generally to intelligent and cooperative robotics;
- Appreciate the problems associated with programming and controlling simulated/real robotic platforms with different perception and action capabilities;
- Understand the challenges behind cooperative robotics and the construction of robotic teams that operate in dynamic, inaccessible, non-deterministic environments;
- Reference the sources used in their work in the context of intelligent robotics, being aware of the best projects/research works in this area around the world. Students must use accurately the standard referencing styles within the text of all written work for all sources used.

4. Detailed Program

1. Introduction
 - 1.1) Artificial Intelligence
 - 1.2) Basic concepts of Robotics
 - 1.3) Artificial Intelligence in Robotics
 - 1.4) History, Evolution, and Current Trends in Intelligent Robotics
2. Architectures for Robotic Agents
 - 2.1) Reactive, Deliberative, Hybrid
 - 2.2) Belief, Desire and Intentions (BDI)
 - 2.3) Cooperative Architectures
3. Perception and Sensorial Interpretation
 - 3.1) Proximity sensors: Sonar or ultrasonic, infrared (IR), touch, light and feel sensors
 - 3.2) Computer Vision: Cameras, Digital Image, Colour Models, Image Processing, Image Analysis
 - 3.3) Odometry, Rotation and Compass Sensors
 - 3.4) Sensor Fusion Techniques
4. Localization and Mapping
 - 4.1) Creation, Representation and Updating of World States.
 - 4.2) Markov and Gaussian Localization
 - 4.3) Grid and Monte-Carlo Localization
 - 4.4) Mapping: Occupancy Grid and SLAM
 - 4.5) World Exploration
5. Mobile robots control: Locomotion and Action.
 - 5.1) Gears, Speed, Torque
 - 5.2) Robot locomotion simulation
6. Plan Automatic Generation:
 - 6.1) Means-Ends Analysis, Linear, non-linear, hierarchic and partially oriented planning
 - 6.2) Planning and Learning: Plan generality
7. Navigation
 - 7.1) Algorithms of navigation in known/unknown environments
 - 7.2) Voronoi Diagrams
 - 7.3) A* and D* Algorithms
 - 7.4) Cellular Decomposition
8. Cooperative Robotics
 - 8.1) Introduction to the cooperation between robots for teamwork
 - 8.2) Joint Intentions, TAEMS, Role-Based, Social Rules
 - 8.3) Communication and Mutual Modeling
 - 8.4) Locker-Room, Strategical Coordination, Partial Hierarchical
 - 8.5) Swarm Robotics
9. Applications
 - 9.1) National and International Robotic Competitions: RoboCup, RoboOlympics, Fira Cup, DARPA Grand-Challenge, Portuguese Robotics Open, Autonomous driving, Micro-Mouse (Micro-Rato) and fire fighting Robots; European Robotics Challenges; Amazon Picking Challenge
 - 9.2) Robotic simulators: Soccerserver 2D and 3D, RoboCup Rescue, Virtual Rescue, Ciber-Mouse, Gazebo, USARSim

- 9.3) Robotic Platforms: ROS; MindStorms, NAO, Bioloid, ERS210A e ERS-7 (Sony Aibos), JACO arm, KUKA LWR, KUKA OmniRob: Hardware, Software Architectures and Robotic Programming Languages.

5. Teaching Methods

Main teaching techniques will be focused on:

- Challenging students to higher level learning as is appropriate in a PhD program of this type. Of course low level learning, i.e., comprehending and remembering basic information and concepts is important. However emphasis of intelligent robotics will be on problem solving, decision making, critical thinking/design, and creative thinking/design.
- Use active learning such as the use of simulators and real robotic platforms. Exposition will be made mostly with interaction in theoretical classes. Some learning will of course be passive, i.e., listening and reading. However, high level learning requires active learning and thus the use of appropriate material/platforms/simulators. Thus the discipline will use simulators for mobile robots navigation (“ciber-mouse”, “soccerserver”) and cooperative robotics (“robosoccer” and “robocup rescue”). It will also use humanoid platforms (DARwIn-OP, Nao, Bioloid, Robonova) and mobile robotic platforms (KUKA miiwa, ERS210A e ERS7 –Sony AIBOs) available at our labs and appropriate software for high-level programming of robots: ROS, OPEN-R SDK (ERS210A e ERS7), FC Portugal base code for Soccer-Server (2D e 3D) and RoboCup Rescue.
- Structured sequence of different learning activities (lectures, demonstrations, reading, analysis, writing, oral presentations, design, experimentation, among others). Learning activities structured in a sequence such that they enable opening classes and assignments about basic principles to lay the foundation for complex and high level learning tasks in later, complex classes and assignments.
- Detailed feedback given to students about the quality of their research work and learning process. High level, active learning require, more than any type of learning, frequent and immediate feedback for students to know whether they are "doing it correctly!"

This high-level teaching method will enable student not only to increase their skills in researching about intelligent robotics but also in all other areas related to informatics and computer science.

Some of the exercises with simulators and real robots will be supported by documentation that will be produced specifically for this course.

6. Evaluation System

This is a research discipline, intended first to teach the students the state of the art in intelligent robotics, and then to help them to do a simple project and a paper of publishable quality in an international conference about this subject. There will be a significant amount of reading/analysis of quality research papers that will be handed out. The evaluation of students will be based on:

- Analysis of a selected scientific paper about intelligent robotics;
- Oral presentation of a selected new trend on intelligent robotics;
- Practical Project with demonstration, oral defence and production of a publishable scientific paper.

7. Bibliography

- Sebastian Thrun, Wolfram Burgard, Dieter Fox ;Probabilistic Robotics, MIT Press, Cambridge, Massachussets, London England, 2005. ISBN: 0-262-20162-3
- Robin R. Murphy; An Introduction to AI Robotics, Bradford Book, MIT Press, Cambridge, Massachussets, London England, 2000. ISBN: 0-262-13383-0

- Howie Choset, Kevin M. Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia E. Kavraki, Sebastian Thrun ;Principles of Robot Motion : Theory, Algorithms, and Implementations, Bradford Book, MIT Press, Cambridge, Massachusetts, London England, 2005. ISBN: 0-262-03327-5
- Jan Peters, Machine Learning for Robotics: Learning Methods for Robot Motor Skills, VDM Verlag Dr. Müller; 2013, ISBN-10: 363902110X; ISBN-13: 978-3639021103
- Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach (3rd Edition), Pearson, 2009, ISBN: 978-0136042594,
- Luis Paulo Reis, Coordination in Multi-Agent Systems: Applications in University Management and Robotic Soccer, PhD Thesis, Faculty of Engineering of the University of Porto, 2003
- Ronald C. Arkin, Behavior-Based Robotics MIT Press, 1998, ISBN 0-262-01165-4
- J., M. Holland, Designing Autonomous Mobile Robots: Inside the Mind of an Intelligent Machine, 2003, ISBN 0750676833
- RoboCup Series (1998, 1999, 2000, 2001, 2002 e 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016), Springer, LNAI, Vols. 1604, 1856, 2019, 2377, 2752, 3020, 3276, 4020, 5001, 5399, 5949, 6556, 7416, 7500, 8371.

B. Teaching Staff

1. Summary

Teaching staff is responsible by a leading world Project – FC Portugal – that won 3 World and 8 European RoboCup – Robotic soccer championships. The team also supervised more than 20 PhD students concluded, including several international PhD students attracted by the international visibility of the team research in robotics and of the RoboCup project. The team has been and is involved in several national and international robotic research and technology transfer projects. More than one hundred and fifty papers about intelligent robotics and intelligent simulation have been published, by teaching staff members, in the previous fifteen years.

