

Proceedings
TAEE2020

2020 XIV Technologies Applied to Electronics Teaching Conference (TAEE)

**XIV Congreso de Tecnologías Aplicadas a la Enseñanza de la
Electrónica**

XIV conferência em tecnologias aplicadas ao ensino da eletrónica

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at the Polytechnic of Porto – School of Engineering



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Preface

The TAEF conference will know in its 14th edition a historical moment. Not only it is the first time that it will be organized outside the Spanish territory, but we will also have the innovative experience of holding this conference in a purely virtual format, in this year's edition.

This choice was the possible solution to a clear and global problem, which arose suddenly during the preparation of the conference. The organization applied a typical engineering approach, instinctively seeing this new problem as an opportunity, and taking advantage of the constraints imposed to experiment with new solutions to novel issues.

We tried to create a different TAEF, not better nor worse, but one that benefits from emerging communication technologies, in order to create and energize an event where we will not be physically in the same place, but we can communicate and work together in a virtual way.

The greatest motivation of TAEF will always be the strong connections, dedication and motivation of the community and it is those factors that will allow success in this new way of collaborating and working together, but at a distance. This new philosophy requires an extra effort from the TAEF association and the local organization, but particularly from all the authors and participants who were asked to do more but in less time. The response was admirable, the participation remained vigorous and contributed with an extra effort that allowed us to move resolutely and decisively to this new format.

This year we also have an interesting set of invited speakers who mix the local and sustainable vision at the Polytechnic of Porto with the different and accumulated experience of those who are long ago members of the TAEF community and also an international and innovative vision where the teaching of electronics is suggested with new tools and methodologies.

A word to the city of Porto, where unfortunately the effects of the COVID19 virus did not allow the Porto Polytechnic to receive TAEF participants as we wished. It will not be possible to visit the beautiful downtown, get to know its historic neighborhoods and cafes, navigate the Douro River or stroll on old streets and bridges. The tradition of welcoming foreigners is strong in the city of Porto and it would have been a pleasure to hold this edition of TAEF in the rooms and spaces of the School of Engineering.

We cannot forget to acknowledge all the external entities that supported this edition of TAEF, including CIETI, SPEE, IEEE and particularly CISCO, which has made itself available to operationalize this online edition of TAEF in record time.

We also sincerely want to express gratitude to all those who participated in some way in the organization of this event, contributing with some of the scarce time of their already overloaded agendas.

Finally, our wishes that the conference will be successful, that it will join in productive work and collaboration professors and researchers from Portuguese, Spanish, Latin American universities, and others who have chosen to join us. In this way, we can all present, share and discuss experiences and activities in the teaching and learning of electronics and related engineering fields, and in this 14th edition we will do so in an innovative but also valuable and exciting new way.

Porto, July 7th, 2020
André Fidalgo and Gustavo Alves
Polytechnic of Porto / School of Engineering

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Keynote 3: Teaching and Learning Electronics with Remote Labs

Scientific Chair: Gustavo R. Alves

Technical Chair: André Fidalgo

Keynote Speakers

Electronics Education in the context of Sustainability

Higher education in general, and particularly in the electronics case, is at present in a very different position than several years ago. In the past, technology aimed to improve living conditions, in a way reasonably independently from their sustainability. These developments have had strong environmental implications, and it is now referred not to Development per se, but Sustainable Development. The design of functional units (e.g. cars, houses, factories) is no longer done in independent layers but in integrated and multidisciplinary projects. After fully exploring purely passive solutions, we need to move towards active solutions. Systems that traditionally working only in open loop (e.g., lighting) should now works in closed loop. Indeed, systems that are more sustainable have this behavior as a result of the massive introduction of electronics and information technologies. Thus, electronics is now seen not only as a means of increasing our comfort but as an unavoidable ally for Sustainable Development. The speech seeks to contextualize the importance of teaching electronics and presents some results from teaching experience.



