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January 12, 2018

To whom it may concern

I am writing this letter in the context of CISTER submission to the evaluation process of Portuguese research units, after reading the CISTER Report 2013-2017 with much interest and elation.

I have known the work of CISTER, and some of its members, for a long time. I am a member of the CISTER External Advisory Board since 2009. I was also a member of the Scientific Advisory Board of INESC-TEC, with which CISTER was associated as an autonomous unit. In my role as Board Member I participated in an internal process of evaluation and strategic analysis as well as accompanied the unit's work. I had also several interactions in the scope of the unit's process of evaluation for the previous period (2008-2012), and have visited the group several times, allowing me to have a detailed perception of CISTER's activities and its evolution over time.

CISTER is a world-class research unit in the area of real-time and embedded systems. This observation is supported on the work CISTER has been performing for the last five years period (see 2013-2017 report), both from the point of view of scientific quality as well as of the produced impact in the community. The report shows that CISTER members regularly publish in the top conferences in the area (which have acceptance rates of 15-30%), as well as in relevant and reputed journals. CISTER research highlights include (and in some cases define) the hottest and most emergent topics in the field. Topics such as mixed criticality, cyber-physical systems, or parallel and multicore real-time processors were some of the upcoming topics for the community to which CISTER contributed from the start.

A recognition of the ranking and quality of CISTER's researchers can be easily seen from the community reaction: CISTER members are often trusted with the organization and chairing of the most reputed of its events. International renowned conferences such as RTSS, RTAS and ECRTS regularly have a CISTER member in the Program or Organizing Committee. This is accompanied with roles in other relevant conferences and journals, as well as chairing of several workshops and satellite events. Noteworthy, the premier and most important event in real-time systems, the IEEE RTSS, took place in Porto, in 2016, organized by Eduardo Tovar and Luis Almeida; I was involved in the decision to move it from Brazil and the most trustworthy and competent group was chosen. It is noteworthy that at least one CISTER researcher has an organizing role every year in every conference in the area.

It is equally important to point out the ability CISTER has in attracting skilled researchers to work in Porto, clearly driven by CISTER's visibility and position in the community. This is a significant reversal of the usual flow we see from Portugal to other countries and institutions. It

is revealing to see this at all levels, from PhD students, as the case of Dakshina Dasari in whose doctoral examination I participated, to post-docs, such as Vincent Nélis or Geoffrey Nelissen, who I am also trying to recruit to Pitt, or even more senior researchers such as Stefan Petters who was recruited from NICTA to CISTER and was there for over 5 years. It is also important to see the growing network of CISTER alumni, with positions in relevant industry in the area, such as Dakshina Dasari, at Bosch Research, in Germany, Guru Raravi, at NVIDIA, in Germany, or José Marinho at ARM, in the UK. Likewise at academia with Borislav Nikolic, at TU Braunschweig, in Germany, Hossein Fotouhi at the Malardalen University, in Sweden and Luis Oliveira, currently a post-doc in my group at the Pitt.

One particular aspect I could witness, given my presence in the EAB of CISTER for over 9 years, is the resilience of the group and its capacity to adapt and face adversity, especially during periods of economic crisis and the associated economic difficulties worldwide and in Portugal in particular. CISTER was able to continue its path, securing many European projects in highly competitive processes, with important partners both academic and industrial partners. This result was clearly made possible by CISTER's international visibility. Consequently, this allowed the unit to maintain a stable competitive funding of around 1M€ per year as shown in the report, in a time of decrease of national funding, and approximately doubling in comparison with the previous 5-year period. Clearly, this is also a result of the past and current efforts to always work at the leading edge of research.

Lastly, I would like to praise the recent integration of the real-time group from the School of Engineering of the University of Porto, which I also know well. Great asset.

All of this makes me consider that CISTER has all the conditions, and the right set of people, to continue its outstanding international level work. Therefore, I highly recommend them for once again achieving the highest ranking in the evaluation process.

Please do not hesitate to contact me if you need any further information, preferably by email at [mosse@cs.pitt.edu](mailto:mosse@cs.pitt.edu).

Sincerely,



Daniel Mosse  
Professor of Computer Science  
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Zurich, 10<sup>th</sup> January 2018*To whom it may concern***Report CISTER Activities, Quinquennium 2013-20177**

I am very pleased to write this letter in support of the Research Centre in Real-Time and Embedded Computing Systems (CISTER) in Portugal, whose External Advisory Board I joined recently. I have known several researchers of CISTER for more than a decade, since we participated together in the ARTIST2 (FP6) and ArtistDesign (FP7) Networks of Excellence on Embedded Systems Design that ran between 2005 and 2012, which consolidated Embedded Systems research in Europe. Since then we meet frequently in international scientific venues such as the IEEE Real-Time Systems Symposium (RTSS), the IEEE/ACM Cyber-Physical Systems Week (CPSweek), the IEEE International Conference on Distributed Computing in Sensor Systems (DCOSS) or even the European Conference on Wireless Sensor Networks (EWSN). In the last two cases, I was the Program Chair of DCOSS 2014, a selected venue that counted with a paper from CISTER, and I was the keynote speaker of EWSN 2015, which was organized by CISTER in Porto, which also allowed me to visit their impressive infrastructure.

