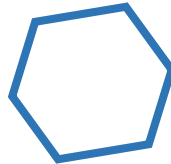




**CISTER**  
Research Center in  
Real-Time & Embedded  
Computing Systems



# Annual Report



**2012**

**isep** Instituto Superior de  
Engenharia do Porto

**POLITÉCNICO  
DO PORTO**



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## Executive Summary

[www.cister.isep.ipp.pt](http://www.cister.isep.ipp.pt)

The Research Centre in Real-Time and Embedded Computing Systems (CISTER) is based upon a research group created in 1997 at the School of Engineering (ISEP) of the Polytechnic Institute of Porto (IPP). Since then it has grown to become the most prominent research unit of IPP and one of the leading international research centres in real-time and embedded computing systems. In both the 2003 and 2007 evaluation processes, the Unit was granted the classification of 'Excellent' (the highest possible mark at that time) from an international panel of experts, being the only Portuguese unit in the areas of Electrical Engineering and Computer Science and Engineering to top-rank in both evaluations.

The strategy laid out by the Unit has been from the start towards top-quality research, able to compete with the best international groups in our research areas.

CISTER focuses its activity in the analysis, design and implementation of Real-Time and Embedded Computing Systems (RTES).

The goal of the unit is to continue (and reinforce) to be one the International leaders of research in real-time embedded systems. This objective is aligned with the growing strategic importance of embedded systems in Europe, and the role that needs to be played in the international research landscape of the area.

CISTER is hosted by ISEP, the main management institution. CISTER and ISEP have recently entered (since 2011) a strategic alliance with the INESC-TEC Associated Laboratory in which CISTER became an autonomous unit of INESC-TEC. It is our belief that this allows the continuation of the synergies in a challenging future environment.

## Management Structure

The research unit is led by a Board of Directors, a Scientific Board and an External Advisory Board. The Board of Directors, is led by the unit's Director/ Coordinator, and includes Vice Directors and an Adjunct Director. The main responsibilities of the Director are: to represent the Unit externally; to manage and co-ordinate the activities of the Unit; to co-ordinate the definition of the plan of activities and budget. The Scientific Board, which includes all the members of the Unit with a PhD degree, has the following main responsibilities: to appoint the Director; to define the scientific research areas and working strategies; to carry out research; and to approve the plan of activities, budget and yearly report.

Board of Directors: Eduardo Tovar (Director), Luis Miguel Pinho (Vice-Director) Stefan M. Petters (Vice-Director), Filipe Pacheco (Adjunct-Director).

The activities of the unit are periodically reviewed by the External Advisory Board. Annually, interactions (including on-site visits) are devised to discuss activities, exploitation of results and future plans of the unit.

External Advisory Board: Tarek Abdelzaher, University of Illinois at Urbana-Champaign, USA; Sanjoy Baruah, University of North Carolina at Chapel Hill, USA; Alan Burns, The University of York, United Kingdom; Rodrigo Maia, Critical Software, Portugal; Daniel Mossé, University of Pittsburgh, USA; Michael Paulitsch, EADS, Germany; Sérgio Penna, Embraer, Brazil; Zlatko Petrov, Honeywell, Czech Republic; Raj Rajkumar, Carnegie-Mellon University, USA.

## CISTER in Numbers

CISTER is currently housed in an entirely new building exclusively devoted to its R&D activities. This single-home (2000 m<sup>2</sup>) is a strong asset to continue to compete among the best in the world in the area of RTES.

CISTER has a strong and solid international reputation, built upon a robust track record of publications (40 publications in 2012), a continuous presence on program and organizing committees of international top conferences. In 2012 CISTER has over 60 collaborators, covering more than 20 nationalities, from which 19 PhD and 24 MSc.

In 2012 the unit had around 902K EUR of competitive funding. During 2012 CISTER had 6 international and industrial driven projects, and 9 fundamental research projects (FCT supported) running.

In 2012 CISTER got approved a set of new projects, accounting for a budget of 154K EUR in the year, with a total budget of 462K EUR.

## Focus and Research Lines

[www.cister.isep.ipp.pt/research](http://www.cister.isep.ipp.pt/research)

CISTER focuses its activity in the analysis, design and implementation of Real-Time and Embedded Computing Systems (RTES). In these systems, correctness depends not only on the logical result of computation, but also on the time at which the results are produced. This implies that, unlike more traditional information and communication systems, where there is a separation between correctness and performance, in real-time systems correctness and performance are very tightly interrelated. Furthermore, considering their tight integration with the surrounding environment, RTES require a more holistic and integrated system perspective. Historically, RTES were an important, but narrow, niche of computer systems, consisting mainly of military systems, air traffic control and embedded systems for manufacturing and process control. Meanwhile, both the emergence of large-scale distributed systems and the pervasiveness of embedded devices, enabled by advances in technology, has broaden real-time concerns into a mainstream enterprise, with clients in a wide variety of industries and academic disciplines. This trend has established real-time embedded systems technology as a priority for commercial strategy and academic research for the foreseeable future and also for a wider number of applications.

Real-Time Embedded Systems technologies are deployed in almost all relevant market sectors across Europe. Consequently, Embedded Systems have a major impact on the way these sectors work and collaborate, how they will develop, how they are perceived by both professionals and the public, and how successful their products will be on the world market. Real-Time Embedded Computing Systems is one of the strategic research and innovation areas in Europe, with impact in very important sectors such as industrial automation, automotive, aerospace, consumer electronics, communication systems and medical systems. For many of these sectors, Europe is a world-wide reference, contrary to general-purpose computing systems, traditionally dominated by non-European organizations.

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### Wireless Sensor Networks (WSN)



Wireless Sensor Networks (WSNs) are triggering a new era in Information and Communication Technologies. These networks of tiny embedded computing systems are enabling a new set of large-

scale monitoring and control applications such as for pervasive Internet, homeland security, critical physical infrastructures monitoring, precision agriculture, environmental monitoring or intelligent transportation systems.

CISTER has been assuming international leadership in the WSNs scientific area, namely on supporting Quality-of-Service (QoS), particularly focusing on timeliness and real-time, reliability and energy-efficiency aspects.

We are addressing the use of both standard and COTS technology and cutting-edge solutions designed from scratch. CISTER pursues excellence-level collaborative R&D sustained by

analytical, simulation and experimental models. We have recently designed, implemented and deployed the largest WSN test-bed in Europe to date, with 300+ sensor nodes.

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## Multicore Systems

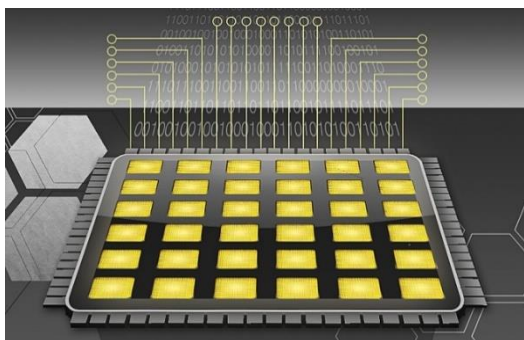


Illustration: Christine Daniloff/MIT

Multicores are spreading at an unprecedented rate. Today, a multicore processor is the default choice in server/desktop/laptop computers and

it is increasingly used in embedded computer systems (such as cellular phones, in-vehicle electronics and medical instrumentation).

The use of multicores in embedded systems is complicated by the fact that many embedded computer systems have real-time requirements, that is, the time at which a program produces its

result is as important as the result itself. The time at which a program computes its result depends on how computer resources (processor cores, memory, bus bandwidth, I/O devices, etc.) are shared among programs and therefore the scientific community has created a toolkit of algorithms for scheduling programs on a single processor so that the program executes at the right time. Unfortunately, scheduling programs at the right time on a multicore is currently not well understood; in particular, there is no such well-established toolkit for multiprocessors.

Researchers at CISTER/IPP-HURRAY are currently developing scheduling algorithms and proof techniques which makes it possible to prove at design time that deadlines will be met at run-time, even if the exact time when programs request to execute is unknown.

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## Cyber-Physical Systems (CPSs)

Although the IT transformation in the 20th century appeared revolutionary, a bigger change is probably yet to come. The terms "Cooperating-Objects" or "Cyber-Physical Systems (CPS)" have come to describe the research and technological effort that will ultimately efficiently allow interlinking the real world physical objects and cyberspace.

Actually the integration of physical processes and computing is not new.

Embedded systems have been in place since a long time to denote systems that combine physical processes with computing.





Synapticon SOMANET

The revolution will come from extensively networking embedded

computing devices, in a blend that involves sensing, actuation, computation, networking, pervasiveness and physical processes.

Such extreme networking poses considerable technical challenges ranging from the (distributed) programming paradigms (languages still lacking temporal semantics, suitable concurrency models and hardware abstractions) to networking protocols with timeliness as a structuring concern, and including systems theory that combines "physical concerns" (control systems, signal processing, etc.) and "computational concerns" (complexity, schedulability, computability, etc.).

## Adaptive Real-Time Systems



ADEX

We are increasingly surrounded by computer controlled devices. Many of which are not perceived as "computers" and are called embedded systems: think of mobile phones, cars, or aircraft. Many of these systems have some sort of real-time requirements, be it responsiveness, quality of service or hard deadlines, where the miss of the latter leads to catastrophic consequences. Beyond the fact that we are more and more surrounded and dependent on such systems, there is

another trend visible. Embedded systems are often networked and/or receive upgrades and extensions during the lifetime of an individual system. These may be, for example, applications downloaded to your mobile phone or an upgrade of your motor control in a garage. A third trend is an increase in mobile systems, requiring effective power management to extend the battery lifetime.

Within this research line we address the issues associated with systems requiring temporal isolation of system parts with different criticality, as well as systems being robust and reliable in the context of additional restrictions like available energy, changing environment or a dynamic set of tasks executed on such a system.

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## Real-Time Software

```
with Ada.Text_IO;  
package Mine is  
  type Integer is range 1 .. 11;  
  i : Integer := Integer'First;  
  procedure Print (j: in out Integer);  
  function Next (k: in Integer) return Integer;  
begin  
  return k + 1;  
end;
```

The current use of software as the key component of any real-time embedded system is increasing the, often contradictory, demands for attributes such as flexibility, adaptation, isolation, reliability or availability. Software infrastructure (such as languages, operating systems, middleware) and

models are, more and more, a fundamental topic for system development, being transversal to application areas and research domains.

In this context, this research line addresses issues associated with the software infrastructure required for developing embedded real-time systems. Our approach is to integrate advanced mechanisms within programming languages, operating systems and middleware, allowing designers and programmers to manage the increasing complexity, and flexibility requirements, simultaneously reducing common errors, and allowing isolation and verification of systems.