Prof. Carlos Felgueiras received the B.S. and Ph.D. degrees in electrical and computer engineering from the Faculty of Engineering, University of Porto, Porto, Portugal, in 1987 and 2008, respectively. He started his professional career in 1987 as electronic designer for automation systems. Later, he was invited to supervise a test laboratory for verifying the accomplishment of European Standards in thermoelectric household appliances. He started the teaching activity in 1994 as Assistant Professor and later as Adjunct Professor and researcher in the Department of Electrical Engineering (DEE), School of Engineering (ISEP), Polytechnic of Porto (P.Porto), Porto, Portugal. His research interests include design for debug and test of mixed-signals,

remote experimentation in e-learning contexts, renewable energy sources and smart buildings. Prof. Felgueiras is member of the Portuguese Engineers Association and also the Global Online Laboratory Consortium (GOLC). He has published about 90 papers and he is a member of scientific committees of several national and international conferences. (email: mcf_at_isep.ipp.pt)

Teaching and Learning Electronics with Remote Labs

Remote experimentation fits into the Technology-Enhanced Learning (TEL) domain and thus is usually applied at Educational Institutions. This keynote will first explain what is (not) a remote laboratory and the implications that follow from this debate. After classifying the different types of remote experiments, their usage inside the classroom will be described in detail, in particular in the areas of electronics, control, and telecommunications, in Engineering Education. The main purpose is to explain how remote experiments fit into a lesson plan and the educational impact they have into the students' learning process. The presented examples will also demonstrate how to design a remote lab for experiments with electronics, i.e. the sort of equipment and architectures they require for being implemented. The keynote will end with a general overview of on-going projects in the field, the current and anticipated trends of remote experimentation, and the research groups currently active in this area. 2020 is the 25th anniversary of the coining of the "remote experimentation" expression, and as such a good opportunity to revisit the path done so far.



Prof. Javier Garcia Zubia is a professor at the University of Deusto, Bilbao (Spain), for more than 30 years. He is a full professor at the faculty of Engineering since 2011. His teaching interests are Digital Systems, including digital electronics, FPGAs and SoC. His research interests fall into two domains: remote experimentation and design of advanced digital systems. He has published several tenths of articles, having an WoS h-index=13 and a GoogleScholar h-index=37. He coedited 3 books about remote experimentation and he has participated in several R&D projects, funded by the regional government, the Spanish

government, the ERASMUS+ program, FP7, H2020, and NSF, among others. This intensive work has supported several invitations for delivering keynotes and receiving international recognition and awards. He has been a member of several editorial boards and program committees. He is a senior member of the IEEE. (email: zubia_at_deusto.es)

Approaching Field Programmable Gate Arrays with Deeds

Our experience in teaching a first year course of digital design shows that the introduction of Field Programmable Gate Arrays (FPGA) is advisable. Students demonstrate a better interest for the topics, if they can really verify the circuits they study and design. Traditional bread-board based prototyping is therefore replaced by FPGA programming, which is nowadays performed at professional level using Hardware Description Language (HDL). We are somehow critical of the current trend of introducing digital system with HDL. Our tool, Deeds (Digital Electronics Education and Design Suite) allows to configure FPGA boards for testing starting with traditional schematics-based entry, which is more compatible with the beginners' skills, and overcomes the pre-requisite of some proficiency in high-level programming languages. Deeds integrates FPGA configuration and testing into its design and simulation flow, making digital design, including microprocessor programming, demonstrable through a few commercially available FPGA boards. Tutorials and projects, designed for flexibility and self-learning, open up many possibilities to hands-on experiments and introduce the basic skills on which building HDL competences later on. Deeds was developed at DITEN, University of Genoa, and it is composed of a set of simulators and a wide collection of associated learning material, covering combinational and sequential logic networks, finite state machine design, microcomputer interfacing and programming. Deeds website: <https://www.digitalelectronicsdeeds.com/index.html>



Prof. Giuliano Donzellini received the Laurea degree in electronic engineering from the University of Genoa, Genoa, Italy, in 1980. After a few years as a design engineer with the Marconi firm, in Genoa, in 1983 he has been appointed Assistant Professor with the Department of Biophysical and Electronic Engineering of the University of Genoa. He has worked on automatic measurements, image analysis and process control systems, phase-locked digital systems, and speleological topographic surveying systems. Currently he is focusing on the development of simulation tools for digital electronics for educational applications (Deeds - Digital Electronics Education and Design Suite) that he exploits in his teaching activity. He has contributed his experience in several EU projects and is author or co-author of several research papers and, most recently, of the book "Introduction to Digital Systems Design" (Springer, 2019). (email: giuliano.donzellini_at_unige.it)

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