This convergence emerges from common research interests in similar domains and, thus, I feel qualified to give a critical opinion on the quality of CISTER activities. Before, though, let me elaborate a few lines on myself.

I have been with ETH Zurich, Switzerland, as a full Professor of Computer Engineering since 1994, where I lead the Computer Engineering research group developing models, methods and software tools for the design of embedded systems, embedded software and bioinspired optimization techniques. Some of our results became reference and impacted significantly the cyber-physical and real-time embedded systems communities, such as the Real-Time Calculus design framework, the Glossy wireless sensor network protocol, and temperature-aware real-time scheduling in multi-core processors, among many other. Because of my research I was appointed to numerous prestigious organizations, positions and awards. For example, in 2015 I was the recipient of the "EDAA Lifetime Achievement Award" and recently, in 2017, I became Associate Vice President of ETH for Digital Transformation. Currently, I am associate editor of IEEE Transaction on Industrial Informatics, IEEE Transactions on Evolutionary Computation, Journal of Real-Time Systems, Journal of Signal Processing Systems, Journal of Systems Architecture, and INTEGRATION, the VLSI Journal.

Coming back to CISTER activities, the research the group develops falls under the hat of Cyber-Physical Systems (CPS), an increasingly relevant area from social, economic and scientific perspectives, that will eventually impact all our lives. It deals with the physical properties of computation and communication and their impact in the interactions with the respective operational environment, so that correct operation can be assured. Examples of CPS that CISTER has been addressing extend from

automotive systems to avionics, smart industry, smart cities and smart grid. Attention has been given to the analysis and design of the embedded distributed and parallel computing platforms that compose most CPS, with a special concern on real-time and dependability issues and covering from networks of simple nodes to high performance computing (HPC) systems.

From the knowledge I have of the group, I can confidently state that it has conquered a place among the international reference groups in CPS / real-time embedded systems (RTES) analysis and design. This achievement is clearly supported by the activity report for the 2013-2017 period. CISTER researchers regularly integrate the organization of the most relevant scientific events in the field (Table 3), they consistently publish their research results in selective conferences and journals in the area (Tables 4 through 6), they partner recurrently with leading industry and academia in international project consortia setting up projects in highly selective funding programs (Table 10), they have been attracting leading researchers for short visits and collaborations (section on Internationalization) as well as highly skilled students from all around the globe, especially they successfully set up a PhD students pipeline that has already generated alumni that are integrated in prestigious industries and academic groups (Table 8 and preceding text), and finally they started having a structured impact on the local ecosystem of enterprises, schools and society in general through outreach activities (see the CiTech initiative consolidating local industry and the associated CiWork industry-academia workshop series).

Nevertheless, despite the impressive results achieved in the reported period, these become even more significant when compared with the previous periods, i.e., along the last 15 years. Not only these metrics show continued growth in all dimensions (except for a few cases in the previous period 2008-2012) but they also show significant improvements in this last period across all metrics (Table 2 – integrated members, Table 7 – publications, Table 9 – students, Table 11 – projects, Table 13 – competitive funding), revealing beyond doubts the success of a strategy to create a world class group in CPS / RTES, properly put in place by a highly skilled and capable team involving several young members.

With a sustained budget of around 1M EUR per year in the last period, several projects that started in 2016/2017, and the announced reduction in infrastructure costs, indicate the potential for some slack in the coming period that maybe be sufficient to accommodate further growth as aspired by the group and exposed in the Outlook section.

Given these considerations, I have no doubts in recommending the highest rank in the assessment of CISTER, not just because of the impressive performance shown in the period under evaluation in which the group established itself as a world reference group in the realm of CPS / RTES but essentially the potential the group shows for the future turning the support it receives into a solid investment.



Prof. Lothar Thiele  
Zurich, 10<sup>th</sup> January 2018

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**TO: Whom it may concern**

**January 15th, 2018, Lisbon**

Sir,

I'm honoured to be part of the External Advisory Board of the CISTER research unit as member of their Industrial Advisory Board (IAB) since 2011.

Both at Altran Portugal, where I am Chief Technology Officer, as well as in my previous role as Engineering Manager and Principal Engineer at Critical Software, I have come to know the CISTER research unit in the scope of bilateral contacts which intended to collaborate for participation in international projects. Nevertheless, I would like to note that CISTER was already known, both from former collaborations (some of them already more than a decade ago such as the work on monitoring and validation of real-time kernels with Prof. Luis Miguel Pinho), as well as from the collaborations in the EMMON project, an European project led by Critical Software, and where CISTER had played a fundamental role, with the work on real-time communication in wireless sensor networks, of Profs. Eduardo Tovar Anis Koubaa.

