RTSI 2015

Tutorial Program

TUTORIAL 1: Co-simulation of Power System and Communications Networks for Smart Distribution Planning and Operation Studies

Date: Thursday, September 17
Time: 10.30-12.15
Location: Room 205

Summary: The co- simulation approach usually involves the integration of two or more simulators to capture the cyber physical dependency of a process. In this specific tutorial co-simulation refers to the simultaneous simulation of power system and communications networks. At the time of this writing, very often each system is simulated separately with each study discipline assuming the other works perfectly. Simulations capturing the operation and interactions of both systems will likely be needed to fully assess the potential reliability benefits and impacts. Interactive simulation utilizing existing distribution and cyber simulation platforms, or co-simulation, is a potential avenue for performing proper smart distribution planning and operation studies

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Speakers: **Fabrizio Pilo,** Universita' di Cagliari, Cagliari (Italy)
Emilio Ghiani, Universita' di Cagliari, Cagliari (Italy)

Biography: FABRIZIO PILO is Full Professor of Power Systems at the Department of Electrical and Electronic Engineering (DIEE) of the University of Cagliari from October 2014. He graduated in Electrical Engineering at the University of Cagliari in 1992 (magna cum laude); in 1998 he earned the Ph.D. from the University of Pisa. In 1996 he became Assistant Professor at the DIEE, in 2001 became Associate Professor. Fabrizio Pilo has 20 years experience in the field of power distribution planning and development. He was one of the advisors of the Italian Regulatory Agency with reference to the implementation of Smart Grid in the Italian power system. He is the Chairman of the CIRED Session 5, Distribution System Development and Convener of the CIGRE WG C6.19 – Planning for Active Distribution Systems. He is IEEE Senior Member and AEIT member. Prof. Pilo is author of more than 150 papers, published in international journals or presented in national and international conferences. He is registered professional engineer and consultant.

Biography: EMILIO GHIANI received is Ph.D in Electrical Engineering and Computer Science in 2005 from University of Cagliari, where currently is an Assistant Professor of Power System at the Department of Electrical and Electronic Engineering (DIEE).His research focuses mainly on the development of methodologies and tools for decision making process in planning and operation of power distribution networks with large penetration of distributed energy sources. His research interests include co-simulation of power and communication system related to Smartgrid operation (e.g., automatic control of voltage and frequency, demand response and management of storage devices).He is author of about 60 papers published on international journals or presented in various national and international conferences. He is IEEE and AEIT member.

TUTORIAL 2: Solving Power Flow and Optimal Power Flow Problems in The presence of Data Uncertainty by Affine Arithmetic

Date: Thursday, September 17
Time: 14.00-15.45
Location: Room 205

Summary: Optimal power system operation requires intensive numerical analyses to study and improve system security and reliability. To address this issue, Power Flow (PF) and Optimal Power Flow (OPF) analyses are important tools, since they are the foundation of many power engineering applications. For the most common formalization of these problems, the input data are specified using deterministic variables resulting either from a snapshot of the system or defined by the analyst based on several assumptions about the system under study. This approach provides problem solutions for a single system state, which is deemed representative of the limited set of system conditions corresponding to the data assumptions. Thus, when the input conditions are uncertain, numerous scenarios need to be evaluated. To address the aforementioned problem, this Tutorial analyzes solution methodologies based on the use of Affine Arithmetic (AA), which is an enhanced model for self---validated numerical analysis in which the quantities of interest are represented as affine combinations of certain primitive variables representing the sources of uncertainty in the data or approximations made during computations. In particular, AA---based techniques are analyzed to solve uncertain PF and OPF problems. The main idea is to formulate a generic mathematical programming problem under uncertainty by means of equivalent deterministic problems, defining a coherent set of minimization, equality and inequality operators.
Compared to existing solution paradigms, this formulation presents greater flexibility, as it allows to find partial solutions and inclusion of multiple equality and inequality constraints, and reduce the approximation errors to obtain better PF and OPF solution enclosures.