## Research Projects

[www.cister.isep.ipp.pt/projects](http://www.cister.isep.ipp.pt/projects)

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### International & Industrial Driven Projects

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#### ENCOURAGE



#### Embedded iNtelligent Controls for bUildings with Renewable generAtion and storaGE

JU grant nr. 269354 ARTEMIS/0002/2010

Funding: 6.37MEUR (CISTER Funding: 266KEUR)

42 months (Jun 2011 to Nov 2014)

The ENCOURAGE project aims to develop embedded intelligence and integration technologies that will directly optimize energy use in buildings and enable active participation in the future smart grid environment. The desired energy savings will be achieved in three complementary ways:

- I. by developing supervisory control strategies that will be able to coordinate larger subsystems and orchestrate operation of the numerous devices in such systems.
- II. through an intelligent gateway with embedded logic supporting inter-building energy exchange.
- III. by developing novel virtual sub-metering technologies and event-based middleware applications that will support advanced monitoring and diagnostics concepts.

The primary application domains are non-residential buildings and campuses,

but the project has relevancy also to residential buildings and neighbourhoods. This will be expressed through several demonstrators comprising public and private office buildings, campus buildings, and private homes. ENCOURAGE aims to achieve 20% of energy savings through the improved interoperability between various types of energy generation, consumption and storage devices; inter-building energy exchange; and systematic performance monitoring.

Partners of the ENCOURAGE consortium include, among others:



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## RECOMP



### Reduced Certification Costs for Trusted Multi-core Platforms

Artemis 100202

Funding: 25.8MEUR (CISTER Funding: 456KEUR)

3 years (Apr 2010 to Mar 2013)

RECOMP recognizes the fact that the increasing processing power of embedded systems is mainly provided by increasing the number of processing cores. The increased numbers of cores is commonly regarded as a design challenge in the safety-critical area, as there are no established approaches to achieve certification. At the same time there is an increased need for flexibility in the products in the safety-critical market. This need for flexibility puts new requirements on the customization and the upgradability of both the non-safety and safety-critical critical part. The difficulty with this is the large cost in both effort and money of the re-certification of the modified software, which means that companies cannot fully leverage the advantages of

modular software system. RECOMP will provide reference designs and platform architectures together with the required design methods and tools for achieving cost-effective certification and re-certification of mixed-criticality, component based, multi-core systems. The aim of RECOMP is to define a European standard reference technology for mixed-criticality multi-core systems supported by the European tool vendors participating in RECOMP.

Partners of the RECOMP consortium include, among others:



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## Fundamental Research Projects

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### AVIACC



#### Analysis and Verification of Concurrent Critical Programs

FCOMP-01-012244-FEDER-020486 PTDC/EIA-CCO/117590

Funding: 94KEUR (CISTER Funding: 24.1KEUR)

3 years (May 2012 to Apr 2015)

The goal of the project is to extract models from concurrent programs and

building an automatic framework for checking (temporal) properties using verification technologies, both static and run-time

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### MASQOTS



#### Mobility mAnagement in wireless Sensor networks under QoS constraints using standard and Off-The-Shelf technologies

FCOMP-01-0124-FEDER-014922 PTDC/EEA-TEL/112220/2009

CISTER Funding: 94.8KEUR

42 months (Feb 2011 to Jul 2014)

MASQOTS aims at real-time and reliable communications in IEEE 802.15.4/ZigBee (15.4/ZigBee, for short) Wireless Sensor Networks (WSNs) supporting physical mobility. Physical mobility concerns mobile sensor/actuator nodes and node groups (e.g. body sensor networks (BSNs), robots), and also mobile sinks (e.g. gateways, user-interface equipment).

The main objective of this project is to design a real-time and reliable mobility management mechanism for IEEE 802.15.4/ZigBee-based WSNs.

We will build upon the most widespread WSN technologies – the 15.4 and ZigBee protocols and the TinyOS

We claim that such developments are crucial for future WSN and will be beneficial in many usage scenarios. This

operating system (OS) – for which the research team in this proposal is international leader. OnWorld predicts that in 2012, 88.3% of the WSN units will be standards-based. Freescale reports over 7 million 15.4/ZigBee units sold in 2008 and In-Stat forecasts 292 million units in 2012. TinyOS is the most used OS for WSNs.

MASQOTS will also address some fundamental (not yet solved) problems, such as the ones related to reliable Radio Link Quality Estimation (LQE), efficient and dynamic resource management, reliable and time-bounded handoff and re-association mechanisms and the provision of (simulation, analytical) models/tools for WSN analysis and dimensioning.

project particularly targets the use-case of modern smart buildings One important aspect of this application

domain is that different users might develop them at different times, and it

is not practical to merge them into a single application.

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## REGAIN



### Real-time scheduling on general purpose graphics processor units

FCOMP-01-0124-FEDER-020447 PTDC/EIA-CCO/118080/2010  
CISTER Funding: 139KEUR

40 months (Apr 2012 to Jul 2015)

Among all processors sold today, 98% are used in embedded computer systems; therefore, catering to this segment is of utmost importance. Moreover, there is a persistent trend in computing that techniques originally developed at the high-end (pipelining, cache-memories, instruction-level parallelism) later propagate to embedded computer systems. Graphics processors are the next technology to do this transition.

Therefore, this project will create a real-time scheduling theory for GPGPUs. This theory will offer (i) a model suited for describing real-time scheduling on GPGPUs, (ii) algorithms for run-time scheduling of tasks using GPGPUs and (iii) algorithms for proving, before run-time, that tasks using GPGPUs meet their deadlines. This project will also test the theory on commercially available GPGPUs.

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## REHEAT



### Real-time scheduling on heterogeneous multicore architectures

FCOMP-01-0124-FEDER-010045 PTDC/EIA-CCO/105716/2008  
CISTER Funding: 130KEUR

3 years (Feb 2010 to Jan 2013)

Parallel processing platforms are spreading at an unprecedented rate. Traditionally, parallel processing platforms were used to reduce the execution time of a large computational job such as predicting the weather but now they are also used in low-end systems and embedded real-time systems thanks to the availability of multicore processors. And those systems are often comprised of a large

number of independent tasks. Designers are well-aware that processing units specialized for a specific function can offer a significant performance boost. Consequently, heterogeneous multicores now enjoy a period of widespread use. Virtually all major semiconductor companies are offering or have declared plans to offer heterogeneous multicores. This project aims to create provable good real-time scheduling algorithms for heterogeneous multicores.

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## RePoMuc



### Real-time Power management on partitioned MultiCores

FCOMP-01-0124-FEDER-015050 PTDC/EIA-EIA/112599/2009  
CISTER Funding: 106KEUR

3 years (Feb 2011 to Jan 2014)

The fundamental objective of the RePoMuc project to provide a methodology for real-time power-management in Multicores, considering: 1. the non-linear behaviour of dynamic frequency and voltage scaling (DVFS) on execution-time and energy, 2. pre-emption delays, and 3. memory bus contention Particular focus will be given to demonstrate with a real-world implementation the practicality and

limitations of the proposed methodology. The approach I intend to take is to build on successful experience of the group in the areas of DVFS power management, real-time multiprocessor scheduling and temporal isolation. The issues of DVFS behaviour, pre-emption delays, and memory bus contention have a fundamental communality in the sense that they are all tightly coupled to the amount of memory traffic.

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## REWIN



### Real-Time Guarantees in Wireless Sensor Networks

FCOMP-01-0124-FEDER-010050 PTDC/EIA-CCO/109027/2008  
CISTER Funding: 68KEUR

3 years (Feb 2010 to Jan 2013)

A class of WSN applications require timely response to events. For example, in a smart nursing home WSN scenario, it is necessary to guarantee that life-threatening events such as heart-attacks are communicated to doctors within a bounded time. The ability to support real-time applications is fundamental to the advancement of capabilities of WSN, and is the motivation for this proposed research. Since communication is an integral part of WSN, the performance of WSN is mainly determined by the quality and

capacity of the wireless channel. The limited previous research that exists is insufficient to guarantee (with mathematical proofs) a low delay for disseminating the occurrence of rare but critical events, such as the heart-attack mentioned above. This project, we will develop methods to offer hard real-time guarantees to individual real-time flows over multi-hop WSN of arbitrary node deployments and arbitrary traffic pattern. These methods will guarantee a small delay for disseminating the occurrence of critical events.

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**SMARTS**

**Slack Management in Hierarchical Real-Time Systems**

FCOMP-01-0124-FEDER-020536 PTDC/EIA-CCO/121904/2010

CISTER Funding: 158KEUR

42 months (Apr 2012 to Sep 2015)

Most of modern computing systems are embedded with the physical environment. When such embedded systems are additionally subject to temporal constraints they are termed real-time systems.

There are a number of relevant trends in real-time systems: the complexity of such systems increases dramatically, often leading to integration of subsystems from various vendors; real-time and best effort applications may share the processor on a given device; the software on such systems may be subject to change leading to dynamic real-time systems.

A widely accepted design paradigm for such complex systems is component-based engineering in which 1) the system is first decomposed into simpler and smaller applications, 2) applications are independently designed and analysed, and 3) applications are composed together to generate the system. Depending on how the applications are grouped together for

composition, the resulting system can be represented as a tree of applications; each parent-children pair denotes a composition where the child-applications were composed together to form the parent-application.

Within this project, we will: propose to investigate a comprehensive reclamation of all slack in a hierarchical system; investigate the impact of preemption, integrate pre-emption estimation techniques and provide a framework for alternative policies. Finally, we will explore how the developed techniques can be applied in a multicore setting.

For this we will build on the work of the ViPCore project (PTDC/EIA-CCO/111799/2009) also executed in CISTER, which in turn builds in among other things on [11, 27]. The multicore development will run in parallel to the other activities once the initial work on uniprocessors have been identified.



