IWoCPS - 5

THE FIFTH INTERNATIONAL WORKSHOP ON CYBER PHYSICAL SYSTEMS

Romanian Academy

Bucharest, Romania

May 26, 2016

PROGRAMME

THE FIFTH INTERNATIONAL WORKSHOP ON CYBER PHYSICAL SYSTEMS

We have a great pleasure to invite you to participate in the Fifth International Workshop on Cyber Physical Systems (IWoCPS-2016). IWoCPS-2016 covers the latest advances in Cyber Physical Systems. The ultimate aim is to stimulate research that will lead to the creation of responsive environments for networking and, at longer-term, the development of Cyber Physical Systems. We envision that the cyber-physical systems of tomorrow will far exceed those of today in terms of adaptability, autonomy, efficiency, functionality, reliability, safety, and usability.

Research advances in cyber-physical systems promise to transform our world with systems that respond more quickly (e.g., autonomous collision avoidance), are more precise, work in dangerous or inaccessible environments (e.g., autonomous systems for search and rescue, firefighting, and exploration), provide large-scale, distributed coordination (e.g., automated traffic control), are highly efficient (e.g., zero-net energy buildings), augment human capabilities, and enhance societal wellbeing (e.g., assistive technologies and ubiquitous healthcare monitoring and delivery).

ORGANIZERS

Romanian Society of Control Engineering and Technical Informatics (SRAIT)
Romanian Academy – Information Science and Technology Section

INTERNATIONAL PROGRAMME COMMITTEE

Ioan Dumitrache – General Chair, SRAIT,Romania
Florin Filip – General Co-Chair, Romanian Academy

Horia Teodorescu (RO)
Radu Mărculescu (USA)
Nicolae Ţăpuş (RO)
Mihail Voicu (RO)
Pedro Albertos (ES)
Georgi Dimirovski (MK)
Doina Banciu (RO)
Joanna Kolodziej (PL)

LOCAL ORGANIZING COMMITTEE

Alexandru Dumitraşcu
Florin Pop
Ioan Sacală
Simona Caramihai
Mihnea Moisescu

CONFERENCE WEB-SITE

http://iwocps.hpc.pub.ro

IWoCPS - 2016 TIME TABLE

Thursday, May 26, 2016

9.00 – 17.00	Registration
9.30 – 9.45	Opening Ceremony
9.45 – 11.30	Workshop session
11.30 – 12.00	Coffee break
12.00 – 13.45	Workshop session
13.45 – 15.00	Lunch
15.00 – 16.45	Workshop session
16.45 – 17.00	Closing Ceremony

Thursday, May 26, 2016

Workshop session I
Session Chairs: Florin Filip, Simona Caramihai – Romania
Thursday, May 26, 2016, 9:45 – 11:30

I.1 A Conceptual Framework for Modeling and Design of Cyber-Physical Systems
Ioan Dumitrache, Simona Caramihai, Ioan Șt. Sacală, Mihnea A. Moisescu – Romania

I.2 Deep Learning and Big Data in the Context of Cyber-Physical Systems
Dragoș C. Popescu, Ioan Dumitrache – Romania

I.3 Vision-based Perception Systems for Automated Guided Vehicles
Szilard Mandici, Robert Varga, Andrei Vatavu, Sergiu Nedevschi – Romania

I.4 Control Strategies for Synchronous Generation of Resistive Loads Correlated to the Robot Motion Environment
Sergiu Boris Cononovici, Victor Vladareanu – Romania,
Hongbo Wang, Yongfei Feng – China

I.5 Some Aspects of Power Grid Stability in the Context of Cyber Attacks
Delia Ioana Dogaru, Ioan Dumitrache – Romania

Workshop session II
Session Chairs: Sergiu Stelian Iliescu, Ioan Șt. Sacală – Romania
Thursday, May 26, 2016, 12:00 – 13:45

II.1 WaterML based Web Service for a SCADA Federation
Szilárd Enyedi, Iulia Ștefan, Liviu Miclea, Andrei Scurtu, Ioan Stoian and Dorina Căpățînă – Romania