Moreover, when I participated in the steering committee of the Artemis Industrial Association (ARTEMIS-IA), from 2012 to 2015 I was able to note the exceptional track record of the group in this extremely important and relevant European program. Embedded systems play a fundamental, although mostly hidden, role in our society. These systems control from smart phones to cars and planes, more and more monitor and control our environment, and even make our home devices connect to the internet. Modern society is increasingly dependent on these systems, therefore their reliable and timely operation are of paramount importance. Europe is paying particular attention to this importance, which can be seen by the setup of the Artemis program and the its later follow-up, the ECSEL (Electronic Components and Systems for European Leadership) program to complement the research activities within the Horizon 2020 framework program.

CISTER is deeply involved in this program, being Prof. Eduardo Tovar a known member of the ARTEMIS-IA chamber of research centres from its start. This membership and participation puts CISTER in a key role, not only of performing internationally exception activities, but also reach in to Portuguese high-tech companies (such as Altran but not only), in some cases supporting their participation in international projects.

In particular I would like to point out the endeavour and international recognition of Profs. Eduardo Tovar, Luis Miguel Pinho and Luis Lino Ferreira in the collaborations to build strong Portuguese consortia in several international project proposals such as CONCERTO, EMC2, ICC and DEWI. Important to refer

that 3 of these proposals were successful, and included many relevant European industrial partners in the consortium:

- CONCERTO (Guaranteed Component Assembly with Round Trip Analysis for Energy Efficient High-integrity Multi-core Systems) partners include Intecs (IT), Thales (FR), Atego (FR), EADS (FR), Aicas (DE), The Open Group (UK), and Oilfield Technology Group (NO).
- EMC2 (Embedded multi-core systems for mixed criticality applications in dynamic and changeable real-time environments) involve partners such as EADS (DE), Thales (FR), Infineon Technologies (DE), Ericsson (SW), BMW (DE), Volvo (SW), Philips Healthcare (NL) and Siemens (DE).
- DEWI (Dependable Embedded Wireless Infrastructure) with partners including Acciona (SP), NXP Semiconductors (FR), Philips (NL), Thales (FR), Alenia (IT) and Volvo (SW).

These projects are a clear indication of the international relevance of the topics which are tackled and the exceptional quality of the involved teams.

I would also like to point out the national relevance and outreach to national industry performed by the research unit. CISTER's CiWork events and CiTech initiative, presented in the Tech Transfer and Outreach section of the 2013-2017 report, are examples of some of the initiatives the unit has performed for more applied innovation and technology transfer efforts at the National level. It is noticeable the effort that the unit is making into transferring its research results to provide higher value to Portuguese industry.

Embedded Systems and more broadly Cyber Physical Systems play a major role in Altran's strategy, where our presence in Automotive, Aeronautics and Railway sectors require for strong competences and solutions on this technical domain. Our strategic cooperation with CISTER is now gearing up in form of a joint initiative to foster the development of combined research work on the field of Cyber-Security dealing with the complex problems of the interplay of safety and security

The national recognition of the unit is also perceptible with the participation (by invitation) of Profs. Eduardo Tovar and Luis Miguel Pinho in the process related to building the national thematic R&I agenda for "Cyber-Physical Systems and Advanced Forms of Computation and Communication", being developed by experts from the Portuguese academia and industry (in which an Altran representative also participates).

And finally, this has also been recognized by CISTER hosting institutions, with the lasting support for the unit's infrastructures (a dedicated building with the required facilities for world-class research). This building reinforces the capabilities of the unit not only to produce high-quality exceptional internationally recognized research, but also to foster greater efforts in innovation and technology transfer activities.

I am looking forward to continue this collaboration in the future and I'm available for any further information if required regarding this report.

Yours Truly.

Rodrigo Maia, MBA, MSc Hons, PMP  
Chief Technology Officer  
Altran Portugal





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**Subject: CISTER Activities 2013-2017**

15/Jan/2018

To the evaluation panel,

I am Professor at the Technische Universität Braunschweig, Germany, where I chair the Institute of Computer and Network Engineering. I was also the Head of the Department of Electrical Engineering from 1999 to 2001. I work in the area of embedded systems for more than 25 years, working in topics such as HW/SW co-design, models of computation as well as embedded architectures for high-performance applications. Theoretical work in compositional system-level performance analysis resulted in the tool SymTA/S, which has been commercialized by a spin-off (Symtvision), being a de facto standard for automotive network design worldwide. I also served in several positions in the German Research Foundation, I've been consultant and advisory board member for U.S. and European funding and research organisations and I was a member of the advisory board of the German Ministry of Economics and Technology for high-tech entrepreneurship programs from 2006 to 2016.

I am a recent member of the CISTER Advisory Board, but I am aware of the work of the research centre for already many years, having met CISTER researchers throughout the years in relevant forums such as RTSS, ECRTS, RTAS, SIES, EMSOFT or DATE. I also visited the research centre in several occasions, in the scope of international conferences organized by CISTER, in 2011 for ECRTS, 2013 for SIES and 2016 for RTSS. I published with people like Stefan Petters, had invited talks in symposia from Luis Almeida, collaborated with CISTER researchers in program committees of numerous top line venues. This letter is therefore supported both by the analysis of the period report as well as my personal knowledge of CISTER.