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## SENODs



### Sustainable ENergy-Optimized Datacenters

FCOMP-01-0124-FEDER-012988 CMU-PT/SIA/0045/2009  
Funding: 292KEUR (CISTER Funding: 219KEUR)

39 months (Oct 2010 to Dec 2013)

Data centres increasingly constitute a critical backbone of the worldwide information technology (IT) infrastructure, forming the server infrastructure for search engines, mail servers, e-commerce, data warehousing and other cloud computing functions. Thousands of data centres operate across the world occupying various millions of square meters. While such data centres generally target large-scale virtual IT services, the design, construction and operation of data centres (i) depend on cyber-physical infrastructure with major power and cooling requirements, (ii) incur significant energy costs, and (iii) can lead to significant economic and societal impact from the failures of physical subsystems. In fact, power and cooling in a data centre cost more than the IT equipment supported. As a result, data centres face an emerging crisis. The SENODs (Sustainable ENergy-Optimized Datacenters) project will rectify that by: (i) using ultimate distributed sensing technologies to

provide fine-grained monitoring of power consumption, cooling and data centre environmental variables to identify, model, analyse and optimize energy costs; (ii) developing intelligent layout optimization algorithms that offer recommendations regarding placement of new servers so as to minimize local hotspots and improve energy efficiency; (iii) providing support for alerts and notifications of actual or pending failures in cooling and other infrastructure equipment to gracefully shut down some or all of centre operations; (iv) online capacity and workload management that allows dynamic reallocation of computing loads driven by energy and cost minimization.

Partners of the SENODs consortium include:




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## Smartskin



### Densely Instrumented Physical Infrastructures

FCOMP-01-0124-FEDER-020312 PTDC/EEA-ELC/121753/2010  
CISTER Funding: 141KEUR

3 years (Mar 2012 to Feb 2015)

Although the information technology transformation of the 20th century appeared revolutionary, a bigger change is on the horizon. The term Cyber-Physical Systems (CPS) has come to describe the research and technological effort that will ultimately allow the interlinking of the real-world physical objects and the cyberspace efficiently. The integration of physical processes and computing is not new.

Embedded systems have been in place for a long time and these systems often combine physical processes with computing. The revolution will come from massively networked embedded

computing devices, which will allow instrumenting the physical world with pervasive networks of sensor-rich embedded computation.

In this project we intend to develop techniques and technologies that allow performing scalable and efficient data processing in large-scale dense cyber-physical systems. This is yet an unsolved problem. The major novelty of this proposal is effectively in the co-design of distributed algorithms for sensor data processing and underlying networked distributed computing systems with corresponding resource management schemes such that the utilization of resources is low.

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## VipCore



### Virtual Processor-based Multicore Scheduling

FCOMP-01-0124-FEDER-015006 PTDC/EIA-CCO/111799/2009  
CISTER Funding: 111KEUR

40 months (Feb 2011 to Jun 2014)

Scheduling on multicores is a much harder problem than those studied under single processor scheduling theories, largely because of the inherent non-parallelism in workload tasks. Although a multicore platform may execute different tasks from a workload at the same time, it is typically not allowed to execute the same task on more than one core simultaneously. This project plans to research multiprocessor frameworks and platforms to tackle these issues.

One important concept is the notion of virtual processors, which allow to use a three-step scheduling strategy: partitioning of workload tasks and assigning virtual processors to each partition, scheduling of tasks on virtual processors within each cluster, and scheduling of virtual processors on the physical cores. Another important concept is the notion of pJobs, which allow tasks to be executed in parallel in the physical cores, increasing the potential parallelism of applications. The project will also research into architectures and platforms for supporting these concepts, and the underlying resource sharing paradigms.

## Highlights 2012

[www.cister.isep.ipp.pt/news](http://www.cister.isep.ipp.pt/news)

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### February

#### CISTER Participates in 1st IPP's Scientific Forum

CISTER was one of the R&D groups present in the first IPP's Scientific forum. In the opening session, with the presence of the Secretary of Science, CISTER Director Eduardo Tovar gave a speech on the internationalization of Research presenting CISTER's

experience and success case. On February 24th, at ISEP, CISTER also presented to a full room its strategic core areas of research with focus on two industry-driven research projects: EMMON for embedded monitoring and SENODS for energy efficient datacenters. CISTER also prepared a booth for the Science Fair showcasing several R&D projects where some of CISTER's PhD students interacted with the visitors.

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### March

#### EMMON consortium plans WSN demonstrator and open day at SANJOTEC high tech park

Around 20 academic and industrial researchers from the EMMON consortium participated in a meeting at SANJOTEC facilities, on the 27/FEB/2012. The main objective of the meeting was to make a status update of the different WPs and to plan activities to drive EMMON to a successful completion. SANJOTEC (a Science and Technology Park located in São João da Madeira - <http://www.sanjotec.com/>) is the location of the second EMMON demonstrator (dubbed DEMMON2) - a real-world application of EMMON technologies. An open day (featuring live presentations and demonstrations to the academic and industrial community) is planned for the 29/MAY/2012.

DEMMON2 will enable to test and validate EMMON Wireless Sensor Network technologies in a real-world environment, allowing a fine-grained real-time monitoring of SANJOTEC environmental conditions. Over 400 wireless sensor nodes are being deployed across several floors/rooms in the main SANJOTEC building. Continuously measuring physical parameters such as temperature, light, humidity, CO/CO2 and Ozone through a high density sensor network enables to get a deep and real-time perception of the quality of the environment and also to take corrective actions such as controlling the buildings' lighting and HVAC systems, improving its energy-efficiency and habitability. In this context, a building management system (from SAUTER) is being integrated with the EMMON WSN system.

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April

### CISTER receives recognition at flagship conference

The Euromicro Conference on Real-Time Systems is one of the flagship events of the community with an acceptance rate smaller than most journals in computer science. This year CISTER has got three papers accepted to the single track, three day event, which is in itself an outstanding achievement rarely matched by other institutions.

As a change compared to last year, the organisers decided to create a special session of outstanding papers submitted to the conference. One of the papers submitted by CISTER/INESC TEC researchers was included in the only three paper strong session of outstanding papers at the conference and is thus shortlisted for the best paper award. We congratulate Guru Ravari and Vincent Nélis on this really outstanding achievement.

### Polytechnic of Porto among the Top-20 Universities in the World

In science and technology (S&T), evaluation of research is more and more based on the actual impact caused by the science and technology that is produced rather than on the quantity or the venue where the results are published. Research assessment must consequently judge not only the reputation of the journal or conferences where results are published, but also, and important, the quality and impact of the produced results.

All rankings have a particular way of assessment and the assessment criteria and resulting accuracy of such rankings is always open to dispute. The recently released Microsoft Academic is one such ranking tool that allows measuring the quality of research based on the impact of citations on an institutional level.

It is outstanding the contribution of CISTER/INESC-TEC to the current ranking of the Polytechnic Institute of Porto in one of the most prominent sub-areas of computer science: real-time and embedded computing. Considering the past five years, Polytechnic of Porto ranks among the top-20 universities of the world and among the top 3 in Europe, in a list that includes over two thousand universities and research institutions from all over the world.

The list is currently led by 10 US giants: Berkeley, UIUC, Microsoft, UNC-CH, MIT, Stanford, CMU, MIT, GATECH, UCLA and UPenn. We follow these top ten and much larger research centres in the 12th place, and ahead of numerous other prestigious and well known institutions.

Very few other Portuguese institutions can claim a similar impact in any other area or sub-area of S&T.

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## June

### CISTER co-responsible for the scientific program of successful conference

The International Conference on Reliable Software Technologies (Ada-Europe) conference has successfully established as an international forum in reliable software technologies, illustrating current work in the theory and practice of the design, development and maintenance of long-lived, high-quality software systems for a variety of application domains.

The 17th International Conference on Reliable Software Technologies – Ada-Europe 2012, took place in Stockholm, Sweden, from June 11 to June 15, 2012. The Program Co-Chairs for this edition of the conference were Mats Brorsson (Professor at KTH Royal Institute of Technology, Sweden) and

Luís Miguel Pinho (CISTER/INESC-TEC, ISEP).

The conference addressed a set of topics of interest, under the general umbrella of reliable software systems. Two important topics were the completion of the technical work for the Ada 2012 ISO standard revision process, and the challenges presented to the development of reliable software by the need for multicore programming models.

This was an important event for the international community in the development of reliable software systems, attracting academic and industrial participants from 4 continents coming from Australia, Belgium, Brazil, Denmark, Finland, France, Germany, Italy, Japan, Norway, Portugal, Spain, Sweden, Switzerland, the Netherlands, UK and USA.

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## August

### CISTER Researchers win Best Paper Award

The paper entitled “Building a Microscope for the Data Center”, by CISTER/INESC-TEC researchers Nuno Pereira, Stefano Tennina and Eduardo Tovar received the Best Paper Award at the 7th International Conference on Wireless Algorithms, Systems and Applications (paper acceptance ratio of 28.6%).

This is a remarkable accomplishment by the team working in the SENODs

project (Sustainable ENergy-Optimized Datacenters), where CISTER is working on integrated solutions to address both the cyber and physical challenges posed by the energy consumption, cooling, and operational needs of large-scale datacenters. These technologies enable energy savings of around 15-20%.

The SENODs project consortium is lead in Portugal by CISTER-ISEP and in the USA by the Carnegie-Mellon University, and the other academic partner is FEUP in Portugal. The project is industrially driven by major Portuguese corporation Portugal Telecom (PT), which is undergoing a major overhaul of its

datacenter facilities with the construction of a very large and state-of-the-art datacenter in Covilhã, to begin operation late 2012/early 2013. SENODs technologies are expected to

reduce the energy bill in roughly 1 MEuros/year.

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## September

### Special Issue of the ACM SIGBED Review on the CONET 2012 Workshop

Following up on the successful CONET Workshop 2012, co-located with the CPSWeek and held in Beijing, China in April 2012, CISTER/INESC-TEC researchers Mário Alves and Nuno Pereira organized and guest-edited a special issue of the ACM SIGBED Review (Volume 9, Number 3, July 2012).

The CONET workshop program included ten high quality papers that were selected after a rigorous reviewing process by the Program Committee, from which eight of them appear in this special issue. The workshop program was complemented by a keynote speech by NSF Career awarded Kamin Whitehouse (University of Virginia, USA) on “A computational approach to energy-efficient buildings” and an industrial talk given by Nic Lane, from

the Mobile Sensing Systems Group at Microsoft Research Asia. To wrap up the workshop, a panel including the keynote speaker, Thiemo Voigt (Swedish Institute of Computer Science) and Tarek Abdelzaher (University of Illinois at Urbana-Champaign), discussed the topic “Smart Cities: playground for cooperating objects?”.

The ACM SIGBED review is a peer-reviewed quarterly publication of ACM SIGBED (special interests group on embedded systems). This on-line newsletter provides a dissemination forum for research on embedded computing. Topics of interest include, but are not limited to, embedded software, embedded system architecture, model-based design, distributed real-time middleware, real-time architectures, feedback control, low-power computing, sensor networks, security, and embedded applications. All papers published in the ACM SIGBED review are listed in the ACM Digital Library.