II.2 WaterML in a SCADA Federation
Iulia Ștefan, Andrei Scurtu, Szilárd Enyedi, Liviu Miclea, Ioan Stoian, Dorina Căpățînă - Romania

II.3 Building Cyber-Physical Energy Systems
Grigore Stamatescu, Iulia Stamatescu, Nicoleta Arghira, Vasile Calofir, Ioana Fagarasan – Romania

II.4 Modern Control and Protection System of Smart Grid Solutions: an Application of Cyber Physical Systems

Iulia Constantin, Ionela Dragomir, Nicoleta Arghira, Iulia Stamatescu, Sergiu Stelian Iliescu, Ioana Făgărașan – Romania

II.5 Cyber Threat Assessments at Nuclear Facilities

Dragos Ionica – Romania

Workshop session III

Session Chairs: Ioan Dumitrache, Mihnea A. Moisescu – Romania

Thursday, May 26, 2016, 15:00 – 16:45

III.1 Intelligent Vehicle Highway in Cyber-Physical Systems Context

Adrian Ungureanu, Ioan Dumitrache, Simona Caramihai – Romania

III.2 Some aspects about VANET security threats and solutions: A Resume

Ion Nicolae Stăncel – Romania

III.3 Precision Agriculture Based on Internet of Things Principles

Ioan Dumitrache, Simona Caramihai, Mihnea A. Moisescu, Ioan Șt. Sacală – Romania

III.4 Autonomous Robots for Health Monitoring, Fire Fighting and Search Missions

Dan Necsulescu, Jurek Sasiadek, Elisha Pruner, Guanqi Nie, Vijay Surabhi, Xuqing Le, Adeel Rehman, Yu Hu – Canada

Book of Abstracts

A conceptual framework for modeling and design of Cyber-Physical systems

Ioan Dumitrache, Simona Caramihai, Ioan Stefan Sacala, Mihnea Alexandru Moisescu

Faculty of Automatic Control and Computers,
University Politehnica of Bucharest,
Bucharest, Romania
e-mails: ioan.dumitrache@acse.pub.ro, caramihai2002@yahoo.com,
ioan.sacala@acse.pub.ro, mamihnea@gmail.com

Abstract – Systems that can tightly integrate physical with virtual components have represented a priority for the research in the area of ICT. Research efforts have been concentrated in domains such as: Internet of Things, Internet of Services and recently in the domain of Cyber Physical Systems. An important driver for the area of research is represented by the large-scale integration of the physical and cyber worlds. The authors propose a Generic System Architecture by taking into account the paradigms of Cyber-Physical Systems.

Deep learning and big data in the context of Cyber Physical systems

Dragoș C. Popescu[1,2], Ioan Dumitrache[1]

[1]Automatic Control and Systems Engineering Department,
University Politehnica of Bucharest
[2]Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering (IFIN-HH)

Abstract – Cyber Physical Systems Paradigm promises to be one of the greatest breakthroughs from the industrial revolution since today. Although it is still in the development phase, during the last decade many important results were achieved. This paper focuses on Deep Learning as one of the most important Big Data Analytics method which is extensively studied and used in complex applications these days. There are considered approaches of using Deep Learning in CPS applications that could bring benefits in modeling and design of such systems but also in complex control applications.

Vision-based perception systems for automated guided vehicles

Szilárd Mandici, Robert Varga, Andrei Vatavu, Sergiu Nedevschi

Technical University of Cluj-Napoca
{szilard.mandici, robert.varga, andrei.vatavu, sergiu.nedevschi}@cs.utcluj.ro

Abstract — This paper presents an overview of how vision-based perception using stereo cameras can enable efficient and robust on-board perception for Automated Guided Vehicles (AGVs) used in factory logistics. First, available perception solutions are presented together with their limitations. Next, user issues are discussed related to the problems that arise in the currently employed systems. Afterwards, proposed solutions are presented to several key issues related to on-board perception. In order to enable the detection of hanging and protruding objects the 2D safety laser scanners are enhanced by fusing their output with the 3D object information provided by omnidirectional stereo cameras mounted downwards looking on an on-board pole. The stereo reconstructed environment is modeled via a probabilistic digital elevation map allowing more accurate object detection, classification and tracking. Load handling operations are treated by special purpose stereo cameras mounted under the forks. Pallet detection is performed by considering both 2D intensity information and 3D reconstructed points. The system performance evaluation demonstrates successful integration of the perception system with the AGV.

