

**Special Issue with Papers of the Symposium on Instrumentation and Engineering Measurement within the IRF'09 Conference**

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Test rig and prototype development, use of measurement techniques and methodologies, measurement analysis, presentation and uncertainty evaluation, data acquisition and monitoring systems, data wireless communication and remote actuation are essential in engineering areas as well as in many other related fields where measurements are crucial. Because of the relevance of these aspects they are also very important in higher education engineering curricula. So, the Symposium on Instrumentation and Engineering Measurement fits within the objectives of the 3rd International Conference on Integrity, Reliability & Failure – IRF'2009 and is part of the scope of the research Unit of System Integration and Process Automation (UISPA), coordinated by the symposium organizer. UISPA integrates the Institute of Mechanical Engineering (IDMEC) at the Faculty of Engineering of University of Porto (FEUP), Portugal.

The Symposium papers range from large structural analyses to detailed case studies which report on the application of procedures, technologies and concepts. Some of the papers dealing with on-line systems for educational purposes are collected in the present iJOE special issue.

It starts with two extended abstracts, which briefly present the topic of the two invited keynotes: Susan Zvacek, from Kansas University, within the Distinguished Lecturer Program (DLP) from IEEE Education Society and Dieter Muller from Bremen University.

**Susan Zvacek** explores the pair “What are my students going to do?” in order to reach the main goals / “What am I going to do?” to support the relevance of teachers choosing the first alternative rather than the second as so frequently happens. She highlights the excellent opportunity of stimulating real student engagement through on-line courses, an “unprecedented “chance for bringing them so many resources, such as “on-line labs, remote-access content repositories and collaborative interaction tools.” And illustrates clearly how on-line courses/resources are so embedded in important concepts provided by the constructivist theory, how they may be explored for “tying theory to practice” and how they can be significant to “diagnose problems” in the real world. A strong emphasis is given to the “design instruction – in on-line or face-to-face” approaches. Finally a few “guidelines may prove helpful to start” when beginning on-line teaching.

**Dieter Muller** presents the relevance and the meaning of “integration of physical and digital worlds in a single environment” named Mixed Reality and how they have been used “to support seamless collaborative work between remote and hands-on laboratories.”

In fact the perception of the concept is very well supported by saying “The Mixed Reality approach brings the virtual world of computers into the physical world of human activity”. The interesting primordium of these developments comprised the interaction between simulations and real-life videos. “Later on, interfaces were developed, which sense and generate real-life data being exchanged between virtual objects and their physical counterparts”. Several examples could be described, not only the “Mixed Reality Lab for e-pneumatics” presented by Dieter Muller but also the collaborative work between the team at UISPA – IDMEC/FEUP and Liliane Machado’s team at Universidade Federal de Paraíba, in Brazil.

The paper “**Experimental Study of Groundwater Flow**” explains how an experimental prototype was designed, produced, assembled and tuned in a Civil Engineering Department. Its scope is to permit the visualization of phenomena associated with groundwater flow. The experimental results are successfully replicated by a finite element model and both are available for online use during lectures – the first for demonstrative sessions using an IP camera and Skype communication tool, the second by free access to the simulating software. The prototype was conceived and produced in a project based learning approach within the framework of a master thesis and resulted in a low cost solution when compared to the market available ones. The experimental measurement values from 48 pressure taps are very close to the corresponding simulation results. Flow line visualization is achieved by dye injection in the granular soil replicating remarkably the corresponding results from finite element analysis of the problem performed with the specific software application.

The paper “**Portuguese Universities Sharing Remote Laboratories**” reports a pedagogical assignment involving teachers/students from two Portuguese universities. This assignment is an interesting case study of a cooperative collaboration on the use of remote labs. The work describes the pedagogical assignment design, summarizes the remote experiments accessed for measuring physical quantities as force, strain, deflexion, Young modulus, straightness evaluation and meteorological quantities. Finally, the work reports teacher thoughts as well as student comments considering, in this case, an inquiry specifically developed for evaluating the pedagogical efficiency of on-line labs in engineering courses, in close cooperation with the Faculty of Educational Sciences of Universidade do Porto. The ten selected items considered of relevance in the scope of remote labs are presented and the results are reported. Free comments from students are also registered.