2. Resumed CVs

Luís Paulo Reis

Name: Luís Paulo Gonçalves dos Reis

Place and Date of Birth: Cedofeita, Porto, October, 15th of 1970

Address: University of Minho, School of Engineering, Universidade do Minho, Campos de Azurém 4800-058

Phone: +351919455251

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Academic Degrees:

- Phd, Sep 2003, Eng. Electrotécnica e de Computadores, FEUP, Artificial Intelligence (MAS)
- MSc, Dec 1995, Eng. Electrotécnica e de Computadores, FEUP, Industrial Informatics (Very Good), 18.3 Val (out of 20)

- Licenciatura (5 Year BSc), Jul 1993, Eng. Electrotécnica e de Computadores, FEUP, Informatics and Systems, 18 Val (out of 20)

Present Position:

- Associate Professor (Professor Associado) at University of Minho, since Sep 2011
- Researcher at LIACC - Artificial Intelligence and Computer Science Lab., since Dec 1995
- Member of the Directive Board of LIACC, since Oct 2007
- Collaborator of Centro ALGORITMI, INESC-TEC and IEETA since 2011/2012
- Director of LIACC, since May 2016

Past Positions:

- Professor Auxiliar at FEUP-DEI, Apr 2006 – Set 2011
- Professor Auxiliar Convocado at FEUP, Oct 2003 – Apr 2006
- Assistente Convocado at FEUP, Dec 2001 – Feb 2004
- Mestre Assistente Convocado at Univ. Fernando Pessoa – Porto, Oct 2001 – Sep 2002
- Mestre Assistente at Univ. Fernando Pessoa – Porto, Oct 1998 – Sep 2001
- Mestre Assistente Convocado at Univ. Fernando Pessoa – Porto, Oct 1996 – Sep 1998
- Researcher at INEB – Instituto de Eng. Biomédica, Sep 1994 – Oct 1995
- Monitor at FEUP – Faculdade de Engenharia da Univ. Porto, Oct 1991 – Nov 1993

Pedagogical and Divulcation Activities:

- Disciplines: Logic Programming, Artificial Intelligence, Robotics, Intelligent Robotics, Intelligent Agents, Planning and Scheduling Methodologies, Database Laboratory, Basic Informatics, Computational and Communication Systems, Alg. And Data Structures, Programming 2, Simulation, among 15 others. Pedagogical classifications over: 4.0 Val (out of 5.0) in almost all disciplines (T, TP e P).
- PhD Programs Disciplines: Intelligent Robotics (MAP-I), Planning and Scheduling Methodologies (PRODEI-FEUP), Robotics (PRODEI-FEUP), Advanced Methodologies for Simulation and Modeling (PRODEI-FEUP adapted also to MAP-I by other member of the team)
- Participation in more than 40 divulcation actions at FEUP and UMinho (including Feira de Ciência e Tecnologia, Mostras de Ciência, Ensino e Inovação da UP, Exposição Ciência e Robótica – Arrábida Shopping, Semanas Abertas da FEUP and Talks in Superior/Secondary Schools).

PhD/Postdoctoral Supervising:

- 17 PhD Thesis supervised already Concluded and 7 PhD Thesis ongoing.
- 6 Postdoctoral researchers supervised.

MSc Supervising

- 96 MSc Thesis supervised concluded.

Research Interests:

- Artificial Intelligence (Multi-Agent Systems, Intelligent Agents, Coordination in Multi-Agent Systems, Simulation, Intelligent Robotics, Robotic Soccer, Constraint Logic Programming).

Main Research Projects:

- *Portus – A Common Framework for Cooperation in Mobile Robotics* (FCT - POSI/SRI/41315/2001, 20000 EUR, 2002 – 2005, Proposal/Final Report Responsible, PR: António Paulo Moreira)
- *FC Portugal: New Coordination Methodologies Applied to the Simulation League* (FCT – POSI/ROBO/43910/2002, 27800 EUR, Oct 2003 – Oct 2004, Principal Researcher)

- *LEMAS – Learning in MAS in the RoboCup Sony Legged League* (FCT POSI/ROBO/43926/2002, 32908 EUR, Oct 2003 – Dec 2004, Proposal/Final Report Responsible, PR: Eugénio Oliveira)
- *Rescue: Coordination of Heterogeneous Teams in Search and Rescue Scenarios* (FCT/POSC/EIA/63240/2004, 32800 EUR, Apr 2005 – Mar 2007, Principal Researcher FEUP)
- *ABSES - Agent Based Simulation of Ecological Systems* (FCT/POSC/EIA/57671/2004, 75000 EUR, Apr 2005 – Oct 2007, Principal Researcher)
- *ACORD - Adaptative Coordination of Robotic Teams* (FCT/PTDC/EIA/70695/2006, 95000 EUR, Jan 2008 – Dec 2009, Principal Researcher)
- *Intellwheels - INTELLWHEELS - Intelligent Wheelchair with Flexible Multimodal Interface* (FCT/PTDC/EEA-CRO/98664/2008, 94500 EUR, Principal Researcher),
- *ERAS - Expeditious Reconstruction of Virtual Cultural Heritage Sites* (FCT - PTDC/EIA-EIA/114868/2009, begin in Jan 2011, Coordinator in FEUP/LIACC)
- *FP7 EuRoC: European Robotics Challenges, 2014*, funding of aprox:500k Eur.
- *QVida+: Estimação Contínua de Qualidade de Vida para Auxílio Eficaz à Decisão Clínica / QLife+: Continuous Quality of Life Estimation for effective Clinical Decision Support*, Portugal 2020, Inv. Principal UMinho, Funding 680k Eur

Main Organization of International Scientific Meetings:

- RoboCup Tutorial-EPIA01, MASTA2001, Festival Nacional de Robótica 2004, Sci. Meeting Port. Robotics Open2004, MASTA2005, IROBOT2005, CENPLF2006, Roboludens2006, RoboCup Dutch Open, MASTA2007, IROBOT2007, IROBOT2008 (Iberamia08), CISTI2009, IROBOT2009, CISTI2010, IROBOT2011, CISTI2011, AI4Games2011, CISTI2012 (Madrid), FNRobotica2012, EuroRoboCup2012 (Eindhoven), RoboCup2012 (Mexico), IEEE ICARSC / FNRobotica2013 (Lisbon), CISTI2013 (Lisbon), EPIA2013 (Azores), CISTI2014(Barcelona), RoboCup2014(João Pessoa, Brazil), CIAIQ2014 (Badajoz, Spain), CISTI2015(Aveiro), WorldCist2015 (Azores), CIAIQ2015 (Aracaju, Brazil), ROBOT2015 – 2nd Iberian Robotics Conf. (Lisbon) CISTI2016 (Gran Canaria, Spain), WorldCist2016 (Recife, Brazil), CIAIQ/ISQR2016 (Porto).

Publications and Communications:

- *More than 250 Papers indexed at SCOPUS.*
- *2 Thesis, 25 editions of Conference Proceedings, 50 Papers in International Journals, 100 Book Chapters/Series (Springer/IEEE), 10 Papers in National Journals, 150 Papers in other International Conferences, 40 Invited Talks including, among others: ICAART2012, LARS/SBR2012, ICINCO2013. WAF 2014, ICSports2014, BRASERO2015, SIROCO2015.*

Program/Scientific Committee in Conferences:

- President of the Portuguese Society for Robotics (2013-2015), President of the General Assembly of the Iberian Association for Information Systems and Technology (2011-...), Vice-President of SPR (2015-2017), Vice-President of APPIA – Portuguese Association for Artificial Intelligence (2016-2017).
- Main Conference/Workshop Organization: MASTA2001(Porto), Festival Nacional de Robótica (Porto, 2004), Scient. meeting FNR2004 (Porto, 2004), IROBOT2005 (Covilhã, 2005), MASTA2005 (Covilhã, 2005), CeNPLf2006 (Porto, 2006), Euro RoboCup2006 (Eindhoven, 2006), IROBOT2007 (Guimarães, 2007), MASTA2007 (Guimarães, 2007), IROBOT2008 (Lisbon, 2008), CISTI2009 (P.Varzim, 2009), CISTI2010 (Santiago Compostela, 2010), CISTI2011 (Chaves, 2011), IROBOT2011 (Lisbon, 2011), AI4Games2011 (Lisbon, 2011), ICAART2012 Sp.Session Int. Robotics (Vilamoura, 2012), Robotica2012 (Guimarães, 2012), EuroRoboCup2012 (Eindhoven, 2012), RoboCup2012 Sim32(Cid. Mexico, 2012), CISTI2012 (Madrid, 2012, IEEE ICARSC2013 (Lisbon, 2013), CISTI2013 (Lisbon, 2013), EPIA2013 (Azores, 2013), ICINCO2013 Doct.Cons (Reykjavic, 2013), ROBOT2013(Madrid, 2013), CISTI2014 (Barcelona, 2014), IBERAMIA2014 Robotics (Sant. Chile, 2014), RoboCup 2014 Sim3D (J.Pessoa, Brazil, 2014), CIAIQ2014(Badajoz, 2014), WorldCIST2015 (Azores, 2015), CIAIQ2015 (Aracaju, 2014), ROBOT2015 (Lisbon, 2015), WorldCIST2016 (Recife, Brazil).
- Main Program Commitees: RoboCup TC (2001-2003), Bal.Rea.Soc.Del.MAS01 (LNAI vol.2103), WAF01 (Madrid, Sp), MASTA01 (Porto, PT), CeNPLf (04-07), Robotica (04-09, Porto, Coimbra, Guim., Algarve, Aveiro, C.Branco), RoboCup04 Int. Symp. (Lisbon, PT), Tékhne – Rev.Est.Polit. (2004-...), AAMAS05 (Utrecht, Ne), MASTA05 (Covilhã, PT), IROBOT05 (Covilhã, PT), RoboCup06 Int. Symp. (Bremen, Ge), CISTI06-09 (PT, ES), IBERAMIA/SBIA06 (Rib.Preto, Brazil), AAMAS06 (Hakodate, Jp), VIPIImage07

(Porto, PT), AAMAS07 (Hawai, USA), ASM07 (P.Mal., Sp), RoboCup07 Int.Symp(Atlanta, USA), IROBOT07 (Guim., PT), MASTA07 (Guim., PT), RoboCup08 Int.Symp(Suzhou, Cn), IACe-T'2008 (Amman, Jordan), ISVC'2008 (Las Vegas, USA), AAMAS08 (Estoril, PT), IBERAMIA08 (Lisboa, PT), SBIA08 (Salvador, Br), ECAI08 (Patras, Gr), ICAART'2009 (Porto, PT), VIPImage09 (Porto, PT), IROBOT09 (Aveiro, PT), MASTA09 (Aveiro, PT), RoboCup09 Int.Symp (Graz, Austria), Robotica 09 (C.Branco, Portugal), AITUM09, CISTI09, WISA09, SDIA09, ASM09, DSIE09, IECON09, ISVC09, ICAART10, CISTI10, Robotica10, RoboCup'2010 Int.Symp, DSIE10, LARS/EnRI10, SOCO2010, AIS2010, AIS 2011, SOCO 2011, DSIE 2011, InECCE 2011, KDIR 2011, Robotica 2011, CISTI 2011, SGamePlay2011, WISA2011, RoboCup Symp. 2011, ASM 2011, ICAART 2011, AI4Games 2011, IROBOT 2011, AITS 2011, MASTA 2011, Robotica2012, ICAART 2012, KDIR2012, AIS2012, VipImage2012,CISTI2012, SOCO2012, EPIA2013, WorldCist2013, IROBOT2013, AI4Games2013, AITS2013, MASTA2013, KDIR2013, Robotica2013, CISTI2013, ICAART2013, AAMAS2013, IJCAI2013, Robot2013. 40 other PCs 2014-2015

Principal Awards and Prizes:

- 2016, 3rd Place RoboCup 2016 - 3D Simulation League, Leipzig, Germany, RoboCup Federation
- 2015, Best Paper ICAART2015 - 7th International Conference on Agents and Artificial Intelligence, INSTIIC
- 2015, 3rd Place RoboCup 2015 - 3D Simulation League, China, RoboCup Federation
- 2015, Winner at EuroRoboCup 2015 - Simulation League 3D – Humanoids, Magdeburg, Germany – RoboCup Federation
- 2015, Best Paper IEEE/ICARSC2015 - 15th International Conf. on Mobile Robots and Competitions, SPR
- 2015, 2nd Place on the Computer Diplomacy Challenge 2015, Int. Computer Games Association (DipBlue),
- 2014, Winner of EuroRoboCup 2014 - Simulation League 3D – Humanoids, Magdeburg, Germany – RoboCup Federation
- 2014, Winner of Portuguese Robotics Open 2014 - Simulation League 3D – Humanoids, Robótica 2014 – Festival Nacional Robótica, SPR
- 2014, Winner of Scientific/Free Challenge, RoboCup 2014 - Simulation League 3D – Humanoids, João Pessoa, Brazil – RoboCup Federation
- 2014, 2nd Place at the World Computer Poker Competition (AAAI, Kuhn Track), AAAI, August 2014
- 2013, 3rd Place RoboCup 2013 - 3D Simulation League, Eindhoven, Holland, RoboCup Federation
- 2013, 1st Place RoboCup 2013 – Scientific Challenge Simulation2D, Eindhoven, Holland, RoboCup Fed.
- 2013, 1st Place RoboCup 2013 – Scientific Challenge Simulation3D, Eindhoven, Holland, RoboCup Fed.
- 2013, Best Paper IEEE/ICARSC2013 - 13th International Conf. on Mobile Robots and Competitions, SPR
- 2013, 1st Place EuroRoboCup 2013 - 3D Simulation League, Magdeburg, Germany, RoboCup Federation
- 2012, Honor Mention Prémio Jaime Filipe - Intellwheels Project, INRr
- 2012, 1st Place EuroRoboCup 2012 - 3D Simulation League, Eindhoven, Holland, RoboCup Federation
- 2012, 2nd Place EuroRoboCup 2012 - Rescue Simulation League, Eindhoven, Holland, RoboCup Federation
- 2012, 3rd Place EuroRoboCup 2012 - 2D Simulation League, Eindhoven, Holland, RoboCup Federation
- 2011, 2nd Place Award "Ser Capaz" - Associação Salvador - Intellwheels Project, Associação Salvador
- 2011, Galardão da Inclusão / Inclusion Award - Applied Research - Intellwheels Project, CRID/IPL
- 2011, 2nd Place EuroRoboCup 2011 - 2D Simulation League, Magdeburg, Germany, RoboCup Federation
- 2011, 2nd Place EuroRoboCup 2011 - 3D Simulation League (Humanoids), Magdeburg, Germany
- 2011, 2nd Place at FreeBots 2011 Competition, Robótica 2011- Intellwheels Project, SPR
- 2011, Best Paper Robótica 2011 - 11th International Conference on Mobile Robots and Competitions, SPR
- 2010, 3rd Place EuroRoboCup 2010 - 3D Simulation League (Humanoids), Magdeburg, Germany,
- 2010, 3rd Place EuroRoboCup 2010 - 2D Simulation League, Magdeburg, Germany
- 2010, Best Paper ICEIS 2010 - 12th ICEIS (Area: Human-Computer Interaction), INSTTIC
- 2009, 3rd Place EuroRoboCup 2009 - 2D Simulation League, Hannover, Alemanha , RoboCup Federation
- 2009, 3rd Place EuroRoboCup 2009 - 3D Simulation League, Hannover, Alemanha , RoboCup Federation
- 2008, Prémio de Incentivo Pedagógico/Pedagogical Award, FEUP - Faculdade de Engenharia da Universidade do Porto (course: Robotics - MIEIC)
- 2007, 2nd Place in PV-League - Physical Visualization (RoboCup), RoboCup Federation
- 2007, European Championship (German Open) 2nd Place RoboCup 2D Simulation Competition
- 2007, European Championship (German Open) Winner RoboCup 3D Simulation Competition