Control strategies for synchronous generation of resistive loads correlated to the robot motion environment

Sergiu Boris Cononovici[1], Victor Vladareanu[1], Hongbo Wang[2], Yongfei Feng[2]

[1] Dept. of Robotics and Mechatronics
Institute of Solid Mechanics of the Romanian Academy
Bucharest, Romania
[2] Parallel Robot and Mechatronic System Laboratory
Yanshan University
Qinhuangdao, China
e-mail: vladareanuv@gmail.com

Abstract — The paper presents the design and simulation of load profiles for a given mechatronic chain and the control strategies for this manipulator in the robot motion environment. The resulting dynamic model is then tested on a complex actuator system, with the aim of simulating various scenarios of actual robotic movement. The work presented herein is part of a larger effort to design and implement a virtual programmable robotic platform, as will be discussed throughout the paper.

Some aspects of power grid stability in the context of cyber attacks

Delia Ioana Dogaru, Ioan Dumitrache

Department of Automatic Control and Systems Engineering
Faculty of Automatic Control and Computer Science
University Politehnica Bucharest
Bucharest, Romania
e-mails: di.dogaru@gmail.com, ioan.dumitrache@acse.pub.ro

Abstract — The power grid is changing structurally adopting the use of information and communication technologies migrating to a more capable smart grid to deliver quality power to its consumers. With the continuous improvements of the power sector there are some aspects of power grid stability issues determined by cyber security vulnerabilities. In this paper different types of attacks on the power grid are presented and their impact on the generation, transmission, distribution and consumption. Also, we analyze some stability concerns (rotor speed, voltage, frequency stability) when the power grid faces different classes of cyber-attacks through simulations in MATLAB/Simulink to underline the severity that cyber-attacks have on different levels: control, communication, software, hardware.

WaterML based web service for a SCADA federation

Szilárd Enyedi[1], Iulia Ștefan[1], Liviu Miclea[1], Andrei Scurtu[1], Ioan Stoian[2], Dorina Căpățînă[2]

[1] Technical University of Cluj-Napoca
Cluj-Napoca, Romania
[2] IPA S.A., Cluj-Napoca subs.
Cluj-Napoca, Romania
e-mails: {Szilard.Enyedi, Iulia.Stefan, Liviu.Miclea}@aut.utcluj.ro
scurtuandrei@rocketmail.com, stoian@automation.ro, dorina@automation.ro

Abstract — Large scale, water management infrastructures have various parts – water collection, distribution, wastewater treatment, to name a few. Being so large, these systems have their own SCADA monitoring and control structures. However, these systems also depend on each other, so they need to communicate and, also, external authorities need to extract information from them. If these systems were connected in a federation, or, software wise, a cloud, they could interchange data easier, among each other and with authorized externals. This paper describes a web service, developed to offer controlled access to the resources of a multi-member federation of SCADA systems. Access to the federation and its data is through a single point of entry and is curated by gateways. The web service returns the requested data in WaterML format, an XML standard specific to water systems.

WaterML in a SCADA federation

Iulia Ștefan[1], Andrei Scurtu[1], Szilárd Enyedi[1], Liviu Miclea[1], Ioan Stoian[2], Dorina Căpățînă[2]

[1] Technical University of Cluj-Napoca
Cluj-Napoca, Romania
[2] IPA S.A., Cluj-Napoca subs.
Cluj-Napoca, Romania
e-mails: iulia.stefan@aut.utcluj.ro, scurtuandrei@rocketmail.com,
{szilard.enyedi, liviu.miclea}@aut.utcluj.ro, stoian@automation.ro, dorina@automation.ro

Abstract — Hydrological measurements sourced from different systems are heterogeneous in nature. The F2S project proposes connecting SCADA systems on the Someș river basin, into a federation. One goal is unifying the data transfer format between the federation members. This paper presents the analysis of the data encapsulation formats and exemplifies, with actual data from the federation, the WaterML format chosen for these hydrologic data structures.