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## October

### SENODS Major Milestone

The SENODS project was motivated by a major overhaul of the datacenter facilities of Portuguese corporation Portugal Telecom (PT), with the construction of a very large and state-of-the-art datacenter in Covilhã, to begin operation late 2012/early 2013.

With the goal of integrating of the technology developed within SENODS in PT’s datacenter facilities, CISTER finished the implementation of a new demonstrator of these solutions. The demonstrator was validated (last October 18) by high-level PT representatives, which responsible for the datacenter facilities of the company. This represents a major milestone of the

project and means that a large scale sensing network, supervisory software and middleware developed at CISTER is on its way to be part of the new high-tech Data Centre of PT.

The SENODs project (Sustainable ENergy-Optimized Datacenters) is developing integrated solutions to address both the cyber and physical

challenges posed by the energy consumption, cooling, and operational needs of large-scale datacenters. The project consortium is lead in Portugal by CISTER-ISEP and in the USA by the Carnegie-Mellon University, and the other academic partner is FEUP in Portugal. The project is industrially driven by major Portuguese corporation Portugal Telecom (PT).

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## November

### CISTER Researcher Vincent Nélis chairs the 6th Junior Researcher Workshop on Real-Time Computing (JRWRTC 2012)

On November 8, CISTER researcher Vincent Nélis chaired (as Technical Program Committee Chairman) the 6th Junior Researcher Workshop on Real-Time Computing (JRWRTC 2012) in Pont-à-Mousson, France. Since 2007, this junior workshop has found its place in the International Conference on Real-Time & Network Systems (RTNS), not

forgetting its roots in the French Summer School of Real-Time Systems. The main purpose of the workshop is to bring together junior researchers working on real-time systems, including PhD students, PostDoc, etc. It provides a relaxed forum to present, share and discuss new ideas and new research directions, review current trends in this area as well as meet the real-time community in comfortable surroundings. The workshop involved short presentations and a poster session to encourage discussions by the conference attendees.

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## December

### CISTER Makes a Splash at RTSS 2012

The IEEE Real-Time Systems Symposium is one of the three flag-ship events in the real-time embedded systems area. This year, CISTER attended with 5 researchers at this important conference. Alongside papers in the main conference and the work-in-progress session, CISTER researchers also organised two co-located workshops.

The PETARS (Power, Energy and Temperature in Real-Time systems) workshop chaired by Stefan M. Petters covered the important topics of power, energy and temperature in real-time systems. This focused half day workshop featured a mix of submitted and invited paper presentations, as well as discussions.

Benny Åkesson co-chaired the 5th Workshop on Compositional Theory and Technology for Real-Time Embedded Systems (CRTS 2012). The program featured a keynote about resource and time management in smart vehicles, given by Ragunathan (Raj)

Rajkumar, as well as two paper sessions on theory for compositionality and composability, and compositional and composable systems, respectively. The day was concluded by a panel with

three panelists from top institutes in the area of real-time systems. In total, the workshop was well attended and from these attendees it received very positive feedback.



## Publications

[www.cister.isep.ipp.pt/docs](http://www.cister.isep.ipp.pt/docs)

### Thesis

1. Fonseca, J, "Supporting Intra-Task Parallelism in Real-Time Multiprocessor Systems", Master Thesis. Oct 2012. Porto.
2. Mekki, M, "On the implications of Interference models for low-power wireless networks", Master Thesis. 15, Aug, 2012. Tunis. This work was performed in the CISTER research unit, Porto, Portugal.
3. Thamri, M, "Evaluation of smart-HOP: a handoff approach for mobile wireless sensor networks", Master Thesis. Aug 2012. Tunis, Tunisa.

### Books & Book Chapters

4. Petters, S, Elphinstone, K, Heiser, G, "Trustworthy Real-Time Systems", Chapter in "Advances in Real-Time Systems", Springer. 16, Jul, 2012, pp 191-206.

### Journal Papers

5. Sousa, P, Pereira, N, Tovar, E, "Enhancing the Real-time Capabilities of the Linux Kernel", ACM SIGBED Review - Special Issue on the 24th Euromicro Conference on Real-Time Systems (ACM SIGBED Rev), ACM. Nov 2012.
6. Lee, J, Easwaran, A, Shin, I, "Laxity dynamics and LLF schedulability analysis on multiprocessor platforms", Real-Time Systems, Springer US. Nov 2012, Volume 48, Issue 6, pp 716-749.
7. Lee, J, Shin, I, Easwaran, A, "Convex optimization framework for intermediate deadline assignment in soft and hard real-time distributed systems", Journal of Systems and Software, Elsevier Science Inc.. Oct 2012, Volume 85, Issue 10, pp 2331-2339.
8. Gaddoura, O, Koubâa, A, "RPL in a nutshell: A survey", Computer Networks (Comput. Netw.), Elsevier. 28, Sep, 2012, Volume 56, Issue 14, pp 3163-3178.
9. Baccour, N, Koubâa, A, Mottola, L, Zuniga, M, Youssef, H, Boano, C, Alves, M, "Radio Link Quality Estimation in Wireless Sensor Networks: a Survey", ACM Transactions on Sensor Networks (TOSN), ACM New York. Sep 2012, Volume 8, Issue 4. U.S.A. Article 34
10. Cheikhrouhoua, O, Koubâa, A, Dinie, G, Alzaid, H, Abid, M, "LNT: A Logical Neighbor Tree Secure Group Communication Scheme for Wireless Sensor Networks", Ad Hoc Networks journal, Elsevier. Sep 2012, Volume 10, Issue 7, pp 1419-1444.
11. Nogueira, L, Pinho, L, Coelho, J, "A Feedback-based Decentralised Coordination Model for Distributed Open Real-Time Systems", Journal of Systems and Software (JSS), Elsevier. Sep 2012, Volume 85, Issue 9, pp 2145-2159.
12. Lu, C, Rajkumar, R, Tovar, E, "Guest Editorial Special Section on Cyber-Physical Systems and Cooperating Objects", IEEE Transactions on Industrial Informatics (TII), IEEE. May 2012, Volume 8, Issue 2, pp 378.

## Conference/Workshop Papers

13. Nogueira, L, Fonseca, J, Maia, C, Pinho, L, "Dynamic Global Scheduling of Parallel Real-Time Tasks", 10th IEEE/IFIP International Conference on Embedded and Ubiquitous Computing (EUC 2012). 5 to 7, Dec, 2012, pp 500-507. Paphos, Cyprus.
14. Raravi, G, Nélis, V, "A PTAS for assigning sporadic tasks on two-type heterogeneous multiprocessors", 33rd IEEE Real-Time Systems Symposium (RTSS 2012), IEEE. 4 to 7, Dec, 2012, pp 117-126. San Juan, Puerto Rico.
15. Bletsas, K, Petters, S, "Using NPS-F for Mixed-Criticality Multicore Systems", 33rd IEEE Real-Time Systems Symposium (RTSS 2012), ACM. 4 to 7, Dec, 2012, Work-in-Progress Session, pp 36-36. San Juan, Puerto Rico.
16. Burmyakov, A, Bini, E, Tovar, E, "The Generalized Multiprocessor Periodic Resource Interface Model for Hierarchical Multiprocessor Scheduling", 20th International Conference on Real-Time and Network Systems (RTNS 2012), ACM. 8 to 9, Nov, 2012, pp 131-139. Pont à Mousson, France.
17. Raravi, G, Nélis, V, Andersson, B, "Real-Time Scheduling with Resource Sharing on Uniform Multiprocessors", 20th International Conference on Real-Time and Network Systems (RTNS 2012), ACM New York. 8 to 9, Nov, 2012, pp 121-130. Pont à Mousson, France.
18. Marinho, J, Petters, S, Bertogna, M, "Extending Fixed Task-Priority Schedulability by Interference Limitation", 20th International Conference on Real-Time and Network Systems (RTNS 2012), ACM New York. 8 to 9, Nov, 2012, pp 191-200. Pont à Mousson, France.
19. Nikolic, B, Petters, S, "Towards Real-Time Agreement Protocols For Many-Cores", 12th International Conference on Embedded Software (EMSOFT 2012). 7 to 12, Oct, 2012. Tampere, Finland.
20. Nogueira, L, Pinho, L, "Server-based Scheduling of Parallel Real-Time Tasks", 12th International Conference on Embedded Software (EMSOFT 2012), ACM New York. 7 to 12, Oct, 2012, pp 73-82. Tampere, Finland.
21. Alkhawaja, A, Ferreira, L, Albano, M, "Message Oriented Middleware with QoS Support for Smart Grids", INForum 2012 - Conference on Embedded Systems and Real Time. (INForum 2012). 6 to 7, Oct, 2012. Caparica, Portugal. InForum 2012
22. Ferreira, L, Albano, M, Guilly, T, Ramiro, M, Faria, E, Dueñas, L, Ferreira, R, Gaylard, E, Pelegrin, F, Roarke, E, Lux, D, Scalari, S, Sørensen, S, Gangolells, M, Pinho, L, Skou, A, "ENCOURAGE architecture: support for heterogeneous smart grids", IEEE International Energy Conference and Exhibition (ENERGYCON 2012). 9 to 12, Sep, 2012. Florence, Italy.
23. Fonseca, J, Nogueira, L, Maia, C, Pinho, L, "Real-Time Scheduling of Parallel Tasks in the Linux Kernel", Simpósio de Informática (INForum 2012). 6 to 7, Sep, 2012. Lisboa, Portugal. *Best paper of the Real-time and Embedded Systems track.*
24. Alkhawaja, A, Ferreira, L, Albano, M, Garibay-Martínez, R, "QoS-enabled Middleware for Smart Grids", 38th Euromicro Conference on Software Engineering and Advanced Applications (SEAA 2012). 5 to 8, Sep, 2012, Work-In-Progress Session. Cesme, Turkey.
25. Garibay-Martínez, R, Ferreira, L, Pinho, L, "A Framework for the Development of Parallel and Distributed Real-Time Embedded Systems", 38th Euromicro Conference on Software Engineering and Advanced Applications (SEAA 2012), IEEE. 5 to 8, Sep, 2012, pp 39-46. Cesme, Turkey.