- 2006 Winner of RoboCup 2006, Bremen (FC Portugal - Simulation 3D League), RoboCup Federation
- 2006 European Championship (Roboludens) 2nd Place RoboCup 2D Simulation Competitio,
- 2006 European Championship (Roboludens) Winner RoboCup 3D Simulation Competitio,
- 2006 European Championship (Roboludens) Winner RoboCup Rescue - Simulation, RoboCup Federation
- 2005 Winner of the Portuguese Robotics Open (FC Portugal - Simulation League)
- 2004 Winner of the Portuguese Robotics Open (FC Portugal - Legged League)
- 2004 Winner of the Portuguese Robotics Open (FC Portugal - Simulation League)
- 2004 2nd Place in the Coach Competition of RoboCup 2004 (FC Portugal), Lisbon , RoboCup Federation
- 2002, 2nd Place in Ciber-Rato 2002 Contest, Universidade de Aveiro
- 2003, 2nd Place in the Coach Competition of RoboCup 2003 (FC Portugal), Padova, RoboCup Federation
- 2002, Winner of the Coach Competition of RoboCup 2002 (FC Portugal), Fukuoka, RoboCup Federation
- 2001, 3rd Place in RoboCup 2001, Seattle (FC Portugal - Simulation League) , RoboCup Federation
- 2001, Winner of German Open 2001 - Robotic Soccer (5dpo - Small-Size League), Paderborn
- 2001, Winner of German Open 2001 - Robotic Soccer (FC Portugal - Simulation League), Paderborn
- 2001, Winner of Ciber-Rato 2001 Contest, Universidade de Aveiro
- 2000, Winner of RoboCup 2000, Melbourne (FC Portugal - Simulation League)
- 2000, Winner of Euro RoboCup 2000, Amsterdam (FC Portugal - Simulation League)
- 1999, 2nd Place in Micro-Rato 1999 Contest, Universidade de Aveiro
- 1999, Innovation Award/Prémio Inovação of Micro-Rato 1999, Universidade de Aveiro
- 1996, Century Award/Prémio Centenário of the Faculty of Engineering, FEUP
- 1994, National Engineering Prize/Prémio Nacional de Engenharia, Ordem dos Engenheiros
- 1994, Engenheiro António Almeida Award, Fundação Eng. António Almeida
- 1994, APRP Award – Associação Portuguesa de Reconhecimento de Padrões, APRP

Selected Publications:

- Luís Paulo Reis and Nuno Lau, *FC Portugal Team Description: RoboCup 2000 Simulation League Champion*, in Peter Stone, Tucker Balch and Gerhard Kraetzschmar, editors, RoboCup-2000: Robot Soccer World Cup IV, Springer LNAI, Vol. 2019, pp.29-40, Berlin, 2001, ISBN 3-540-42185-8
- Luis Paulo Reis, Nuno Lau and Eugénio C. Oliveira, *Situation Based Strategic Positioning for Coordinating a Team of Homogeneous Agents*, in M.Hannebauer, J.Wendler and E. Pagello Eds, Balancing Reactivity and Social Deliberation in Multi-Agent System – From RoboCup to Real-World Applications, Springer LNAI, Vol. 2103, pp. 175-197, Berlin, 2001, ISBN 3-540-42327-3
- Luís Paulo Reis and Nuno Lau, *COACH UNILANG – A Standard Language for Coaching a (Robo) Soccer Team*, in Andreas Birk, Silvia Coradeschi and Satoshi Tadokoro, editors, RoboCup-2001: Robot Soccer World Cup V, Springer Lecture Notes in AI, Vol. 2377, pp.183-192, Berlin, 2002, ISBN 3-540-43912-9
- Nuno Lau, Luis Paulo Reis, FC Portugal - High-level Coordination Methodologies in Soccer Robotics, Robotic Soccer, Book edited by Pedro Lima, Itech Education and Publishing, Vienna, Austria, pp. 167-192, December 2007, ISBN 978-3-902613-21-9
- Francisco Reinaldo, Marcus Siqueira, Rui Camacho and Luís Paulo Reis. *Multi-Strategy Learning Made Easy*. In N. Bardis et al. (Eds.) WSEAS Transactions on Systems, World Scientific and Engineering Academy and Society Press, Greece, Issue 10, Vol. 5, pp. 2378-2384, 2006, ISSN 1109-2777 (SCImago Q3)
- João Certo, Nuno Cordeiro, Francisco Reinaldo, Luís Paulo Reis and Nuno Lau, *FCPx: A Tool for Evaluating Teams Performance in RoboCup Rescue Simulation League*, in Gelbukh, A. and Reyes-Garcia, C. eds, Special Issue: Advances in Artificial Intelligence, Research in Computing Science, Vol. 26, pp.137-148, November 2006, ISSN: 1870-4069
- Pedro M. Moreira, Luis Paulo Reis, A. Augusto de Sousa, *Best Multiple-View Selection for the Visualization of Urban Rescue Simulations*, International Journal of Simulation Modelling, DAAAM International Vienna, Austria, Vol. 5, Number 4, pp. 167-173, December 2006, ISSN: 1726-4529 (SCImago Q2)
- Daniel Castro Silva, Vasco Vinhas, Luís Paulo Reis and Eugénio Oliveira, *Biometric Emotion Assessment and Feedback in an Immersive Digital Environment*, International Journal of Social Robotics, Springer Verlag, Volume 1, Number 4, pp. 307-317, November, 2009, ISSN:1875-4791 (SCImago Q4)
- Luis Mota, Luís Paulo Reis and Nuno Lau, *Multi-Robot Coordination using Setplays in the Middle-size and Simulation Leagues*, Mechatronics, Elsevier, Vol. 21, Issue 2, pp. 434-444, March 2011, ISSN: 0957-4158, DOI: 10.1016/j.mechatronics.2010.05.005 (ISI-JCR, IF: 0.94; SCImago Q2)
- Rodrigo A.M. Braga, Marcelo Petry, Luís Paulo Reis, A. Paulo .Moreira, *IntellWheels: A Modular Development Platform for Intelligent Wheelchairs*. JRRD - Journal of Rehabilitation Research and Development, Department of

Veterans Affairs, USA, Vol. 48, Issue 9, pp. 1061-1076, December 2011, ISSN: 0748-7711, DOI:10.1682/JRRD.2010.08.0139 (ISI-JCR, IF: 1.71; SCImago Q1)

- Pedro H. Abreu, J.Moura, Daniel C. Silva, Luís Paulo Reis, Júlio Garganta, *Performance Analysis in Soccer: a Cartesian Coordinates based Approach using RoboCup Data*, Soft Computing - A Fusion of Foundations, Methodologies and Applications, Springer Verlag, Germany, Vol. 16, pp. 47–61, ISSN: 1432-7643, January 2012 ((ISI-JCR, IF: 1.51; SCImago Q2)
- Pedro Abreu, João Moreira, Israel Costa, Daniel Castelão, João Moreira, Luís Paulo Reis, Júlio Garganta, *Human vs. Virtual Robotic Soccer: A Technical Analysis about Two Realities*, European Journal of Sport Science, Taylor & Francis, Vol. 12, Issue 1, pp.26-35, January 2012, ISSN: 1746-1391 (ISI-JCR, IF: 0.89; SCImago Q2).
- Luís Paulo Reis editor, *RISTI -Iberian Journal on Information Systems and Technology: Special Issue on Intelligent Systems and Decision Support Systems*, Vol 8., AISTI, December 2011, ISSN: 1646-9895
- Daniel Silva, Rodrigo A.M. Braga, Luís Paulo Reis, Eugénio Oliveira. *Designing a Meta-Model for a Generic Robotic Agent System using GAIA Methodology*. Information Sciences, Volume 195, pp. 190-210, July 2012, Elsevier, ISSN: 0020-0255, <http://dx.doi.org/10.1016/j.ins.2012.01.029>, (ISI-JCR, IF:2.84; SCImago Q1)
- João Lobato Oliveira, Luiz Naveda, Fabien Gouyon, Luís Paulo Reis, Paulo Sousa, Marc Leman. *A Parameterizable Spatiotemporal Representation of Popular Dance Styles for Humanoid Dancing Characters*. Special Issue on Music Content Processing by and for Robots, EURASIP Journal on Audio, Speech, and Music Processing, Hindawi Publishing Corporation, USA, ISSN: 1687-4714, 1687-4722, <http://dx.doi.org/10.1186/1687-4722-2012-18> ((ISI-JCR, IF: 0.34; SCImago Q3)
- João Lobato Oliveira, Matthew E. P. Davies, Fabien Gouyon, Luís Paulo Reis: *Beat Tracking for Multiple Applications: A Multi-Agent System Architecture With State Recovery*. IEEE Transactions on Audio, Speech & Language Processing 20(10): 2696-2706 (2012) (ISI-JCR)
- Catarina B. Santiago, João Lobato Oliveira, Armando Sousa, Luís Paulo Reis: *Overcoming Motor-Rate Limitations in Online Synchronized Robot Dancing*. International Journal of Computational Intelligence Systems, 5(4), 700-713 DOI: 10.1080/18756891.2012.718120 (August, 2012) (ISI-JCR)
- Fernando Almeida, Pedro Henriques Abreu, Nuno Lau, Luís Paulo Reis: *An automatic approach to extract goal plans from soccer simulated matches*. Soft Computing Journal, Springer 17(5): 835-848 (2013) (ISI-JCR)
- Catarina B. Santiago, Armando Sousa, Luís Paulo Reis: *Vision system for tracking handball players using fuzzy color processing*. Machine Visions Applications Journal, Springer, 24(5): 1055-1074 (2013) (ISI-JCR)