Building Cyber-Physical energy systems

Grigore Stamatescu, Iulia Stamatescu, Nicoleta Arghira, Vasile Calofir, Ioana Făgărășan

Department of Automatic Control and Industrial Informatics
University ”Politehnica” of Bucharest, Romania
e-mails: {grig, iulia, nicoleta, vasile, ioana}@shiva.pub.ro

Abstract — The built environment, as hallmark of modern society, has become one of the key drivers of energy demand. This makes for meaningful application of novel paradigms, such as cyber-physical systems, with large scale impact for both primary energy consumption reduction as well as (micro-) grid stability problems. In a bottom-up approach we analyze the drivers of CPS design, deployment and adoption in smart buildings. This ranges from low-level embedded and real time system challenges, instrumentation and control issues, up to ICT security layers protecting information in a world of ubiquitous connectivity. A modeling and predictive control framework is also discussed with outlook of deployment for HVAC optimization to a new facility for research from our campus.

Modern control and protection system of smart grid solutions: an application of Cyber Physical systems

Iulia C. Constantin[1], Ionela M. Dragomir[1],
Nicoleta Arghira[2], Iulia Stamatescu[2], Sergiu Iliescu[2], Ioana Fagarasan[2]

[1] Protection and Automation Department
National Dispatching Center, Transelectrica
Bucharest, Romania
[2] Department of Automatic Control and Industrial Informatics,
Faculty of Automatic Control and Computer
University "Politehnica" of Bucharest,
Bucharest, Romania
e-mails: iulia.constantin@transelectrica.ro, ionela.dragomir@transelectrica.ro
{nicoleta, iulia, iliescu,ioana}@shiva.pub.ro

Abstract — The cyber physical systems concept, defined as an integration of computation, networking and physical process, can be retrieved in many power systems applications, due to its important advantages related to efficiency, dependability and rapidity. The paper aims to underline the advantages of this concept in an integrated application of protection and control in a modern, digitized transmission substation of an electrical power system.

Cyber threat assessments at nuclear facilities

Offensive scenario for critical infrastructures

Dragoș Ionica

University Politehnica of Bucharest
dragos.ionica@cyberint.ro

Abstract — In order to promote awareness, this article presents a technical scenario that can be used by a group of hackers to compromise a critical infrastructure, by hacking the physical access systems and then get into the process network to access the critical data and compromise it. Greater awareness is needed in regard to understanding realistic cyber threats impacting nuclear security, what are plausible attack scenarios and which are the possible targets, possible physical compromises that could be assisted by cyber attacks (including operations such as generation, transportation, storage, etc.) and how to enhance nuclear security programs with regards to computer security – prevention, detection, and response.

Intelligent vehicle highway in Cyber-Physical systems context

Adrian I. Ungureanu, Ioan Dumitrache, Simona Caramihai

Department of Automatic Control and Systems Engineering
University "Politehnica" of Bucharest
Romania, Bucharest
e-mails: adrian.ungureanu91@gmail.com,
ioan.dumitrache@acse.pub.ro, simona.caramihai@aii.pub.ro

Abstract — Problems of traffic congestions, due to increasing traffic demand still exists in modern societies. Over 20 years of research in transportation systems resulted in a number of architectures that aim at enabling efficient use of the existing transportation infrastructure in an autonomous fashion. At the same time, a number of open problems still exist e.g. scalability impact on performance, robustness etc. With the technological advancement regarding communication, processing and modelling systems a new paradigm has been raised, Cyber-Physical Systems (CPS). They are embedded computers and networks that monitor and control physical systems, with feedback loops, where physical systems influence computation and computation systems influence physical world. This new paradigm enables the design of a new approach of management and control systems for highway traffic. This paper will make an overview of some architectures, presents a number of current research problems in the field and proposes a new framework in the context of Cyber-Physical Systems.