26. Pereira, N, Tennina, S, Tovar, E, "Building a Microscope for the Data Center", 7th International Conference on Wireless Algorithms, Systems and Applications (WASA 2012). 8 to 10, Aug, 2012. Yellow Mountains, China. *Best Paper Award*
27. Berezovskyi, K, Bletsas, K, Andersson, B, "Makespan computation for GPU threads running on a single streaming multiprocessor", 24th Euromicro Conference on Real-Time Systems (ECRTS 2012), IEEE. 11 to 13, Jul, 2012, pp 277-286. Pisa, Italy.
28. Nelissen, G, Berten, V, Nélis, V, Goossens, J, Milojevic, D, "U-EDF: An Unfair but Optimal Multiprocessor Scheduling Algorithm for Sporadic Tasks", 24th Euromicro Conference on Real-Time Systems (ECRTS 2012), IEEE. 11 to 13, Jul, 2012, pp 13-23. Pisa, Italy.
29. Raravi, G, Andersson, B, Bletsas, K, Nélis, V, "Task Assignment Algorithms for Two-type Heterogeneous Multiprocessors", 24th Euromicro Conference on Real-Time Systems (ECRTS 2012), IEEE. 11 to 13, Jul, 2012. Pisa, Italy. *Outstanding Paper Award*
30. Tovar, E, Pereira, N, Bate, I, Indrusiak, L, Penna, S, Negrão, J, Viana, J, Philipp, F, Mayer, D, Heras, J, Pacheco, F, Loureiro, J, "Networked Embedded Systems for Active Flow Control in Aircraft", 11th International Workshop on Real-Time Networks (RTN 2012). 10, Jul, 2012. Pisa, Italy.
31. Gupta, V, Tovar, E, Pereira, N, "CoS: A New Perspective of Operating Systems Design for the Cyber-Physical World", Operating Systems Platforms for Embedded Real-Time Applications Workshop (OSPERT 2012). 10, Jul, 2012. Pisa, Italy.
32. Awan, M, Petters, S, "Device Power Management for Real-Time Embedded Systems", 1st PhD. Students Conference in Electrical and Computer Engineering (StudECE 2012). 28 to 29, Jun, 2012. Porto, Portugal.
33. Dasari, D, Nélis, V, "An Analysis of the Impact of Bus Contention on the WCET in Multicores", 9th IEEE International Conference on Embedded Software and Systems (ICCESS 2012), IEEE. 25 to 27, Jun, 2012, pp 1450-1457. Liverpool, United Kingdom.
34. Marinho, J, Nélis, V, Petters, S, Puaut, I, "An Improved Preemption Delay Upper Bound for Floating Non-preemptive Region", 7th IEEE International Conference on Distributed Computing in Sensor Systems (SIES 2012), IEEE. 20 to 22, Jun, 2012, pp 57-66. Karlsruhe, Germany.
35. Awan, M, Petters, S, "Online Intra-Task Device Scheduling for Hard Real-Time Systems", 7th IEEE International Symposium on Industrial Embedded Systems (SIES 2012), IEEE. 20 to 22, Jun, 2012, pp 48-56. Karlsruhe, Germany.
36. Gupta, V, Tovar, E, Lakshmanan, K, Rajkumar, R, "Inter-application Redundancy Elimination in Sensor Networks with Compiler-Assisted Scheduling VG-CAS-11", 7th IEEE International Symposium on Industrial Embedded Systems (SIES 2012). 20 to 22, Jun, 2012, pp 112-119. Karlsruhe, Germany.
37. Prabh, S, Royo, F, Tennina, S, Olivares, T, "BANMAC: An Opportunistic MAC Protocol for Reliable Communications in Body Area Networks", The 8th IEEE International Conference on Distributed Computing in Sensor Systems (DCOSS 2012), IEEE. 16 to 18, May, 2012, pp 166-175. Hangzhou, China.
38. Marinho, J, Nélis, V, Petters, S, Puaut, I, "Preemption Delay Analysis for Floating Non-Preemptive Region Scheduling", Design, Automation & Test in Europe Conference & Exhibition (DATE 2012), IEEE. 12 to 16, Mar, 2012, pp 497-502.

39. Santos, M, Tennina, S, Alves, M, Bourroche, M, Cahill, V, Almeida, D, Simões, J, Carrozza, G, Hill, A, Chasapis, G, "EMMON - EMbedded MONitoring", Embedded World Conference 2012. 28, Feb to 1, Mar, 2012. Nuremberg, Germany.
40. Fotouhi, H, Zúñiga, M, Alves, M, Koubâa, A, Marrón, P, "Smart-HOP: A Reliable Handoff Mechanism for Mobile Wireless Sensor Networks", 9th European Conference on Wireless Sensor Networks (EWSN 2012), Springer Berlin Heidelberg. 15 to 17, Feb, 2012, 7158, pp 131-146. Trento, Italy.

### Conference/Workshop Posters/Demos

41. Pereira, D, Pedro, A, Pinho, L, Pinto, J, "Towards Specification and Verification Frameworks for Concurrent Real-Time Systems", Poster presented in High Integrity Language Technology ACM SIGAda's Annual International Conference (HILT 2012). 2 to 6, Dec, 2012. Boston, U.S.A..
42. Maia, C, Nogueira, L, Pinho, L, "Supporting Real-Time Parallel Task Models with Work-Stealing", Poster presented in DATE'12 Fourth Friday Workshop on Designing for Embedded Parallel Computing Platforms: Architectures, Design Tools, and Applications (DEPCP 2012). 16, Mar, 2012. Dresden, Germany.
43. Maia, C, Nogueira, L, Pinho, L, "Supporting Real-Time Parallel Task Models with Work-Stealing", Poster presented in DATE'12 Fourth Friday Workshop on Designing for Embedded Parallel Computing Platforms: Architectures, Design Tools, and Applications (DEPCP 2012). 16, Mar, 2012. Dresden, Germany.
44. Garibay-Martínez, R, Ferreira, L, Pinho, L, "Parallel Real-time Support for Distributed Adaptive Embedded Applications", Poster presented in Design Tools and Architectures for Multi-Core Embedded Computing Platforms (PARMA-DITAM). 24, Jan, 2012. Paris, France. Workshop in conjunction with the 7th International Conference on High-Performance and Embedded Architectures and Compilers (HiPEAC 2012).

### Technical Reports

45. Awan, M, Petters, S, "Energy-conscious tasks partitioning onto a heterogeneous multi-core platform", 18, Oct, 2012. Technical report only.
46. Vahabi, M, Tovar, E, "Data Gathering Approach in Dense Sensor Networks", 12, Oct, 2012.
47. Vahabi, M, Tennina, S, Tovar, E, Andersson, B, "Response Time Analysis of Slotted WiDom in Noisy Wireless Channels", 12, Oct, 2012.
48. Dasari, D, Nikolic, B, Nélis, V, Petters, S, "A Tighter Analysis of the Worst-Case End-to-End Communication Delay in Massive Multicores", 28, Jun, 2012. Porto, Portugal.
49. Raravi, G, Nélis, V, "A PTAS for assigning sporadic tasks on two-type heterogeneous multiprocessors", 17, May, 2012. Technical Report

## People

[www.cister.isep.ipp.pt/people](http://www.cister.isep.ipp.pt/people)



Åkesson, Benny

PhD Eindhoven University of Technology, Netherlands

Research Associate



Benny Åkesson was born in Landskrona, Sweden in 1977. He earned a M.Sc. degree in Computer Science and Engineering at Lund Institute of Technology, Sweden in 2005. In 2010, he received his Ph.D. degree in Electrical Engineering at Eindhoven University of Technology, the Netherlands, on the topic of "Predictable and Composable SoC Memory Controllers". This research was conducted in collaboration with NXP Semiconductors. Prior to joining the CISTER research unit, Dr. Åkesson worked as Postdoctoral Researcher and Assistant Professor at the Eindhoven University of Technology, where he is led the memory research team in the Electronic Systems group at the faculty of Electrical Engineering. His primary research interests include memory controller architectures, real-time resource scheduling, performance modeling, and virtualization. He is the author of a book about memory controllers for real-time embedded systems.



Albano, Michele

PhD University of Pisa, Italy

Research Associate



Michele Albano received his BSc degree in Physics in 2003, and his BSc, MSc and PhD degrees in Computer Science in 2004, 2006 and 2010 respectively, all of them from the University of Pisa, Italy. He was visiting researcher at Universidad de Malaga (Spain) in 2007, at Stony Brook University (New York, USA) in 2009, and before being a researcher he worked as software engineer and wireless technology specialist in private companies in the period 2001-2006, and he founded an SME. In 2006 and 2007 he was involved in EU funded projects SMEPP and XtremOs, and in the period 2010-2012 he held a post-doctoral researcher position at the Instituto de Telecomunicações (Portugal), He is currently a Research Scientist in the CISTER and has published the book "Data Centric Storage in Wireless Sensor Networks: Advanced Techniques". His main research interests are in the areas of wireless sensor networks, energy saving in wireless communication, and peer-to-peer networks.



Al-Asadi, Amine

Technical Staff, Administrative Support

Amine Al-Asadi joined the Cister Research Unit in September 2011. She is part of our technical support staff and assists the group in organizational matters as well as administrative work.



Ali, Kiran

MSc Student

Kiran Ali got her first degree in Computer Science from Gomal University, Dera Ismail Khan, Pakistan. Currently, she is pursuing a Master's in Computer Science with specialization in Parallel and Distributed Systems from University of Porto, Portugal. Her area of interest is Parallel and Distributed Embedded Systems.



Ali, Hazem

PhD Student

Hazem completed his MSc in Embedded and Intelligent Systems at the School of Information Science of the Halmstad University, Sweden, September 2010. He is currently doing his PhD at CISTER in the area of real-time languages.



Alkhawaja, Abdel Rahman

PhD Student

Abdel Rahman received his bachelor degree in Computer Engineering from University of Jordan in 2006 and completed his master in Computer Network Engineering in Halmstad University, Sweden, 2011. He has previously worked in network operation center. His research interests are wireless sensor networks, mobile communication system and networking. Currently, he is doing his PhD at CISTER Research Unit.





Almeida, Inês

## Administrative Assistant

Inês Almeida used to live in Brussels where she worked as a professional contemporary performer. Four years ago she came back to her origins and got her degree in Administrative Assistance and Translation from the Administration and Accountancy School of the Polytechnic Institute of Porto. Currently, she is pursuing a Master's in Innovation and Technological Entrepreneurship at the Faculty of Engineering of the University of Porto, Portugal.



Almeida, Sandra

## Management Support

Sandra Almeida joined the group in 2002. She is the Financial & Administrative Manager. She got a degree in Management Assessorship, from the Polytechnic Institute of Porto, School of Accounting and Administration.