The paper “**Virtual Laboratories for a Course about Indoor Environmental Quality**” describes a set of applications specifically developed by the author for the Indoor Environmental Quality course within a “Master programme on Energy for Sustainability and a Ph. D. programme on Sustainable Energy Systems at the University of Coimbra”, both included on the “MIT-Portugal Initiative educational programme”.

The applications were developed using LabVIEW software, either for modeling physical processes or for data acquisition. The phenomena in which rely the applications are detailed along the text. The work also reports the student increase of enthusiasm in topics included in the Indoor Environmental Quality course. The applications were used either during explanatory classes or accessed online.

The student enthusiasm justifies the present efforts for creating the real remote set-ups in the near future, at the Department of Mechanical Engineering of Universidade de Coimbra.

The paper “**Matlab Based Remote Control of Thermo-Optical Plant**” presents an approach for the remote control of Thermo-Optical Plant within remote labs at the Faculty of Electrical Engineering and Information Technology, Slovak University of Technology, in Bratislava. This experiment intends to control a bulb temperature and its light intensity and allows the direct measurement of bulb and room temperature, the fan current and its rotational speed. The system is conceived in order to communicate with a computer by a common USB port. Due to the experiment structure and to the process dynamics the data transfer rate is quite acceptable and the control algorithm, if written using the “Matlab Fcn” blocks from Simulink, permits “its quasi-continuous control”. This approach is briefly

explained and it has been recognized that other problems, as the booking system and the experiment hardware safety protection, have not yet been considered.

The paper **“Real-Time Management and Control of a Bus Public Transport Network: the STCP Experience”** is included in this issue considering the interesting system which is described, illustrating how real-time remote monitoring and control and decision support is a fundamental tool in such an everyday public life service. The SAEI system provides automatic vehicle location by GPS and uses an efficient mobile communications network. In this sense it is an excellent example for highlighting the pedagogical interest of the use of some experimental remote systems developed and dedicated for learning processes. The work describes briefly the fleet tracking and management systems used in the main bus operator in Porto Metropolitan Area (STCP). The work reports some architectural and functionality aspects, emphasizes the relevance of accessing real-time information and subsequent analysis of obtained data for an extended “control, management and regulation functions for passenger information and services, still enabling its “integration with other” STCP available systems. This last particularity grants to the system innovative characteristics.

The paper **“Teaching Kinematics and Dynamics of Multibody Mechanical Systems using the Object Oriented Language Modelica”** supports the use of software Dimola utilizing the non-proprietary and open source object oriented language Modelica, developed for simulating complex mechanical, electrical and electronics, hydraulics, thermal and control systems, for educational purposes. It is interesting to note that the use of Modelica has also been spreading into the industrial field as is the case of automotive companies: Audi, BMW, Daimler, Ford, Toyota and VW. It has been employed in energy efficient vehicle design and/or for improving air conditioning systems. This particular aspect reinforces the work relevance.

A set of multibody simulation systems are described: a simple pendulum, a four-bar mechanism and a cylinder engine. The work highlights the student engagement for this type of graphical software and the relevance of the virtual reality which can be achieved with it.

Finally, the paper **“Measurement Rounding Errors in an Assessment Model of Project Led Engineering Education”** analyzes the rounding errors that occur in assessment procedures of an interdisciplinary Project-Led Education process implemented in an Engineering course. The assessment model is based on multiple evaluation components with different weights. In the present work, the measurement process is related to the application of the assessment model in order to obtain a result, i.e. the students' final grade. This analysis intends to improve not only the reliability of the assessment results, but also teachers' awareness to this problem. Presented as a general problem of engineering assessment it could also be extended to future student assessment in on-line components.

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The Guest Editor:

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