Speaker: **Alfredo Vaccaro,** University of Sannio, Benevento (Italy)

Biography: ALFREDO VACCARO (M'01, SM'09) received the M.Sc. degree with honors in electronic engineering from the University of Salerno, Salerno, Italy, and the Ph.D degree in electrical and computer engineering from the University of Waterloo, Ontario, Canada. From 1999 to 2002, he was an Assistant Researcher at the University of Salerno, Department of Electrical and Electronic Engineering. From March 2002 to October 2015, he was an Assistant Professor in electric power systems at the Department of Engineering of the University of Sannio, Benevento, Italy, where he is currently an Associate Professor of electrical Power System. His special fields of interest include soft computing and interval---based method applied to power system analysis, and advanced control architectures for diagnostic and protection of distribution networks. Prof. Vaccaro is a member of the Editorial Boards of IET Renewable Power Generation, and the International Journal of Reliability and Safety, and he is the Executive Editor of
The International Journal of Renewable Energy.

TUTORIAL 3: Power Efficiency in the Design of IoT Devices

Date: Friday, September 18
Time: 8.30-10.00
Location: Room 205

Summary: In the future, objects and people will be almost permanently connected and exchanging information in the so called Internet of Things (IoT). While the potential influence of IoT in our daily life is enormous, there are major challenges related to its energy sustainability The evolution of battery energy density is below the curve of Moore's law thus making power consumption the limiting factor of next-generation smart systems. Furthermore, technology allows integrating various types of energy harvesting devices, which are able to scavenge energy from the environment thus potentially compensating the increased gap between the energy demand and its availability.
Contents: Introduction to smart systems for IoT: examples and design challenges; optimizing energy consumption I: power management; optimizing energy consumption II: trading off accuracy for energy consumption; energy storage devices: overview and their efficient management; energy generation devices: overview and their efficient management; sensors and actuators: issues and energy challenges.

Speakers: **Enrico Macii**, Politecnico di Torino (Italy)
Massimo Poncino, Politecnico di Torino (Italy)
Michelangelo Grosso, ST-Polito s.c.a.r.l. (Italy)

Biography: ENRICO MACII is a Full Professor of Computer Engineering at Politecnico di Torino. Prior to that, he was an Associate Professor (from 1998 to 2001) and an Assistant Professor (from 1993 to 1998) at the same institution. From 1991 to 1997 he was also an Adjunct Faculty at the University of Colorado at Boulder. He holds a Laurea Degree in Electrical Engineering from Politecnico di Torino (1990), a Laurea Degree in Computer Science from Università di Torino (1991) and a PhD degree in Computer Engineering from Politecnico di Torino (1995). Since 2007, he is the Vice Rector for Research and Technology Transfer at Politecnico di Torino, and since 2012 also the Rector's Delegate for International Affairs. His research interests are in the design of electronic digital circuits and systems, with particular emphasis on low-power consumption aspects. In the fields above he has authored around 450 scientific publications including the book: "Ultra Low-Power Electronics and Design", published by Kluwer in 2004. Enrico Macii is a Fellow of the IEEE.

Biography: MASSIMO PONCINO is a Full Professor of Computer Engineering at Politecnico di Torino. His research interests include several aspects of design automation of digital systems, with particular emphasis on the modeling and optimization of low-power systems. He is the author or coauthor of more than 250 journal and conference papers, as well as a book on low-power memory design. He is an Associate Editor of the ACM Transactions on Design Automation of Electronic Systems and of IEEE Design & Test. Prior to that, he was an Associate Editor of IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (2006-2012). He was the Technical Program Co-Chair (in 2011) and the General Chair (in 2012) of the ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED). He serves on the Technical Program Committee of several IEEE and ACM technical conferences, including DAC, ICCAD, ISLPED, DATE, ASP-DAC, GLSVLSI, and CODES-ISSS.

Biography: MICHELANGELO GROSSO, R&D Engineer. Michelangelo Grosso graduated with a Master degree in Electronic Engineering (cum laude) and a PhD degree in Computer and System Engineering, both from Politecnico di Torino, in 2004 and 2008 respectively. From 2008 to 2011, he worked as post-doc researcher within the Department of Control and Computer Engineering of Politecnico di Torino. In January 2012, he joined ST-PoliTO, a research center resulting from the joint venture between STMicroelectronics and Politecnico di Torino, as Application Development Engineer. He has been working on smart system design since then, also within EU-funded projects (FP7 SMAC, DIMMER, CONTREX). His research interests are in the design automation of digital circuits and systems, test, dependability and power efficiency. In these fields, he has co-authored a book chapter and over 50 scientific publications on peer-reviewed international journals and conference proceedings.