The value of CISTER researchers is highly recognized, as can be seen not only from the number of publications, but mainly from the conferences and journals where these are published, with papers in all top conferences and journals of the area, from researchers such as Eduardo Tovar, Stefan Petters, Luis Miguel Pinho, Luis Almeida, Vincent Nélis, Geoffrey Nelissen, Benny Akesson, Konstantinos Bletsas, Ali Awan, to name a few. More than the quantity (which is nevertheless relevant), the quality of the venues is to be noted. And the trend in the last years is for improvement.

There are many examples of outstanding research. I will only mention a few. I am very impressed by the work in real-time memory scheduling by Benny Akesson who I count among the internationally leading scientists in that field. Luis Almeida made several highly recognized contributions to the advancement of the CAN bus, the leading vehicle field bus in automotive electronics worldwide. In the last couple of years he provided outstanding work in video streaming over energy constraint wireless sensor networks. Timing analysis for multicore systems is a topic of highest industrial interest where CISTER has recently provided a number of excellent solutions.

The importance of these works has also been recognized by industry, with CISTER participating in several high-profile European projects, of the Artemis and ECSEL programs. Not only RECOMP and EMC2, projects in which we collaborated, but as well, as can be seen in page 21 of the period report, other projects such as DEWI, SCOTT or Productive 4.0. CISTER's role in these projects is a recognition of the industrial-relevance of the works of the research centre.

Another important dimension of the research centre is its graduation program, which has produced almost 20 students in the past 5 years, with high-quality contributions to the community. Many of these students are now spread over the world (one of them, Borislav Nikolic, in our Institute as a postdoc). As reflected in pages 16-17, the program is an important axis of the centre research contribution, with the foreseen growth allowing to expect even more from CISTER in future years.

I would like also to note the organizational capabilities of the research centre and its researchers. As mentioned, I had the pleasure to visit the research centre in several occasions, in conferences organized by CISTER and in project meetings. It is relevant to note the huge success and smooth working of these events, and the professionalism of the local team. In particular I would like to point out Eduardo Tovar and Luis Almeida for RTSS 2016 and Filipe Pacheco and Vincent Nélis for SIES 2013.

Concluding, CISTER is a world-wide recognized research centre in real-time embedded computing, with major contributions to the advance of the area, and important competences which make me believe the centre will continue to be at the front of research in the topics in their roadmap.

Best regards,



Prof. Dr.-Ing. Rolf Ernst

WASHINGTON UNIVERSITY IN ST. LOUIS

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January 9, 2018

**Subject: Report on CISTER Activities 2013-2017**

TO WHOM IT MAY CONCERN:

I am writing to express my recognition of the outstanding contribution of CISTER to the state-of-the-art in real-time and embedded systems over the last years, and my acknowledgement of its position among the top research centers in the area, in Europe and worldwide. I am a professor of Computer Science & Engineering at Washington University in St. Louis, where I co-direct the very highly regarded real-time and embedded systems research group<sup>1</sup>; I therefore consider myself qualified to provide an evaluation of CISTER's research activities which are also primarily in real-time and embedded systems.

Real-time and embedded computing relates to computing as supportive of significant practical and industrial applications. Research in this area has the potential to revolutionize both the economic realities and the everyday life. As such it attracts a lot of attention and funding worldwide, both from industrial and public bodies. Based upon frequent interactions with CISTER researchers over an extended period of time (including multiple visits to Porto, co-authorship of research papers, and service on PhD dissertation committees), I strongly feel that the CISTER research unit definitely deserves such support and its track record shows that it can indeed make good use of it. I note that the results of the unit have been solidly consistent and notable. The scientific output is very impressive and translates to papers every year in all of our top-tier conferences (IEEE RTSS, IEEE RTAS and EuroMicro ECRTS), which serve as the stage for all cutting-edge research in our area. I would also like to highlight that the trend in research productivity has been very positive: as Table 7 of the CISTER 2013–2017 Quinquennium Report shows, publication numbers overall, and in top journals in particular, have increased significantly despite no similar increase in the number of integrated researchers.

In addition to these impressive productivity numbers, I would also like to highlight that some top-quality and highly influential research has happened in CISTER during this five-year period. For instance a CISTER-authored paper that was presented in the 2015

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<sup>1</sup>The ranking site [csrankings.org](http://csrankings.org) ranks us as the top-rated Computer Science department in the area of embedded and real-time systems.

ACM Symposium on Applied Computing engendered a significant amount of follow-up work, including from my research group, and led eventually to the conditional sporadic DAG tasks model, currently accepted as being the most expressive tractable model for representing parallelizable real-time code. CISTER has facilitated the integration of this very powerful formal model into industrial practice by working closely with industrial partners in developing tool-suites that enable its use in system design and implementation.