Alves, Mário

PhD University of Porto, Portugal

## Professor, Research Associate

Mário Alves was born in 1968 and has a Degree (1991), a MSc (1995) and a PhD (2003) in Electrical and Computer Engineering at the University of Porto, Portugal. He is a Professor in ECE at the Polytechnic Institute of Porto (ISEP/IPP) and a Research Associate and Wireless Sensor Networks (WSNs) research line leader at CISTER. He has been actively participating in the organization of several international conferences and workshops (e.g. EWSN, ECRTS, IEEE WFCS, CONET). His personal research interests are mainly devoted to supporting quality-of-service (QoS) in large-scale and dense WSNs, mainly based on standard and COTS technology. He is currently involved in several national and international projects and networks of excellence. The WSN team at CISTER has been attaining many important achievements and international visibility, such as 1) deploying the largest WSN test-bed in Europe so far (300+ nodes, under the EMMON project); 2) scoring over 115000 visits and 6000 downloads of the open-ZB toolset; and 3) being founding members of and active contributors to the TinyOS 15.4 and ZigBee Working Groups.





Awan. Muhammad Ali

PhD Student

Muhammad Ali Awan did his master's Degree from Royal Institute of Technology(KTH) Sweden in System on Chip Design with a focus on Digital System Design and Embedded Systems. He worked as Lecturer in National University of Science and Technology Pakistan. He also worked as a researcher in IMEC, Belgium for two years. His research focus was on High Level Memory Management. Currently he started his PhD in Cister and participating in a research on "Real-Time Power Management on Partitioned Multicores".



Barros, António

Lecturer, PhD Student

António Manuel de Sousa Barros was born in 1974 and has a 5 year degree (1997) and a master degree in Electrical and Computer Engineering at the University of Porto. Since 2001 he has been a teacher assistant at the Department of Computer Engineering. He was researcher at the Biomedical Engineering Institute (University of Porto) from 1998 to 2001. He also worked as freelancer in the fields of electronics and computer programming. Since January 2005 he is also with the CISTER. His interests are in real-time telecommunication systems and reliable software.



Berezovskyi, Kostiantyn

PhD Student

Kostiantyn Berezovskyi holds M.Sc. degree from Taras Shevchenko National University of Kyiv. At university he paid great attention to software development and have gathered experience in parallel programming. Now he is a PhD student at CISTER. His interests are related to the schedulability analysis of general purpose graphics processor units.



Bletsas, Konstantinos

PhD University of York, United Kingdom

Research Associate

Konstantinos Bletsas (born in 1978 in Greece) has a Degree in Electronic and Computer Engineering (2002) from the Technical University of Crete (Chania, Greece) and a PhD in Computer Science (2007) from the University of York (UK). His PhD was about the response time analysis of hard real-time systems with application-specific co-processors. He joined the group in 2007 to do research on multiprocessor scheduling algorithms.







Burmyakov, Artem

PhD Student

Artem Burmyakov received a masters' degree in Computer Sciences from Moscow Engineering and Physics Institute. He worked as a software engineer within CERN for more than 4 years, participating in the LHC GCS and the UAB projects. Nowadays he is a doctoral student within CISTER. His professional interests are related to the development of control, real-time and distributed systems.



Dasari, Dakshina

PhD Student

Dakshina Dasari was born in 1980 in India. She has a Bachelors Degree from Karnataka University Dharwad and finished her Masters in 2004 from National Institute of Technology, Surathkal (NITK), India. She has five years of working experience - 3 yrs at Sun Microsystems and 2 yrs at Citrix Pvt Ltd as Software Engineer. She has previously worked in the area of Networking.



Easwaran, Arvind

PhD University of Pennsylvania, U.S.A.

Research Associate

Arvind Easwaran was born in Mumbai (formerly Bombay), India, in 1979. In 2001 he graduated with a Bachelor of Engineering (BE) in Computer Engineering from Mumbai University, India. After that he had a brief stint first at the Indian Institute of Technology (IIT), Bombay, as a Project Engineer with Prof. Subramani Arunkumar, and then at Infosys Technologies Ltd. as a Software Engineer. In 2005 he was awarded the Master of Science in Engineering (MSE) degree, and in 2008 he was awarded the Doctor of Philosophy (PhD) degree, both in Computer and Information Science from the University of Pennsylvania, USA. His academic advisors were Prof. Insup Lee and Prof. Oleg Sokolsky. During PhD studies, he also had a brief stint at Honeywell, Advanced Technology, as a research intern. Since January 2009, he has been working at CISTER as a research scientist in the area of real-time scheduling theory.





Ferreira, Luis Lino

PhD University of Porto, Portugal

Professor, Research Associate



Luis Lino Ferreira was born in 1971 and has a MSc (1997) and a PhD (2005) in Electrical and Computer Engineering at the University of Porto. Since 1996 he works as a professor at the Department of Computer Engineering, School of Engineering of the Polytechnic Institute of Porto. He was a researcher at the Systems and Robotics Institute, Industrial Automation Group (University of Porto), from 1994 to 1996, in the area of Real-Time Control Systems. Since 1997 he is a member of the IPP-HURRAY research group, where he is currently working on Wireless and mobile networks.



Fonseca, José

PhD Student



José Carlos Fonseca was born in 1987, in Porto, Portugal. He holds a BSc (2010) and a MSc (2012) both in Computer Engineering from the School of Engineering of the Polytechnic Institute of Porto (ISEP). Currently, José is pursuing a PhD in Electrical and Computer Engineering at the University of Porto. Since he joined CISTER Research Unit in February 2012, his main research interests are in real-time operating systems and scheduling theory for multi- and many-core platforms.



Fotouhi, Hossein

PhD Student



Hossein Fotouhi received his degree on Electrical Electronics Engineering in 2004 and worked afterwards about three years in Iran in different places such as University of Guilan and Telecommunication Center as a network engineer. He obtained his Master of Science in Communication Network Engineering in 2009 from University Putra Malaysia. His MSc thesis was on "optimizing energy consumption in MAC layer for Wireless Sensor Networks" Currently, he is doing his PhD research in CISTER Research Unit since July 2009. His research interests are wireless sensor networks, mobility management, handoff mechanism and fuzzy logic theory.



### Garibay-Martínez, Ricardo

#### PhD Student

Ricardo Garibay-Martínez was born on 1984 in Morelia, Mexico. Ricardo received his Bachelors Degree from Morelia Institute of Technology (ITM) in 2007 and finished his Master of Science in Computer Science from Centre for Scientific Research and Higher Education of Ensenada (CICESE), Mexico. He has experience working as a lecturer and as a researcher for PEMEX Petroleum Company. Since 2007, he has been working in the area of Adaptive Resource Management in Distributed Dynamic Real-Time Systems. Currently, he is working as a researcher and PhD student in CISTER/IPP-HURRAY Research unit. His current research interests are Adaptive RT Systems, RT Software and Multi-core Systems.



### Gonçalves, Joel

#### Junior Researcher

Joel Gonçalves graduated in Informatics Engineering at the School of Engineering, Polytechnic Institute of Porto, in 2010. In 2012, he got his MSc in Informatics Engineering and Computation at the Faculty of Engineering, University of Porto. His main research interests are software architecture, distributed systems, real-time systems and simulation. Joel worked in research centers in Portugal (CISTER/ISEP and LIACC/FEUP) and Germany (LFE/TUM) where he covered many subjects from the mentioned research areas. He has published several papers in national and international conferences. Currently he is enrolled in the PhD program in Informatics Engineering at Faculty of Informatics Engineering, University of Porto.



### Gupta, Vikram

#### PhD Student

Vikram Gupta is a PhD candidate in Electrical and Computer Engineering in the Carnegie Mellon University (CMU) - Portugal joint program beginning August 2008 and is supervised by Prof. Raj Rajkumar (ECE-CMU) and Prof. Eduardo Tovar (ISEP-IPP). His current research includes developing clock synchronization methods for Wireless Sensor Networks. Before joining PhD program, he was working as a research associate at Indian Institute of Technology (I.I.T.) Delhi, India, where he focussed on Performance Assessment and Interoperability of WiMAX (802.16) on a Campus based Test Bed. He received his degree of Bachelor of Technology from National Institute of Technology (V.N.I.T.) Nagpur India in May 2007.





Koubâa, Anis

PhD Nat. Polytechnic Institute/INPL, France

Professor, Research Associate



Anis KOUBÂA was born in 1977 in Tunisia and has an Engineering Degree in Telecommunications (2000) from Sup'Com (Tunisia), a Master Degree in Computer Science (2001) from University of Nancy I (France), and a PhD in Computer Science (2004) from National Polytechnic Institute (INPL). His PhD work addressed the definition and analysis of graceful degradation of real-time quality of service in guaranteed-rate Networks using (m,k)-firm model. From March 2005, he is involved in a post-doc project on Real-Time Communication in Wireless Sensor Networks at CISTER research group. His main research activities focus on real-time, quality of service and wireless sensor networks. His Post-Doctoral work in CISTER is focused on Wireless Sensor Networks with an emphasis on real-time aspects.



Loureiro, João

PhD Student



João Loureiro holds a degree in Mechatronic Engineer since 2009 from Pontifícia Universidade Católica de Minas Gerais, Brazil. He has worked in research and development of embedded systems, both inside industry and university. His research interests are in Real Time Embedded Systems, Cyber-Physical Systems and Sensor Networks. Currently his research includes the development of a network architecture for extreme dense sensing for active flow control. João Loureiro is a PhD candidate in Electrical and Computer Engineering in FEUP and researcher at the CISTER Research Unit.



Maia, Cláudio

PhD Student



Cláudio Maia, born in 1980, holds a degree (2007) in Computer Science Engineering at the Polytechnic Institute of Oporto. From 2006 to 2009, he was a researcher and software engineer at Critical Software S.A. During that time, his main areas of research were mobile and wireless communication systems and manufacturing systems. Since October 2009, he is a Researcher in the CISTER Research Unit, involved in the CooperatES project. His main research interests are in the fields of Dynamic Distributed Real-time Systems, Operating Systems and Mobile and Wireless Communication Systems.



**Marau, Ricardo**

PhD University of Aveiro, Portugal

Research Associate



Ricardo Marau is a Research Fellow at CISTER - Research Center in Real-Time and Embedded Computing Systems. He graduated in Electronics and Telecommunications Engineering in 2004 and received his PhD degree in Computer Engineering from the University of Aveiro, in 2009. He visited the University of Cantabria, Spain, in 2005, the Polytechnic University of Valencia, Spain, in 2008, the Carnegie Mellon University in Pittsburgh, USA, in 2008, and the University Carlos III, Spain, in 2010. During the period of 2009-2012 he has been a research fellow at the Electrical and Computer Engineering Department of the University of Porto, being involved in the project iLAND (EU ARTEMIS JU) as technical manager and work-package leader. His research interests are on Switched Ethernet Real-time, scheduling and communication middlewares.