Some aspects about VANET security threats and solutions: a resume

Ion Nicolae Stăncel

Remote Control and Electronics in Transport Department,
University Politehnica of Bucharest
Bucharest, Romania
e-mail: ion.stancel@upb.ro

Abstract – Due to recent advances in software, hardware and communication technologies, a whole new range of different types of networks are being tested, studied and deployed in various environments. The Vehicular Ad-Hoc Network (VANET) is one of those networks that received a lot of interest in the last couple of years. VANETs promise a new approach in providing safety and a lot of other applications to the drivers. We can consider it almost a key component in Intelligent Transport Systems (ITS). The need for a robust VANET networks is strongly dependent on their security and privacy features, which will be discussed in this paper. There are also presented some forms of attacks and solutions that can be implemented.

Precision agriculture based on internet of things principles

Ioan Dumitrache, Simona Iuliana Caramihai,
Mihnea Alexandru Moisescu, Ioan Ștefan Sacală

Control Engineering and Computer Science Faculty,
University Politehnica of Bucharest
Bucharest, Romania
e-mails: ioan.dumitrache@acse.pub.ro; simona.caramihai@aii.pub.ro;
mihnea.moisescu @upb.ro; ioan.sacala @acse.pub.ro

Abstract — The quantity and quality of agricultural products that become part of the food supply chain is becoming an important problem as the population is fast-increasing. Information and Communication Technology is becoming part of Agriculture organizations as farmers have had to explore innovative ways to increase production and minimize risk. The next step therefore is to network these individual systems into cyber-physical production systems integrated with smart devices in the Internet of Things. These can map the entire process electronically, from the farm's computer to the harvesting operation. Thus, these systems have the potential to substantially increase efficiency and quality. CPS and IoT based architectures need to address complex. The paper proposes an architecture for the future agricultural enterprise as a complex system, addressing sustainability and adaptability towards environmental and market changes.

Autonomous robots for health monitoring, fire fighting and search missions

D. Necsulescu[1], J. Sasiadek[2], E. Pruner[1], G. Nie[1], V. Surabhi[1], X. Le[1], A. Rehman[1], Yu Hu[1]

[1] University of Ottawa, Department of Mechanical Engineering, Ottawa, Ontario, Canada,
[2] Dept. MAE, Carleton Univ., Ottawa, Canada,
e-mails: necsu@uottawa.ca, jurek.sasiadek@carleton.ca

Abstract – Autonomous mobile robot are investigated in this paper for applications regarding self-organizing robot formations and applications for health monitoring, fire fighting and robotic search missions. In the case of decentralized control, the ability to achieve the shapes of these formations has to be built in the controllers of each autonomous robot. Self-organizing formations controllers were designed using velocity potential fields to drive the robots toward the goal and avoid collisions as well as local minima. The novel robot control is further developed for applications in health monitoring, fire fighting and search missions. The paper brings together authors experimental results of the proposed approaches.

General Information

Location

IWoCPS-2016 will be held at the Romanian Academy, 125 Calea Victoriei, 1st district, Bucharest, Romania. The Opening Ceremony and papers' presentations will be organized in the Council Hall of the Romanian Academy.

Access to Workshop site

The Workshop site can be accessed by the following means of transportation:

By underground - The workshop site is at 10 minutes walk from Piața Romană or Piața Victoriei underground stations

By bus - No. 133

Contact

Correspondence in connection to the IWoCPS-2016 Workshop should be addressed as it follows:

IWoCPS - SRAIT
University Politehnica of Bucharest
Faculty of Automatic Control and Computers
313 Spl. Independenței, Sector 6
77206 Bucharest
ROMANIA
PHONE +(40) 21 402 91 67
FAX +(40) 21 402 95 87

Working language

The working language of IWoCPS-2016 is English and will be used for presentations and discussions.

Name badge

An admission badge bearing the participant's name will be issued to all registered participants, thus authorizing access to all workshop sessions.

Refreshments

Refreshments will be available at the Workshop site daily.

Registration and information desk

The IWoCPS-2016 Registration Desk will be open at the Workshop site, Romanian Academy, 125 Calea Victoriei, starting from May 26th 2016, 9:00 hrs.