CISTER has been especially noted for attracting young talent from around the world to Portugal and providing them with the opportunities to develop fully into established researchers (Cucu, Andersson, Bletsas, Prabh, Easwaran, Nelis, Nelissen, Yomsi). This is ultimately to the benefit of our entire research community, which in turn routinely entrusts CISTER researchers with important organizational roles, such as regular membership in the technical program committees of all our top conferences as well as of other related events, editorial boards of our flagship journals, scientific societies (IEEE, ACM, Euromicro) and evaluation panels and doctoral committees in many different countries. Such services are mainly undertaken by the most distinguished members (e.g., Eduardo Tovar, Miguel Pinho, Luis Almeida, Anis Koubaa, Konstantinos Bletsas or Stefan Petters) but increasingly also by the younger academics of the unit, such as Vincent Nelis, Geoffrey Nelissen, Ricardo Severino or Patrick Yomsi. In the period, it is notable that various members of CISTER were Program Committee Chairs of RTAS, ECRTS and RTCSA, were Track Chairs in RTSS and were General Chairs of ECRTS and RTAS, as well as of other relevant conferences in the field.

The reputation and international standing of CISTER researchers is also reflected in the increasing external collaborations of the unit, being it scientific works done together with other top international researchers, or research projects with leading international partners from both the academia and the industry (an extensive list is presented in the 5-year activity report in pages 9 and 10).

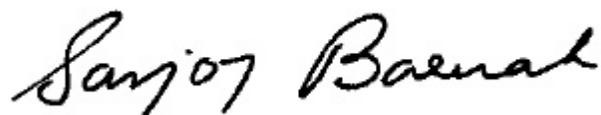
During the period CISTER was involved in around 30 projects, with approximately a 50/50 decomposition between industry-driven and fundamental research projects. Although I'm aware of many relevant CISTER projects, I would like to point out a few relevant projects in my area of expertise. That is the case of the European projects CONCERTO (<http://www.concerto-project.org/>) on model driven design of multicore real-time systems), P-SOCRATES (<http://www.p-socrates.eu/>) on parallel software for time-critical many-core systems) or EMC2 (<https://www.artemis-emc2.eu>) on embedded multi-core systems for mixed criticality applications in dynamic and changeable

real-time environments. These projects have allowed the unit to showcase its research activities, and together with new projects presented in page 20 and starting 2016 and 2017, give all the confidence in the prosecution of exceptional results in addressing the proposed cutting edge work topics presented in the Outlook section (some of which with seminal work done by CISTER researchers).

Concerning the unit plans for the next period, it is important to note the investment in a stable and international-quality research staff and PhD students' pipeline, to enable continuing to produce high-quality scientific production. A remark to the difficult balance between publication in top journals and top conferences in the field, usually used to set the research directions of the community, and that the unit is intending to tackle, as noted in page 36.

Let me conclude by reiterating my strong opinion that by all relevant metrics of academic excellence, the CISTER research unit has clearly established itself at the vanguard of research in real-time systems internationally. It shows great promise and potential in terms of both the intellectual capabilities of its researchers and the excellent physical facilities that match highest international standards. I emphatically believe that it is in the interests of both the international research community and your country to see this standing validated once again with the higher-most classification, along with the support that this brings, in the upcoming years. If there is any further information I can provide, please feel free to contact me either by email ([baruah@wustl.edu](mailto:baruah@wustl.edu)), or by telephone (+1.314-935-7546).

Sincerely yours,

A handwritten signature in black ink that reads "Sanjoy Baruah". The script is fluid and cursive, with the first letters of "Sanjoy" and "Baruah" being capitalized and prominent.

Sanjoy Baruah  
Professor

Embraer S.A.

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São José dos Campos, January 10th, 2018

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Subject: 2013-2017 Quinquennium Report of the CISTER Research Centre

I am an Aerospace Engineer at EMBRAER, a Brazilian aerospace conglomerate that produces commercial, military, and executive aircraft and provides aeronautical services. EMBRAER is today one of the largest aircraft manufacturers in the world. I have joined EMBRAER in 1982 as a computer analyst working for the Flight Test Division, and currently I am responsible for the Flight Test Division's Research&Development Coordination. Formerly, I was responsible for the Flight Test Ground Station team, in charge of in-house software development for flight test data real-time and post-flight processing systems.

I am very glad to provide this report as member of CISTER's Industrial Advisory Board (IAB). My first contact with researchers from CISTER was during the "EUROMICRO Conference on Real-Time Systems" in 2009 (ECRTS'09). In this conference I got acquainted with professor Tovar, which was serving as chair of the "International Workshop on Real-Time Networks". During several discussions with him and other members of CISTER, I came to know some of the skills and projects that CISTER was involved with. I also came to appreciate the impressive array of contributions the team has delivered, and the noticeable engagement of the team with the research community, as evidenced by the regular presence in first-class scientific venues such as the Real-Time Systems Symposium, the Real-Time and Embedded Technology and Applications Symposium and the Euromicro ECRTS, just to give a few of the most relevant examples. I am not surprised to see in this report a higher level of engagement with the international community with a consistent set of key roles in these (and other conferences), as well as a significant increase in publications.

In 2015, I had the pleasure to visit CISTER in my role of IAB member. This allowed me to interact with more researchers from CISTER, namely Vincent Nélis, David Pereira and Ricardo Severino, who are leading activities in the scope of relevant projects of the unit, such as P-SOCRATES, SCOTT or SafeCOP. I had also the opportunity to witness *in loco* the evidence of the high quality of the research unit: the quality of their facilities, collaborators, methods and approaches.