**Marinho, José**

PhD Student



José Marinho holds an MSc degree on Electrical Engineering from the University of Coimbra (2008). He has previously worked at Instituto de Telecomunicações (Coimbra, Image Processing Lab) during his master thesis (LDPC decoding on the CELL/BE marked 20/20). Later José moved onto the Instituto de Sistemas e Robótica Coimbra (Mobile Robotics Lab) where he worked for a year period as a fresh graduate researching on and implementing bayesian inference mechanisms. José has a big interest on the embedded computing panorama. Being on the final leg of his PhD José is currently looking for opportunities to extend his knowledge in the fields of embedded operating systems and related hardware within the real-time context or other affine research fields.



**Mekki, Maher**

Undergrad Student



Maher was born in 1988 in Tunisia and he is a third year engineering student in the high school of communication Tunis (Sup'com). Currently, Maher is a trainee at Cister-Research Unit within his graduation internship. His interests are in telecommunication engineering, computer network and programming.



Nikolic, Borislav

PhD Student

Borislav graduated at the Faculty of Electrical Engineering in Belgrade with major in Computer Science in 2007. He spent almost two years in industry developing large-scale enterprise applications. Currently, Borislav is doing his PhD at CISTER/IPP-HURRAY Research unit. He is amateur road cyclist and big fan of FC Red Star Belgrade. His research interests include real time and embedded systems, distributed and parallel computing, gossip protocols, ORMs and software architecture and design.



Noda, Claro

PhD Student

Claro Noda graduated in Physics from University of Havana, Cuba in 1996. He worked in Scientific Instrumentation at the Superconductivity Laboratory, IMRE (1996-2001) where he completed his Master in Physical Sciences in 2000 and later continued research activities at the "Henri Poincaré" Complex Systems Group. He has also taught at the General Physics Department in the Faculty of Physics in Havana (2005-2008). Currently he's a MAP-Tele PhD student at University of Minho and a researcher at CISTER/ISEP, Portugal.



Nogueira, Luis Miguel

PhD University of Porto, Portugal

Professor, Research Associate

Luís Nogueira got his BSc in Computer Engineering at the School of Engineering, Polytechnic Institute of Porto, in 2000. In 2002, got his MSc and in 2009 his PhD in Informatics (Systems and Networks) at the Faculty of Science, University of Porto. Since 2001 he is teaching assistant at the Department of Computer Engineering of the School of Engineering of the Polytechnic Institute of Porto. From 2000 to 2003 he was a researcher at NIAD&R (Distributed Artificial Intelligence & Robotics Group) of LIACC (Artificial Intelligence and Computer Science Lab), University of Porto. Now, his current research interests are in the fields of Dynamic Distributed Real-time Systems, Quality of Service and Ad-hoc Networks.





### Pacheco, Filipe

PhD University of Porto, Portugal

Research Center Adjunct Director

Professor, Research Associate



Filipe de Faria Pacheco Paulo (born Filipe de Faria Pacheco in 1971) has a degree (1994), MSc (1997) and PhD (2009) in Electrical and Computer Engineering at the University of Porto. Since 1996 he is a teaching assistant at the Department of Computer Engineering, - School of Engineering of the Polytechnic Institute of Porto. He was researcher at the Systems and Robotics Institute, Industrial Automation Group (University of Porto), from 1994 to 1996, in the area of User Interfaces. He is currently working in Multimedia and Real-Time networks projects.



### Pedro, André

PhD Student

André Pedro was born in Covilhã, Portugal, in 1987. In 2009 he received his degree in Computer science engineering at Universidade da Beira Interior, Covilhã. In 2011 he has concluded the Master's degree in Computer science engineering at Universidade do Minho, Braga with thesis "Learning and testing Stochastic discrete event systems". Now, he begin his Phd study where must be highlighted the Ada contracts for verification of real-time systems. His research interests include: discrete event systems, real-time scheduling, and model-checking.



### Pereira, David

PhD MAPi, Portugal

Research Associate

David Pereira was born in Porto, Portugal, in 1980. In 2003 he received his degree in Computer Science at University of Porto. In 2007 he finished his Master's degree in Computer Science also in University of Porto, in the areas of formal logics for specifying and reasoning about intelligent agents. He has a PhD in Computer Science, in the MAP-i PhD program, organized by the Universities of Minho, of Porto and of Aveiro. His research is focused in the mechanization of Kleene algebra and Kleene algebra with tests in the Coq theorem prover (see <http://coq.inria.fr/>). He also mechanized a deductive proof system for dealing with the partial correctness of parallel programs, under the spirit of Rely/Guarantee thinking. Besides being a happy Coq user and adept of formal program verification, David is keen to apply is formal methods background into the realm of programming languages for real-time programs, namely the well-know and powerful Ada.





Pereira, Nuno

PhD University of Minho, Portugal

Professor, Research Associate



Nuno Pereira received a degree in computer engineering from the School of Engineering, Polytechnic Institute of Porto, Porto, Portugal, a M.Sc. and Ph.D. degrees from the University of Minho, Braga, Portugal, in 2002 and 2005 and 2010 respectively. He is a researcher at CISTER, a top-ranked research unit of the Portuguese research system since 2001. He started his research work dedicated to traffic scheduling combining multimedia and industrial communication protocols, and also analyzed the timing behavior of several industrial communication protocols. More recently, Nuno developed novel medium access control protocols for wireless networks and explored efficient ways to obtain aggregated quantities in large scale, dense wireless networks.



Petters, Stefan M.

PhD Technical University Munich, Germany

Research Centre Vice-Director

Research Associate



My research interests include real time and embedded systems in general and more specifically system energy management, mixed-criticality systems, adaptive real-time systems, (probabilistic) worst case execution time (WCET) analysis, and (probabilistic) schedulability analysis.



Pinho, Luis Miguel

PhD University of Porto, Portugal

Research Centre Vice-Director

Professor, Research Associate



Luis Miguel Pinho has a MSc (1997) and a PhD (2001) in Electrical and Computer Engineering at the University of Porto. He is Coordinator Professor at the Department of Computer Engineering - School of Engineering of the Polytechnic Institute of Porto, and Vice-Director and Research Associate at the CISTER research unit, where he currently leads the real-time software research line. His main research interest is on the software infrastructure for real-time embedded systems, in particular languages and operating systems. He is especially interested in Ada, the best language for real-time embedded systems. Miguel is a member of ISO/IEC JTC1/SC22/WG9 and board member of Ada-Europe. He served as General Chair and Program Co-Chair of the Ada-Europe 2006 conference, was a Keynote Speaker at RTCSA 2010 and Program Co-Chair of Ada-Europe 2012. He is Editor-in-Chief of the Ada User Journal, and a member of the HiPEAC network of excellence.





Prabh, Shashi

PhD University of Virginia, U.S.A.

Research Associate



Shashi Prabh received M.S. and Ph.D. in Computer Science from New York University in 2001 and the University of Virginia in 2007, respectively. He joined the Real-Time Computing Systems Research Center (CISTER) of the School of Engineering (ISEP), Polytechnic Institute of Porto (IPP) as Research Associate in 2007. The areas of his research are modeling, analysis and quality of service provisioning in wireless networks. He has contributed to the research on real-time communications in wireless ad-hoc and sensor networks.



Raravi, Gurulingesh

PhD Student



Gurulingesh Raravi finished his Masters Degree at IIT Bombay in 2005. He has three years of working experience. Currently, he is pursuing PhD in the area of Real-Time Scheduling on Heterogeneous Multiprocessor Platform.



Ribeiro, André

IT Support



André Ribeiro was born in 1991 in S. João da Madeira. In 2009, André finished his high school degree specialised in Information System's Management and Programming, and in 2012 his Bachelor in Informatics Engineering/Computer Science. Currently, André is enrolled at ISEP, in the Master Programme in Informatics Engineering/Computer Science.



Santos, Pedro

Technical Staff



Pedro Santos was born in 1994 in Porto, and is currently enrolled in the 2nd year of the FEUP's course, in Electrical and Computer Engineering, at the University of Porto. His main interests are in the fields of Wireless Sensor Networks, Real-time Systems, Programming, Artificial Intelligence, Automation and Electronics Systems.



Saraiva, Bruno

MSc Student

Bruno Saraiva, born in 1987, holds a degree (2010) in Computer Science Engineering at the School of Engineering, Polytechnic Institute of Oporto. Currently he is developing his Master's Thesis at CISTER Research Unit, involved in the SENODS project. His main interests are in the field of Networking, Multi-Agent Systems and Mobile.



Severino, Ricardo

Lecturer, PhD Student

Ricardo Severino was born in 1982 and has a Degree (2006), and a MSc (2008) in Electrical and Computer Engineering at the Polytechnic Institute of Porto – School of Engineering (ISEP/IPP). Since 2006, he has been working in the area of Wireless Sensor Networks, namely on improving quality-of-service (QoS) in WSNs by using standard and commercial-off-the-shelf (COTS) technology, at CISTER. In this line, he has been actively participating in the ART-WiSe and Open-ZB research frameworks, as well as in international projects such as ArtistDesign, CONET, and EMMON. He is also a founding member and contributor of the 15.4 and ZigBee TinyOS Working Groups. Recently, his MSc Thesis work was awarded with the EWSN'09 Best MSc Thesis Award at the prestigious European Conference on Wireless Sensor Networks (EWSN'09).





Sousa, Paulo Gandra de

PhD University of Minho, Portugal University of Minho, Portugal

Professor, Research Associate Associate



Paulo Gandra de Sousa is a Professor of Informatics at Instituto Politécnico do Porto (Polytechnic Institute of Porto, Portugal) - ISEP/IPP since 1996. He graduated in 1995 from ISEP-IPP; in 1998, he concluded a post-graduation on "Distributed Systems, Computer Architectures and Computer Communications" at Universidade do Minho (University of Minho, Portugal), and achieved his PhD in 2002 (also from Universidade do Minho). He worked for 3 years as an application developer for a Portuguese software house in the field of electronic archive, database retrievals and component development. Prior to CISTER he was a member of the R&D Group on Knowledge Engineering and Decision Support (GECAD, ISEP/IPP) and the technical contact point for the ISEP/IPP node of AgentLink – European Network of Excellence in Agent Based computing. He is one of the founders of the Portuguese chapter of the International Association of Software Architects (IASA). His main research interests are Distributed (Intelligent) Systems, Large Scale Systems, and Enterprise Application Architectures.