Detailed CV at: https://dl.dropboxusercontent.com/u/1910031/CV_LuisPauloReis_2015.pdf

Nuno Lau

Name: José Nuno Panelas Nunes Lau

Place and Date of Birth: Porto, November 28, 1970

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Email: nunolau@ua.pt **Homepage:** <http://www.ieeta.pt/~lau>

Academic Degrees:

- PhD, Dec 2003, Electrical Engineering, Universidade de Aveiro
- DEA, Set 1994, Biomedical Engineering, Université Claude Bernard – Lyon I
- Graduation, Electrical and Computers Engineering, Fac. Eng. Uni. Porto, 17 val.

Present Position:

- Assistant Professor, Aveiro University, since Dec 2003
- Researcher at IEETA, Intelligent Robotics and Systems (IRIS), since 2015

- Principal Investigator of the Intelligent Robotics and Systems (IRIS) research group at IEETA, since 2015

Past Positions:

- Researcher of IEETA, Transversal Activity on Intelligent Robotics (ATRI), 1999-2014
- Assistant Researcher, Aveiro University, 1995-2003
- Stagiary Assistant, Aveiro University, 1994-1995
- Monitor, FEUP, 1991-1993
- INESC-Aveiro researcher, 1994-1999

Teaching courses:

- Aveiro University: Intelligent Mobile Robotics, Distributed Artificial Intelligence, Distributed Systems and Operating Systems, Distributed Computing, Large Scale Computing, Computer Architecture I, Computer Architecture II, Operating Systems, Programming I, Programming II, Introduction to Informatics, Project, Programming Systems and Software Engineering, Seminar
- Porto University: Programming I, Programming II
- MAP-I: Intelligent Robotics

Supervising experience:

- 11 PhD, Aveiro University (7), Porto University (2), UTAD (1) (6 concluded, 5 ongoing)
- 29 MSc, Aveiro University (22 finished, 2 ongoing), Porto University (5 finished)
- 16 Final Year Projects, 8 in the area of Robotics, Electrical Engineering and Computer Science graduations, Aveiro University, co-supervisor
- 2 Final Year Projects in the area of Robotics, Porto University, co-supervisor
- 9 Research Scholarships, 7 FCT, 2 IEETA

Area of Scientific Activity:

- Intelligent Robotics, Coordination of Multi-Agent Systems, Reconfigurable Systems

Research Projects:

- FC Portugal: New Coordination Methodologies Applied to the Simulation League (FCT – POSI/ROBO/43910/2002, 27800 EUR, Out 2003 – Out 2004, Coordinator at Aveiro University)
- Rescue: Coordination of Heterogeneous Teams in Search and Rescue Scenarios (FCT/POSC/EIA/63240/2004, 32800 EUR, Abr 2005 – Mar 2007, Principal Investigator)
- POCTI/DIV/2005/00132 - Concurso MicroRato da Universidade de Aveiro: Actividades de Divulgação da Robótica Móvel (member of research team), Jul 2005-Jul 2007
- POSI/ROBO/43908/2002 - CAMBADA - Cooperative and Autonomous Robots with Advanced Distributed Architecture (research team member)
- POSI/CHS/43140/2001 - Confibest - Methods and Models for Problem Oriented Reconfigurable Systems
- PTDC/EIA/70695/2006 - ACORD - Adaptative Coordination of Robotic Teams (member or research team)
- FCT RIPD/ADA/109636/2009 - INTELLWHEELS - Intelligent Wheelchair with Flexible Multimodal Interface, 2010-2012 (coordinator at Aveiro University)
- QREN/ADI - LUL - Living Usability Lab, 2010-2012 (member of research team)
- QREN PRODUTECH PSI, 2010-2014 (member of the research team)
- QREN PRODUTECH PTI, 2010-2014 (coordinator at Aveiro)
- QREN Cloud Thinking, 2013-2015 (coordinator of WP5)
- FP7 EuRoC: European Robotics Challenges, 2014- (challenger team leader), funding Univ. Aveiro of aprox:500k Eur.

Organization of Scientific Meetings:

- Micro-Mouse Robot Contest, Aveiro University, member of Organizing Committee, 2001-2006
- 5th Inter-University Programming Marathon, member of Technical Organizing Committee, Out 2005
- 1st Inter-University Programming Contest, member of Scientific Committee, Mar 2005.
- IROBOT'2005 – 1st International Workshop on Intelligent Robotics, EPIA – Portuguese Conference on Artificial Intelligence, Covilhã, member of Organizing Committee, 5 Dez 2005
- CiberMouse@RTSS2006 Robotic, Cyber Robotic Competition at Real-Time Systems Symposium, Rio de Janeiro, Brazil, 2006
- IROBOT'2007 – 2nd International Workshop on Intelligent Robotics, EPIA – Portuguese Conference on Artificial Intelligence, Guimarães, Dec 2007
- CiberMouse@RTSS2007, Cyber Robotic Competition at Real-Time Systems Symposium, Tucson, USA, 2007
- Festival Nacional de Robótica 2008, member of the Organizing Committee, Universidade de Aveiro, 2-6 April 2008, <http://robotica.ua.pt/robotica2008/>
- IROBOT'2008 – 3rd International Workshop on Intelligent Robotics, IBERAMIA – 11th edition of the Ibero-American Conference on Artificial Intelligence, Lisbon, Portugal, Oct 2008
- CiberMouse@RTSS2008, Cyber Robotic Competition at Real-Time Systems Symposium, Barcelona, Spain, 2008
- EPIA 2009 – 14th Portuguese Conference on Artificial Intelligence, Aveiro, 12-15 October 2008, member of the Organizing Committee, <http://epia2008.appia.pt>
- CyberRescue@RTSS2009, Cyber Robotic Competition at Real-Time Systems Symposium, Washington DC, USA, 2009
- IROBOT'2011 – 5th International Workshop on Intelligent Robotics, held at EPIA'2011 – Portuguese Conference on Artificial Intelligence, Lisbon, Portugal, October 12-15, 2011
- IROBOT'2013 – 6th International Workshop on Intelligent Robotics, held at EPIA'2013 – Portuguese Conference on Artificial Intelligence, Angra do Heroísmo, Portugal, October 12-15, 2013
- ICARSC'2014 – IEEE International Conference on Autonomous Robot Systems and Competitions, Espinho, Portugal, May, 2014
- IROBOT'2015 – 7th International Workshop on Intelligent Robotics, held at EPIA'2015 – Portuguese Conference on Artificial Intelligence, Coimbra, Portugal, September, 2015
- IROBOT'2017 – 8th International Thematic Track on Intelligent Robotics, held at EPIA'2017 – Portuguese Conference on Artificial Intelligence, Porto, Portugal, September, 2017

Publications and Communications:

- 1 Thesis, 15 international journal papers, 20 book chapters/series, 20 national journal papers, more than 130 papers in conference proceedings

Program/Scientific Committee in Conferences:

- RoboCup2017, ICARSC2017, EPIA 2017, IWANN2017, RoboCup2016, RoboCup2015, ICARSC2015, EPIA2015, Robot2015, CISTI2015, IWANN2015, SAC2015, ICARSC2014, CISTI2014, FEIM2014, IBERAMIA2014, EPIA2013, EASSS2012, Robotica2012, BIOTEC2012, CISTI2012, DSIE2012, MASTA2011, IROBOT2011, AI4Games2011, IWANN2011, ICAART2010, CISTI2010, IRSC2009, MASTA2009, IROBOT2009, IWANN2009, CISTI2009, ICAART2009, IbPria2009, IROBOT2008, CISTI2008, AAMAS2008, Robótica2008, MASTA 2007, IROBOT 2007, AAMAS 2007 (Honolulu, Haway), CISTI 2007, AAMAS 2006 (Hakodate, Japan), Robótica 2006 (Guimarães, Portugal), CISTI 2006, IROBOT 2005 (Covilhã, Portugal), MASTA 2005 (Covilhã, Portugal), Robótica 2004 (Porto, Portugal), IROBOT 2007 (Guimarães, Portugal), MASTA 2007 (Guimarães, Portugal)

Reviewer in Journals / other conferences:

- IROS2015, AAMAS2014, IROS2014, ICRA2013, ICRA 2012, ICC2012, IROS2011, RoboCup2011, Transactions on Industrial Informatics, Journal of Autonomous Agents and Multi-Agent Systems, European Journal of Sports Science, Neurocomputing Journal, 9th RoboCup Symposium (Fukuoka, Japan), 8th RoboCup Symposium (Lisbon, Portugal), World Automation Congress 2004 (Sevilla, Spain).

Principal Awards and Prizes:

- 3rd Place RoboCup 2016 - 3D Simulation League, Leipzig, Germany, RoboCup Federation
- 3rd Place RoboCup 2016 - MSL League, Leipzig, Germany, RoboCup Fed., 2014
- 3rd Place RoboCup 2015 - 3D Simulation League, China, RoboCup Federation
- Winner at EuroRoboCup 2015 - Simulation League 3D – Humanoids, Magdeburg, Germany – RoboCup Federation
- Best Paper IEEE/ICARSC2015 - 15th International Conf. on Mobile Robots and Competitions, SPR
- Winner of EuroRoboCup 2014 - Simulation League 3D – Humanoids, Magdeburg, Germany – RoboCup Federation
- Winner of Portuguese Robotics Open 2014 - Simulation League 3D – Humanoids, Robótica 2014 – Festival Nacional Robótica, SPR
- 2014, Winner of Scientific/Free Challenge, RoboCup 2014 - Simulation League 3D – Humanoids, João Pessoa, Brazil – RoboCup Federation
- 3rd Place RoboCup 2014 - MSL League, João Pessoa, Brazil, RoboCup Fed., 2014
- 3rd Place RoboCup 2013 - 3D Simulation League, Eindhoven, Holland, RoboCup Fed., 2013
- 1st Place RoboCup 2013 – Scientific Challenge Simulation2D, Eindhoven, Holland, RoboCup Fed., 2013
- 1st Place RoboCup 2013 – Scientific Challenge Simulation3D, Eindhoven, Holland, RoboCup Fed., 2013
- Best Paper Robótica 2013 - 13th International Conference on Mobile Robots and Competitions, SPR, 2013
- 1st Place EuroRoboCup 2013 - 3D Simulation League, Magdeburg, Germany, RoboCup Federation, 2013
- Winner of RoboCup Dutch Open 2012 Simulation 3D League, RoboCup Federation, Eindhoven, 2012
- Winner of Portuguese Robotics Open 2012 MSL League, Festival Nacional de Robótica, Guimarães, 2012
- Best Paper Award, 11th International Conference on Mobile Robots and Competitions, Robotica 2011, Lisboa, 2011
- Winner of Portuguese Robotics Open 2011 MSL League, Festival Nacional de Robótica, Lisboa, 2011
- 2nd Place in RoboCup German Open 2011, 3D Simulation League, RoboCup Federation, Magdeburg, Germany, 2011
- 2nd Place in RoboCup German Open 2011, 2D Simulation League, RoboCup Federation, Magdeburg, Germany, 2011
- 3rd Place in RoboCup World Championship 2010, MSL League, RoboCup Federation, Singapore, 2010
- 2nd Place in RoboCup German Open 2010, MSL League, RoboCup Federation, Magdeburg, Germany, 2010
- 2nd Place in RoboCup German Open 2010, 2D Simulation League, RoboCup Federation, Magdeburg, Germany, 2010
- 2nd Place in RoboCup German Open 2010, 2D Simulation League, RoboCup Federation, Magdeburg, Germany, 2010
- Winner of Portuguese Robotics Open 2010 MSL League, Festival Nacional de Robótica, Leiria, 2010
- 3rd Place in RoboCup World Championship 2009, MSL League, RoboCup Federation, Graz, Austria, 2009
- Winner of Portuguese Robotics Open 2009 MSL League, Festival Nacional de Robótica, Castelo Branco, 2009
- Winner of RoboCup 2008 MSL League, Robot World Cup Soccer Games and Conferences, RoboCup Federation, China, 2008
- Winner of Portuguese Robotics Open 2008 MSL League, Festival Nacional de Robótica, Aveiro, 2008
- 2nd Place in RoboCup World Championship 2007, PV-League (Mixed Reality League), RoboCup Federation, Atlanta, USA, 2007
- Winner of RoboCup German Open 2007, 3D Simulation League, RoboCup Federation, Hannover, Germany, 2007
- Winner of RoboCup World Championship 2006, 3D Simulation League, RoboCup Federation, Bremen, Germany, 2006
- Winner of RoboCup Dutch Open 3D Simulation League RoboCup Federation, Eindhoven, Holland, 2006
- Winner of RoboCup DutchOpen Rescue Simulation League RoboCup Federation, Eindhoven, Holland, 2006
- 2nd in Coach Competition Simulation League at 8th RoboCup International Competitions and Conferences, RoboCup Federation, Lisbon, 2004
- 2nd in Coach Competition Simulation League at The 7h RoboCup Int. Competitions and Conferences, RoboCup Federation, Pisa, 2003
- Winner of Coach Competition Simulation League at The 6th RoboCup Int. Competitions. and Conferences, RoboCup Federation, 2002
- Winner of RoboCup German Open 2001, Simulation League, RoboCup Federation, 2001
- 3rd Place in Simulation League at The Fifth Robot World Cup Soccer Games and Conferences, RoboCup Federation, 2001
- Winner of Simulation League, The Fourth Robot World Cup Soccer Games and Conferences, RoboCup Federation, Seattle, 2000
- Winner of EuRobocup 2000 Simulation League RoboCup Federation, Amsterdam, 2000
- Innovation Prize at Micro-Mouse Contest, Aveiro, 1999
- Best paper at RECPAD 94, Associação Portuguesa de Reconhecimento de Padrões, 1994

Selected publications:

- Brígida Mónica Faria, Luis Paulo Reis, Nuno Lau. A Methodology for Creating an Adapted Command Language for Driving an Intelligent Wheelchair. *Journal of Intelligent & Robotic Systems*, February 2015
- João Cunha, Rui Serra, Nuno Lau, Luís Seabra Lopes, António J. R. Neves. Batch Reinforcement Learning for Robotic Soccer Using the Q-Batch Update-Rule. *Journal of Intelligent & Robotic Systems*, January 2015
- Rui L. Aguiar, Diogo Gomes, João Paulo Barraca, Nuno Lau. CloudThinking as an Intelligent Infrastructure for Mobile Robotics. *Wireless Personal Communications*, vol. 76, no. 2, p. 231-244, May 2014 (IF 2013: 0.979)
- Nuno Lau, Luis Seabra Lopes, Gustavo Corrente, Nelson Filipe, Ricardo Sequeira, “Robot team coordination using dynamic role and positioning assignment and role based setplays”, *Mechatronics*, Elsevier, Vol. 21, n 2, pp. 445-454, ISSN 0957-4158, 2011
- Joao Silva, Nuno Lau, Antonio J.R. Neves, Joao Rodrigues, Jose Luis Azevedo, “World modeling on an MSL robotic soccer team”, *Mechatronics*, Elsevier, Vol 21, n 2, pp. 411-422, ISSN 0957-4158, 2011
- Luis Mota, Luis Paulo Reis, Nuno Lau, “Setplay usage in the Middle Size League”, *Mechatronics*, Elsevier, ISSN 0957-4158, Vol 21, n 2, pp. 434-444, 2011
- Nima Shafii, Luís Paulo Reis and Nuno Lau, “Biped Walking using Coronal and Sagittal Movements based on Truncated Fourier Series”, *RoboCup 2010: Robot Soccer World Cup XIV*, LNCS, Springer, June 25, 2010
- Hugo Picado, Marcos Gestal, Nuno Lau, Luis P. Reis, and Ana M. Tomé, “Automatic generation of biped walk behavior using genetic algorithms”, *Bio-Inspired Systems: Computational and Ambient Intelligence 10th IWANN 2009* Salamanca, Spain, June 10-12, 2009 Proceedings, Part I, University of Salamanca, Spain, pp. 805-812, June 9-12, LNCS 5517, Springer-Verlag, 2009
- Nuno Lau, Luís Seabra Lopes, Nelson Filipe, and Gustavo Corrente, “Roles, Positionings and Set Plays to Coordinate a MSL Robot Team”, In: *Progress in Artificial Intelligence*, 14th Portuguese Conference on Artificial Intelligence, EPIA 2009, Aveiro, Portugal, October 12-15, 2009, Proceedings, LNAI 5816, pp 323-337, Springer, October 12-15, 2009
- Nuno Lau, Luís Seabra Lopes, Gustavo Corrente, “CAMBADA: Information Sharing and Team Coordination”, *Proc. of the 8th Conference on Autonomous Robot Systems and Competitions, Portuguese Robotics Open - ROBÓTICA'2008*, April, Aveiro, 2008, pp. 27-32
- Nuno Lau, Luís Paulo Reis e João Certo, Understanding Dynamic Agent's Reasoning, In *Progress in Artificial Intelligence*, 13th Portuguese Conference on Artificial Intelligence, EPIA 2007, Guimarães, Portugal, December 3-6, 2007, Springer LCNS, Vol. 4874, pp. 542-551, 2007
- João Figueiredo, Nuno Lau, Artur Pereira, “Multi-agent Debugging and Monitoring Framework”, 1st IFAC Workshop on Multivehicle Systems (MVS'06), Bahia Convention Center, Salvador, Brazil, October 2 – 3, 2006
- Luís Paulo Reis, Nuno Lau, Francisco Reinaldo, Nuno Cordeiro and João Certo. “FC Portugal: Development and Evaluation of a New RoboCup Rescue Team”. 1st IFAC Workshop on Multivehicle Systems (MVS'06), Bahia Convention Center, Salvador, Brazil, October 2 – 3, 2006
- Luís Paulo Reis, Carlos Carreto, Eduardo Silva and Nuno Lau, "IROBOT'05: 1st International Workshop on Intelligent Robotics", In C. Bento, A. Cardoso and G. Dias (eds.) *Proc. Portuguese Conference on Artificial Intelligence*, IEEE – Institute of Electrical and Electronics Engineers, Inc., University of Beira Interior, Covilhã, Portugal, p. 225, December, 2005, ISBN 0-7803-9365-1
- Francisco Reinaldo, João Certo, Nuno Cordeiro, Luís P. Reis, Rui Camacho, Nuno Lau, “Applying Biological Paradigms to Emerge Behaviour in RoboCup Rescue Team”, *Actas do 1st Workshop on Intelligent Robotics – IROBOT'05*, Springer, 2005
- Hugo Marques, Nuno Lau and Luís Paulo Reis, “FC Portugal 3D Simulation Team: Architecture, Low-Level Skills and Team Behaviour Optimized for the New RoboCup 3D Simulator”, *Actas do Encontro Científico – 4º Festival Nacional de Robótica – Robótica 2004*, págs 31-38, Porto, Abril, 2004
- Cláudio Teixeira, Nuno Lau and Luís Paulo Reis, “FC Portugal 2003 Shoot Evaluation Based on Goalie Movement Prediction”, *Actas do Encontro Científico – 4º Festival Nacional de Robótica – Robótica 2004*, págs 149-155, Porto, Abril, 2004
- Nuno Lau, Artur Pereira, Andreia Melo, António Neves, João Figueiredo, “Ciber-rato: uma competição robótica num ambiente virtual”, *Actas do Workshop Entretenimento Digital e Jogos Interactivos – Games 2004*, Lisboa, Julho (2004)

- Luis Paulo Reis and Nuno Lau, “COACH UNILANG - A Standard Language for Coaching a (Robo)Soccer Team”, RoboCup-2001: Robot Soccer World Cup V, Andreas Birk, Silvia Coradeschi, Satoshi Tadokoro editors, LNAI 2377, págs. 183-192, Springer Verlag, Berlin, 2002
- Luis Paulo Reis and Nuno Lau, “FC Portugal Team Description: RoboCup 2000 Simulation League Champion”, RoboCup-2000: Robot Soccer World Cup IV, Peter Stone, Tucker Balch and Gerhard Kraetzschmar editors, LNAI 2019, págs. 29-40, Springer Verlag, Berlin, 2001
- Luis P. Reis, Nuno Lau, Eugénio C. Oliveira, “Situation Based Strategic Positioning for Coordinating a Team of Homogeneous Agents”, Balancing Reactivity and Social Deliberation in Multi-Agent Systems, Markus Hannebauer, Jan Wendler, Enrico Pagello, editors, LNCS 2103, págs. 175-197, Springer Verlag, 2001
- Edited by Peter Stone, with Minoru Asada (humanoid), Tucker Balch (workshop), Raffaelo D'Andrea (Cornell team), Masahiro Fujita (legged), Bernhard Hengst (UNSW team), Gerhard Kraetzschmar (mid-size), Pedro Lima (engineering challenge), Nuno Lau (FC Portugal team), Henrik Lund (RoboCup Jr.), Daniel Polani (scientific challenge), Paul Scerri (simulation), Satoshi Tadokoro (rescue), Thilo Weigel (CS Freiburg team), and Gordon Wyeth (small-size), “RoboCup-2000: The Fourth Robotic Soccer World Championships”, AI Magazine, Vol. 22, nº1, págs. 11-38, Spring, 2001

Detailed CV: More detailed CV at: <http://www.ieeta.pt/~lau>

Armando Sousa

Name: Armando Jorge Miranda de Sousa

Place and Date of Birth: Porto, February 1971

Address: Faculty of Engineering of Univ. Porto, Rua Dr. Roberto Frias, s/n, 4200-465, Porto

Phone:+351 96 677 67 97 **Fax:**+351 22 508 14 43

E-Mail: asousa@fe.up.pt **HomePage:** www.fe.up.pt/asousa

Academic Degrees:

- PhD, July 2004, Eng. Electrotécnica e de Computadores, FEUP – Unanimity
- MSc, Dec 1997, Eng. Electrotécnica e de Computadores, FEUP, Industrial Informatics - Very Good)
- Licenciatura (5 Year BSc), Jul 1994, Eng. Electrotécnica e de Computadores, FEUP, Automation, Control and Instrumentation

Present Position:

- Professor Auxiliar at FEUP, since July 2004, up to present
- Researcher at INESC TEC – “CROB” Center for Robotics and Intelligent Systems – since 2007

Past Positions:

- Researcher at ISR – Automation Group – since 1993
- Invited Professor at UTAD – year 2000
- Lecturer at FEUP since 1997
- Lecturer at ISEP year 1996/7

Pedagogical and Divulcation Activities:

- 2009/10 up to present - Professor of Robotics and Intelligent Robotics for MIEIC (MsC. program) and ProDEI (doctoral program)

- Professor of several other Automation, Control, Systems and Computational Intelligent Courses
- 2009/10 up to present - General Coordinator for Reception of new students at FEUP (about 1000 students/year)
- 2009/10 up to present - General Coordinator for “Projeto FEUP” cross-program course
- Group member for the integration of new students at UP
- Participation in many more than 20 divulgation actions on behalf of FEUP, INESC Porto and ISR-P (including demonstrations, faculty and university open days, science fairs, other activities and invited presentations)
- Invited Jury for over 25 MScs and PhDs in and out of University of Porto
- Regular Member of Scientific Panel/Program committee of over 15 conferences and 2 journals