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In 2016, project SCOTT (“Secure Connected Trustable Things”) was granted funding from the Electronic Component Systems for European Leadership Joint Undertaking, thus proving the value of the partnership between EMBRAER and CISTER, which together will be working on WP16 – Secure Wireless Avionics for Sensing and Actuation – to explore security solutions for different layers and interfaces of wireless aeronautical networks.

In 2017, EMBRAER Portugal led the submission of project AnALISAR (“Arquitetura Aviónica modular Integrada para Sensoriamento Remoto”) to the portuguese “Sistema de Incentivos à Investigação e Desenvolvimento Tecnológico” (SI I&DT - Aviso Nº 03/SI/2017) and trusted CISTER to lead four important tasks related to the development and implementation of a secure digital data communication protocol in avionics mission critical systems.

I have been following the activities of CISTER researchers in the area of critical embedded platforms where they also excel and lead internationally and cutting-edge research. I have been also following the activities to build a Portuguese ecosystem of companies working in the embedded real-time system domain, and in particular the relevant series of industrial workshops (CiWork) where my colleagues from EMBRAER Portugal had also the opportunity to participate.

CISTER’s 2013-2017 Quinquennium Report brings relevant research topics that will greatly contribute to the development of the next generation digital avionics. In particular:

- Methodologies and algorithms to enable analysis and configuration from model-based system specification to enable validation of timing properties of software components in early stages of the system development;
- Time and space isolation mechanisms for safety-critical and mixed-critical systems in complex embedded computing platforms, mainly multi- or many-core;
- Communication mechanisms for highly-dense sensor and actuator networks.

It is a great honor to be part of the Industrial Advisory Board (IAB) of CISTER, and to continue to support the development of CISTER, in which I firmly believe. My view is that this is a world-class research centre, with proven results, and a great potential to deliver impactful research in several areas.

Yours sincerely,



Sérgio Duarte Penna

EMBRAER – Flight Test Division, Research&Development Coordination

# UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

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Tarek Abdelzaher, Professor  
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Subject: CISTER 2013-2017 Report

To whom it may concern,

It is my greatest pleasure to write this letter in firm support, acknowledgement, and recognition of the excellence and leadership of the CISTER (Research Centre in Real-Time and Embedded Computing Systems) research unit as a top-tier international research organization.

I am a professor and Willett Faculty Scholar at the Department of Computer Science of the University of Illinois at Urbana Champaign. I have worked in embedded real-time systems for almost 20 years. I have also had the pleasure and honor of being part of the CISTER External Advisory Board (EAB) since 2006 (and have generally followed the activities of the research center since around 2000). Based on the path of CISTER and its past achievements, as well as my outlook for the coming years, I firmly believe that CISTER's exceptional performance can only have an exceptional classification. CISTER is internationally recognized as a landmark and flagship establishment in real-time and embedded computing systems for its scientific and technological output and its exceptional contributions to this area of research.

It is my conviction that the research focus of CISTER is becoming increasingly important for economic and social progress as real-time and embedded computing systems are becoming increasingly critical in national and international industrial and strategic infrastructure projects and initiatives. With the high popularity of labels such as Cyber Physical Systems, the Internet of Things, and Cooperating Objects, all research directions at CISTER, research at the center can only be described as of strategic importance. To my knowledge, the importance of the CISTER focus is well supported by the fact that the European Commission has endorsed a large research framework around this area, with a considerable sum of funding being committed to this effort (ARTEMIS Program) and with a current continuation (ECSEL).

CISTER is truly international. In the past reporting period, over 20 different nationalities were represented in the research center. The research unit has a great team of PhD students coming from a varied set of countries such as Portugal, Sweden, France, Germany, Russia, Ukraine, Serbia, India, Cuba, Iran, Pakistan, Mexico, Egypt and the Czech Republic. The center's multinational diversity further exists not only in PhD students but also at the level of postdocs and research scientists. CISTER currently employs a great number of reputed international researchers hired from the international arena. That is the case, for example, of Vincent Nelis and Geoffrey Nelissen (PhD graduates of the ULB, Brussels, Belgium), Konstantinos Bletsas (PhD Graduate of the University of York, UK), Raghuraman Rangarajan (PhD Graduate of the IITB, India) and Anis Koubaa (PhD Graduate, U. Nancy, France), among others. Some started their Postdoc life at the center, then moved on to other prominent positions elsewhere, such as Liliana Cucu (now at INRIA, France), Arvind Easwaran (now at NTU, Singapore) and Shashi Prabh (now at Shiv Nadar University, India), offering another measure of international impact of CISTER.

CISTER has engaged, starting in 2008, with PhD programs in collaboration with the Faculty of Engineering of the University of Porto, where CISTER leads the Real-Time and Embedded Systems stream, leading to almost 20 PhD students graduating from the research unit in the last 5 years. I've seen the work of some of those students and can personally attest for its high quality. They have been consistently publishing in the top venues in the area, which (in computer science) tend to be both journals and conferences such as the IEEE RTSS, IEEE RTAS, ECRTS or RTCSA. Notably, many of these students received best paper and outstanding paper awards. That is the case of José Marinho at IEEE RTCSA 2013, Alexandre Esper at RTNS 2015, Syed Rashid at ECRTS 2016 and José Fonseca at RTNS 2017.