TUTORIAL 4: Low-Noise Impedance Sensing: Circuits and Micro-Technological Applications

Date: Friday, September 18
Time: 10.30-12.00
Location: Room 205

Summary: starting from a review of the basics of impedance and its classic applications in macro-scale industrial environment, novel sensor miniaturization trends and related challenges are illustrated. Along with the increasing impact of parasitics, the amplitude of detectable signals decreases, demanding for low-noise front-ends. The limits of the classic transimpedance amplifier are discussed along with advanced analog topologies (integrator-differentiator cascade with continuous-time or discrete reset networks) that allow increasing the sensing speed while preserving high resolution. Optimal signal recovery by means of the lock-in synchronous detector (analog vs. digital implementation) is reviewed together with calibration and compensation issues. Design criteria of state-of-the-art CMOS integrated vs discrete-component implementations are discussed. The effectiveness of the proposed high-resolution impedance sensing solutions is illustrated in three major applications examples: (1) label-free detection of biological cells growing in static cultures or flowing in microfluidic channels, (2) capacitive detection and sizing of single airborne particulate matter (PM10) in custom-designed micro-capacitors, (3) contact-less transparent monitoring of the optical power of light propagating in silicon photonic platforms for reconfiguration of complex photonic circuits and closed-loop stabilization of optical devices.

Speaker: **Marco Carminati**, DEIB, Politecnico di Milano (Italy)

Biography: MARCO CARMINATI, received B.Sc. and M.Sc. both cum laude in Electronic Engineering from Politecnico di Milano in 2003 and 2005 respectively. Member of IEEE since 2007, received PhD in Electronics in 2010 with full marks. In 2008 he was awarded a Rocca Fellowship and spent a semester at the Massachusetts Institute of Technology (MA, USA) working at RLE on BioMEMS and microfluidics. Since 2010 he is senior post-doctoral fellow at Dipartimento di Elettronica, Informazione e Bioingegneria of Politecnico di Milano working in the field of sensors and low-noise circuits and innovative instruments for current (femtoAmpere resolution) and impedance (zeptoFarad) measurements with application to micro- and nano-(bio) science. Since 2014 he is member of GE association and contract professor of the Biochip master course at Politecnico di Milano. He is author of about 60 peer-reviewed publications, 5 book chapters and holds one patent in the field of silicon photonics. Since 2015 he serves as secretary of the TC-34 “Nanotechnology in Instrumentation and Measurement” of the IEEE I&M Society.

TUTORIAL 5: The Challenge of Thriving on Uncertainty in Systems Research and Innovation

Date: Friday, September 18
Time: 14.15-15.45
Location: Room 205

Summary: Over the last few years, integration of stochastic methods into a multi-scale framework (from macro-scale to nano-scale) or development of multi-scale models in a stochastic setting for epistemic uncertainty quantification (UQ) is becoming an emerging research frontier for systems modeling, innovation and competitive development in Science and Technology. Traditional human approach to experience is based on decision making in a natural uncertain environment by incomplete knowledge. Stochastic vs. Combinatorially Optimized Noise ambiguity emphasises the current major double-bind problem, even in most advanced research laboratories and instrumentation systems, just at the inner core of human knowledge extraction by experimentation. To design and develop more robust, resilient and antifragile cyber-physical system, we can use novel tools to combine effectively and efficiently analytical asymptotic exact global solution panoramas to deep local computational precision achievement.
This tutorial presents fundamental concepts, inter- and trans-disciplinarity modeling examples to show how both information science and engineering can give a fundamental contribution to enhance relational competence for current innovative system development and beyond, towards a more sustainable economy and wellbeing, in a global competition scenario.

Speaker: **Rodolfo A. Fiorini,** Politecnico di Milano (Italy)

Biography: RODOLFO A. FIORINI, obtained his Ph.D. degree in Energetics from Politecnico di Milano University, in 1984. The U.S.A. DOL appointed him with the Ph.D. degree in Bioengineering in 1989. A senior member of the IEEE and the EMBS, Dr. Fiorini is currently tenured professor at the Department of Electronics, Information and Bioengineering (DEIB) at Politecnico di Milano University, Milano, IT where he founded the Research Group on Computational Information Conservation Theory (CICT), and he is responsible for the main course on Wellbeing Technology Assessment. His current research interests include biomedical cybernetics, neuroscience, wellbeing, consciousness, nanoscience, computer simulation techniques, information theory, anticipatory learning systems, networked-control systems, machine learning, machine intelligence, statistical and deterministic signal processing, statistical and combinatorial optimization techniques, decision support systems, advanced management systems. Author of more than 230 national, international, scientific and technical, articles, papers, seminars, presentations and books.