Experience in Supervision:

- 1 Phd student supervised to completion and currently Supervising 3 PhDs – please refer to detailed CV for details
- 37 MSc Thesis (plus 6 ongoing) – please refer to detailed CV for details

Research Interests:

- Robotics and Automation
- Information Fusion, Vision Systems,
- Intelligent Systems and Intelligent Robotics,
- Robotic Soccer
- Education

Research Projects:

- PEC 137 – Robôs em movimento –Ciência Viva, 2013
- MEDIS - A Methodology for the Formation of Highly Qualified Engineers at Masters Level in the Design and Development of Advanced Industrial Informatics Systems 544490-TEMPUS-1-2013-1-ES-TEMPUS-JPCR 2013
- Vingere - Ciências e engenharia em português: vídeo e interação 122015 Engenharia - vídeo e interação 2013
- BESTCase – RL4 - Cooperation and perception for augmented autonomy NORTE-07-0124-FEDER-000060 BESTCASE-RL4 – 2013 -
- PRODUTECH-PTI - Novos Processos e Tecnologias Inovadores para a fileira das Tecnologias de Produção - SI IDT – 13851/2011 – PRODUTECH-PTI – 2011
- RobVigil - “Robot Vigiância”, Projeto QREN, InescTec, 2011/12 - SI IDT - 7905/2010
- Portus – "Common Framework for Cooperation in Mobile Robotics"
FCT - POSI/SRI/41315/2001, 20000 EUR, 2002 – 2005,
Principal Researcher: António Paulo Moreira
- ACORD - "Adaptative Coordination of Robotic Teams"
FCT/PTDC/EIA/70695/2006, 95000 EUR, Jan 2008 – Dec 2009,
Principal Researcher: Luis Paulo Reis
- CleanRob – "Autonomous Cleaning Robot" (DEEC/FEUP, ISR-P) – 2004 (ongoing),
Principal Researcher: Armando Sousa, projecto DEEC/FEUP/ISR-P
- SoftCore Robot – “FPGA based versatile Robot” – IPG 44 UP – July 2007 to July 2008,
Principal Investigator: Armando Sousa

Publications and Communications:

- 2 Thesis, 8 Book Chapters, 5 Papers in Peer Reviewed Journals, 62 Papers in International Conferences

Principal Awards and Prizes:

- 2015 Prémio de excelência pedagógica da Universidade do Porto
- 2009 Pedagogic award of FEUP
- 2006 Mundial RoboCup, Bremen, Alemanha - F180: 2º Classificado;
- 2006 "Dutch Open", Eindhoven, Holanda: F180: Vencedor; F2000: 5º Lugar (2º lugar no “desafio” desta liga)
- 2005 "German Open", Paderborn, Alemanha: F2000: Quartos de Final;
- 2004 Mundial, Lisboa, Portugal: F180: 5º Classificado e F2000
- 2004 "German Open", Paderborn, Alemanha: F180: 2º Classificado;
- 2003 Mundial, Pádua, Itália: F180: 5º Classificado e F2000: 14º Classificado
- 2003 "German Open" Paderborn, Alemanha: F180: 2º Classificado e F2000: 3º Classificado
- 2002 "German Open", Paderborn, Alemanha: F180: 2º Classificado e F2000: 5º Classificado
- 2001 Mundial, Seattle, EUA: F180: 6º Classificado
- 2001 "German Open", Paderborn, Alemanha, 2001: F180: Vencedor; F2000: 3º Classificado
- 2000 "Open Europeu", Amsterdão, Holanda 2000 – F180 e F2000
- 1998 Mundial, Paris, França: F180 - 3º Classificado

Some Relevant Publications:

- P Silva, C Santiago, L P Reis, A Sousa, J Mota and G Welk - “Assessing physical activity intensity by video analysis” - Journal Physiological Measurement – Volume 36, Issue 5, 1 May 2015, Article number 1037, Pages 1037-1046 – DOI: 10.1088/0967-3334/36/5/1037
- Luís Cruz, Luis Paulo Reis, Nuno Lau, Armando Sousa "Optimization Approach for the Development of Humanoid Robots' Behaviors" – Advances in Artificial Intelligence – IBERAMIA 2012 - (Book Chapter) Lecture Notes in Computer Science Volume 7637, 2012, pp 491-500; DOI:978-3-642-34654-5_50
- Catarina B. Santiago, Armando Sousa, Luis Paulo Reis - "Vision system for tracking handball players using fuzzy color processing" - Machine Vision and Applications 07/2013; 24(5), pp 1055-1074; Springer Journal - Springer-Verlag Berlin Heidelberg; ISSN: 0932-8092; WOS:000320512000014; DOI: 10.1007/s00138-012-0471-z
- Catarina Santiago, João Oliveira, Luís Paulo Reis, Armando Sousa, Fabien Gouyon - "Overcoming Motor-Rate Limitations in Online Synchronized Robot Dancing" - International Journal Of Computational Intelligence Systems Volume: 5 Issue: 4 Pages: 700-713; ISSN: 1875-6883; DOI: 10.1080/18756891.2012.718120 (August, 2012) – WOS:000307642700007 - <http://www.tandfonline.com/doi/abs/10.1080/18756891.2012.718120>
- Catarina B. Santiago, Lobinho Gomes, Armando Sousa, Luís Paulo Reis and Maria Luísa Estriga, "Tracking Players in Indoor Sports Using a Vision System Inspired in Fuzzy and Parallel Processing" book chapter in “Cutting Edge Research in New Technologies”, ISBN 978-953-51-0463-6, ed. Constantin Volosencu; April 5, 2012; pp. 117-140 ;DOI: 10.5772/33886
- Catarina Santiago, Armando Sousa, Luís Paulo Reis, Maria Luísa Estriga, "Real Time Colour based Player Tracking in Indoor Sports" - book chapter in "Computational Vision and Medical Imaging Processing: Recent Trends", editors: J. M. Tavares and R. M. Jorge. (Springer selected papers) - 2011, vol 19, pp 17-35, ISBN 978-94-007-0010-9
- Hélder P. Oliveira, Armando J. Sousa, A. Paulo Moreira and Paulo J. Costa, “Modeling and Assessing of Omni-directional Robots with Three and Four Wheels”- Book Chapter in “Contemporary Robotics - Challenges and Solutions” - Published by In-Tech, Edited by A. D. Rodić; ISBN 978-953-307-038-4, December 2009
- Erik Moreira Pegoraro, Armando Sousa, “FEUP Fuzzy Tool II - Improved tool for education and embedded control”, 5th Iberian Conference on Information Systems and Technologies (CISTI), 16-19 June 2010, Santiago de Compostela, Spain, pp. 1-6
- André Carvalhosa, Pedro Machado, Armando Sousa, José Carlos Alves, "Soft Core Robot with Joint Wheel Motion Controller" – IECON 2009 - The 35th Annual Conference of the IEEE Industrial Electronics Society, 3-5 November 2009, Porto, Portugal, pp. 3168-3173
- Luís Paulo Reis, António J. R. Neves, Armando Sousa, "Real-Time Vision in the RoboCup - Robotic Soccer International Competitions", Computer Vision in Robotics – VipIMAGE 2009 - II ECCOMAS Thematic Conference on Computational Vision and Medical Image Processing, 14 a 16 de Outubro 2009, pp.319-324
- H. P. Oliveira, Armando J. Sousa, A. P. Moreira, P. J. Costa, “Precise Modeling of a Four Wheeled Omni-directional Robot, 8th Conf. Autonomous Robot Systems and Competitions” - ROBOTICA2008, pp. 57-62, Aveiro, April 2008.

- *João Martins, Armando Sousa, "Comparing Self Localization using Kalman Filter and Particle Filter", 3rd Int. Workshop on Intelligent Robotics – IRobot 2008 – October 14th, 2008, ISCTE, Portugal, pp. 119-130*

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