CISTER is also known for outstanding work in the area of sensor networks. CISTER researchers, such as Anis Koubaa, Eduardo Tovar and Mario Alves, have a number of papers in wireless sensor networks with over than 100 citations, and have performed seminal work on how to guarantee timeliness for wireless sensor networks and cyber-physical systems (CPS) applications by using standards such as IEEE 802.15.4 and ZigBee, an area of particular interest to me. I myself was Program Co-Chair of the 12th European Conference on Wireless Sensor Networks, which was organized by CISTER, February 2015, with Eduardo Tovar as General Chair. Besides sensor networks, many other seminal results have been produced by the research center. For example, in the area of multiprocessor scheduling, various seminal discoveries were made by researchers at CISTER, including Konstantinos Bletsas, Vincent Nelis, Bjorn Andersson, Stefan Petters, Eduardo Tovar or Geoffrey Nelissen.

Members of the CISTER research center have also been very active in organizing and reviewing for several sensor network and real-time computing conferences and related events. In just a small period of time, several researchers at the center have been program chairs of main events in the area: PC Chair IEEE RTAS 2013 (Eduardo Tovar); PC Chair ECRTS 2013 (Stefan Petters); PC Co-Chair WFCS 2014 (Eduardo Tovar) and WFCS 2017 (Luis Ferreira); PC Co-Chair RTNS 2016 (Luis Miguel Pinho); PC Co-Chair of IEEE RTCSA 2017 (Luis Almeida) and RTCSA 2016 (Eduardo Tovar).

The CISTER quinquennium (2013-2017) report also presents the topics proposed for the coming years. They open interesting new directions in multiprocessors, mixed-criticality systems, cyber-physical systems, and parallel computation. These topics are most relevant and timely. The research center has already shown its ability to produce state-of-the-area results in these topics, and it is my conviction that the trend will continue in the forthcoming years.

It is also commendable that the work plan will be sustained and anchored in various industry-related initiatives. The research center had more than 10 international projects active in 2017, of which 6 will span 2018-2020. These include the big Productive 4.0 and SCOTT projects (that will cover industry 4.0 and secure wireless communications, respectively) in application domains such as industry, aerospace and automotive. All these projects include key industries from Europe (Airbus, BMW, Thales, Siemens, Bosch, etc.), and the research unit was able to collaborate with a number of Portuguese companies in the area, such as Critical Software, GMV Portugal, Tekever. These projects have been driven by various CISTER researchers such as Ramiro Robles, Ricardo Severino, Luis Ferreira and Michele Albano.

In summary, I believe the CISTER unit is a top-tier research center on par with the best international centers in the field. I truly hope it gets the high recognition it deserves and I look forward to further results and breakthroughs from this vibrant organization.

Sincerely,

A handwritten signature in black ink, reading "Tarek F. Abdelzaher". The signature is fluid and cursive, with the first name "Tarek" being the most prominent.

Tarek Abdelzaher



8th January 2018

**Professor Alan Burns FREng**

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Dear Sir/Madam.

**RE: CISTER Activity Report Quinquennium 2013-2017**

I am a Professor (with a Personal Chair) in the Computer Science Department at the University of York; a top 10 University in the UK. I have been at the University of York since 1990 and held the post of Head of Department from 1999 until June 2006. I am head of the Real-Time Systems Research Group, one of the largest Academic research groups in the world focusing on the engineering of real-time systems. I have authored/co-authored 500 papers/reports and books. Many of these are in the real-time area. I have advised a number of industries including BAE and Rolls Royce Aeroengines. I am a Fellow of the (UK) Royal Academy of Engineering and the IEEE.

The area of research on embedded and real-time systems is an area rich in both for the scientific challenges and economic and societal importance. Real-time embedded systems are omnipresent in our daily lives, from cellular phones or smart cities infrastructures to critical systems such as in the avionics and automotive industries. Relevant current societal challenges, such as greener technologies, smarter and autonomous environments, energy-efficiency, etc., are only to be achieved with increasing research in real-time embedded computing, as put forward by relevant international initiatives such as Artemis/ECSEL in Europe or the NSF CPS program in the USA.

I am very knowledgeable about the activities of the CISTER research unit since its creation in 1997. As a member of the community, I have followed their work and have witnessed first their remarkable growth, in terms of the spectrum and quantity of research outputs, as well as the quality and international impact of their activities.

As a member of the unit's Advisory Board I have also been able to follow their positioning and their effort in meeting the highest demands whilst growing, and the challenges that had to be faced during these years. In this period of 2013-2017 I would like to point out the growth that was possible to achieve when the unit stopped being spread in multiple buildings over the ISEP campus, and moved into a self-contained building. I would also like to comment on the unexpected difficulties the unit had in demonstrating the excellence of the unit in the previous evaluation process, whose result was unfortunately and, in my opinion, not born out by the evidence of the unit's outputs.