Informatics at Instituto Politécnico do Porto (Polytechnic Institute of Porto, Portugal) - ISEP/IPP since 1996. He graduated in 1995 from ISEP-IPP; in 1998, he concluded a post-graduation on "Distributed Systems, Computer Architectures and Computer Communications" at Universidade do Minho (University of Minho, Portugal), and achieved his PhD in 2002 (also from Universidade do Minho). He worked for 3 years as an application developer for a Portuguese software house in the field of electronic archive, database retrievals and component development. Prior to CISTER he was a member of the R&D Group on Knowledge Engineering and Decision Support (GECAD, ISEP/IPP) and the technical contact point for the ISEP/IPP node of AgentLink – European Network of Excellence in Agent Based computing. He is one of the founders of the Portuguese chapter of the International Association of Software Architects (IASA). His main research interests are Distributed (Intelligent) Systems, Large Scale Systems, and Enterprise Application Architectures.



### Sousa, Paulo Baltarejo

PhD University of Porto, Portugal

Lecturer, Research Associate



Paulo Baltarejo Sousa received a degree in computer engineering from the School of Engineering, Polytechnic Institute of Porto, in 2003. In 2007, he received an MSc in Electrical and Computer Engineering from Technical Institute, Technical University of Lisbon. In 2013, he received a PhD in Informatics Engineering from Faculty of Engineering, University of Porto. Since 2003 he is teaching assistant at the Department of Computer Engineering of the School of Engineering of the Polytechnic Institute of Porto and also research at CISTER. Now, his current research interests are in the field of real-time scheduling algorithms for multiprocessor systems with special focus on implementations in operating systems. Now, his current research interests are in the field of real-time scheduling algorithms for multiprocessor systems with special focus on implementations in operating systems.



### Souto, Pedro

PhD Stony Brook University, USA

Professor, Research Associate



Pedro Ferreira do Souto, received a Licenciatura in Electrical Engineering from the University of Porto in 1986, and a Ph.D. in Computer Science from the Stony Brook University, USA, in 1999. He is a Assistant Professor at the Department of Informatics Engineering of the Faculty of Engineering of the University of Porto.

His research interests include distributed systems, fault-tolerance, real-time systems and multiprocessing.



Tennina, Stefano

PhD University of L'Aquila, Italy

Research Associate



Stefano Tennina was born in L'Aquila, Italy, in 1978. He received the Laurea degree (cum laude) in Electronic Engineering from the University of L'Aquila, Italy, in 2003 and the Ph.D. degree in Electrical and Information Engineering from the same Institution in 2007. Since August 2002, he has been with the Department of Electrical and Information Engineering and the Centre of Excellence in Research DEWS, holding the position of post-doctoral researcher. He is currently a Research Scientist in the CISTER Research group, involved in the EMMON project of the ARTEMISIA 7th European Framework. His main research interests are in the area of communication protocol design, and wireless communication systems, with particular emphasis on applied analysis and experimentation on physical networks testbeds. His current research activity is mainly focused on fully distributed positioning algorithms, and source coding.



Thamri, Meriam

Undergrad Student



Meriam Thamri was born in 1988 in Tunisia. Currently, she is a third year engineering student at the Higher School of Communication of Tunis (Sup'Com). For her graduation project, she was accepted as a trainee for a 6 month internship in the CISTER Research Unit. Her work will be focused on wireless sensor networks and the handoff process. Her interests are mainly in the areas of information and communication technologies, mathematics and programming.



Tovar, Eduardo

PhD University of Porto, Portugal

Research Centre Director

Professor, Research Associate



Eduardo Tovar is the head of CISTER Research Center. He was born in 1967 and has received the Licentiate, MSc and PhD degrees in electrical and computer engineering from the University of Porto, Porto, Portugal, in 1990, 1995 and 1999, respectively. Currently he is Professor of Industrial Computer Engineering in the Computer Engineering Department at the Polytechnic Institute of Porto (ISEP-IPP), where he is also engaged in research on real-time distributed systems, wireless sensor networks, multiprocessor systems, cyber-physical systems and industrial communication systems. He heads the CISTER Research Center, a top ranked ("Excellent") unit of the FCT Portuguese network of research units. Since 1991 he authored or co-authored more than 100 scientific and technical papers in the area of real-time computing systems, wireless sensor networks, distributed embedded systems and industrial computer engineering. Eduardo Tovar has been consistently participating in top-rated scientific events as member of the Program Committee, as Program Chair or as General Chair. Examples are: IEEE RTSS (Real Time Systems Symposium); IEEE RTAS (Real-Time and Embedded Technology and Applications Symposium); IEEE SDRS (Symposium on Distributed Reliable Systems); IEEE ICDCS (International Conference on Distributed Computing Systems); ACM EMSOFT (Annual ACM Conference on Embedded Software); Euromicro ECRTS (Euromicro Conference on Real-Time Systems); IEEE ETFA (Emerging Technologies on Factory Automation) or IEEE WFCS (Workshop on Factory Communication Systems). He is team leader within the 6th Framework IST Network of Excellence ARTIST2, on distributed embedded systems. Euromicro ECRTS (Euromicro Conference on Real-Time Systems); IEEE ETFA (Emerging Technologies on Factory Automation) or IEEE WFCS (Workshop on Factory Communication Systems). He is team leader within the 6th Framework IST Network of Excellence ARTIST2, on distributed embedded systems.



Vahabi, Maryam

PhD Student

Maryam Vahabi received her degree in Electrical Engineering from University of Guilan in 2003. She obtained her Master of Science in Communication Network Engineering from University Putra Malaysia in 2009 and her Master research was on wireless sensor networks. She has joined the IPP-HURRAY! in July, 2009. Currently, she is doing her PhD in CISTER/IPP-HURRAY Research unit. Her current research interests are sensor networks, real-time systems and schedulability analysis.



Yomsi, Patrick MeumeuMeumeu

PhD Université Paris Sud, France

Research Associate

Patrick Meumeu Yomsi received his Ph.D. degree in 2009 from the Université Paris Sud, Orsay in France. After his degree, he worked in a number of research projects addressing various aspects of real-time computing systems. He was successively a member of AOSTE Research Unit at the French National Institute in Computer Science and Control (INRIA) in Paris Rocquencourt, France, then a member of PARTS Research Unit at Université Libre de Bruxelles (ULB) in Brussels, Belgium, and finally a member of TRIO Research Unit at INRIA in Nancy, France. He is currently a Research Scientist at CISTER Research Unit at ISEP/IPP. His research interests include real-time scheduling theory, real-time communication and real-time operating systems.







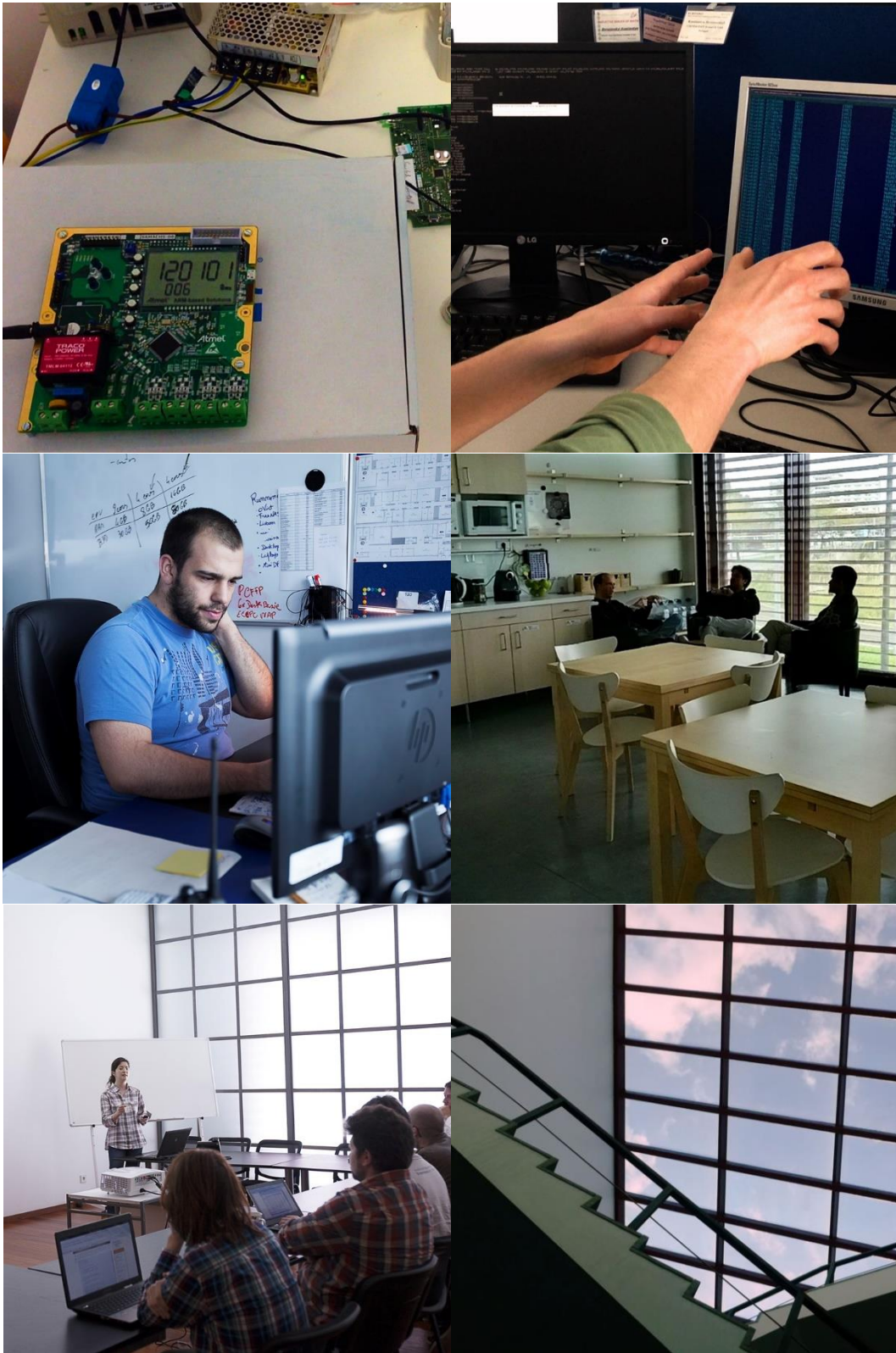
## Facilities

[www.cister.isep.ipp.pt/info](http://www.cister.isep.ipp.pt/info)



CISTER has evolved gradually (in the last 15 years) from a few rooms at ISEP Campus to an entirely new building. This single-home (2000 m<sup>2</sup> area) for CISTER is a strong asset which will help the unit to continue to meet the demands and challenges of the current and future projects and to pursue a work plan of high standard that matches the best in the world in the area of real-time and embedded systems.







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