An important dimension of the unit (that the 2013-2017 report presents in the International Leadership section) is the international visibility of its researchers. In particular I have followed the work of several of its key researchers such as Eduardo Tovar, Luis Miguel Pinho, Konstantinos Bletsas and Vincent Nélis, as well as of Luis Almeida, who has recently joined the unit and Stefan M. Petters, who left the unit towards the end of the period. The

dynamics of the group is very impressive. Since its inception, the reputation and visibility of the unit allowed them to attract highly skilled post-docs and invited scientists from reputed Universities, such as Chalmers, Virginia, Pennsylvania, Munich, Brussels, and my own group at York (both Bletsas and Petters have spent extended times at York).

Eduardo Tovar and Luis Almeida have been members of the relevant international technical committees in the areas of real-time and embedded systems, such as Euromicro, ACM SIGs and IEEE committees, for more than a decade; a clear statement of their role in the area. In the period, Eduardo Tovar was elected Vice-Chair of ACM Special Interest Group in Embedded Systems (ACM SIGBED) and Luis Almeida elected Vice-Chair of the IEEE Technical Committee on Real-Time Systems. Both are also General Chairs of CPS Week 2018, the premier international event on Cyber-Physical Systems, which joins together four of the top ACM and IEEE conferences in the area, and which will take place next April in Porto. In the period Tovar and Almeida have also been organizers of IEEE RTSS 2016, with Tovar being PC Chair of RTAS 2013, and Petters PC Chair of Euromicro ECRTS, the three most important world-wide events in real-time embedded systems.

On another topic, it is worthy of note CISTER's relevant contribution to the Ada programming language, both in terms of research as well as service to the community. Ada has always been directly connected, and a language of excellence, for critical real-time systems. Luis Miguel Pinho was Program Co-Chair of the International Conference on Reliable Software Technologies (Ada-Europe 2016), having in 2017 celebrated the 10<sup>th</sup> year as Editor-in-Chief of the Ada User Journal. Pinho is also member of the board of the Ada-Europe organization, and an expert on ISO/IEC JTC1/SC22/WG9, the working group responsible for the evolution of the language.

Another dimension to note, as pointed out in the Publications section of the report, is the publication strategy of the unit. Members of the research unit consistently publish high-quality papers in the most reputed journals and international events of the area. It is perceptible from the report that although continuing to target selective and highly relevant venues such as IEEE RTSS, IEEE RTAS, Euromicro ECRTS (as with many areas of Computer Science, in the area of embedded and real-time systems, it is more difficult and it has higher impact to publish in these top conferences), the unit made an effort to increase publication in top journals.

It is impressive to witness how the younger researchers of the unit, such Geoffrey Nelissen, Patrick Yomsi, Ricardo Severino and David Pereira have gained international visibility and recognition by engaging both with relevant responsibilities in conference services, as documented in the International Leadership section of the quinquennium report (pages 7-8) and through leadership of important components within relevant international projects as documented in the Projects section of the quinquennium report

I have also witnessed the steady growth of the PhD graduation activities at CISTER. It is important to note the increased visibility and quantity (maintaining top quality) of the research outputs coming from the graduation activities within the embedded and real-time systems stream in a doctoral program, in collaboration with the FEUP School, with more than 15 CISTER graduates in the last five years. This is a natural outcome of the program created by the unit in 2009, which obviously could not produce graduates before 3-4 years. As a result of the unit's work, CISTER has been able to participate in important international projects with industrial relevant partners. In the period I would like to specifically point out

the ECSEL EMC2 and DEWI projects, and the FP7 P-SOCRATES. Within EMC2, one of the largest European projects ever in the domains of multicores and critical systems, CISTER was deeply involved in both research activities in the impact of multicores in the correct timing behaviour of critical applications as well as involved in the industry-driven demonstrators in the automotive and avionics domains. In the DEWI project, also a large ECSEL project, on wireless sensor technology, CISTER was a core partner, leading the technical board and the aeronautics domain of the project, with CISTER researcher Ramiro Robles assuming that leading role. And finally of note, the P-SOCRATES FP7 project, led by CISTER, which tackled the challenge of parallel real-time computing. It is also important to note the more recent projects, such as Productive4.0, Enable-S3 (or SCOTT), which although more recent demonstrate the industrial networks of CISTER.

It is possible to see that both the research topics being tackled, as presented in the research highlights as well as the topics presented in the outlook plan, are in the forefront of international research. CISTER consistently drives to work at the cutting edge of research and on the internationally agreed hot topics. The unit has been doing foundational work in topics such as multiprocessor and parallel real-time scheduling, wireless sensor networks, and programming languages. In the future plan it is important to note that the topics which are laid out are part of the world-wide strategic and research roadmaps, such as mixed-criticality systems, high-performance real-time embedded systems, or the holistic view of time, energy and other non-functional properties of cyber-physical systems.

CISTER is therefore well positioned to continue its internationally recognized outstanding research activities. With the necessary tools and resources, I would expect them to sustain (and grow) their international reputation and leadership in the economic and societal important area of real-time embedded systems.



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