



P31 – International Summer School on Intelligent Agents in Automation, Introductory/Advanced

Credits	6 credits
Examiner	Luis Ribeiro, Linköping University
Contact	Mats Björkman mats.bjorkman@liu.se +46 (0) 13 - 28 11 36
Target group	This event is designed to provide advanced training for PhD students and practitioners on the advanced automation technologies that will be the basis for Industry 4.0.
Fee for industrial members	Regular registration fees (before the 1st of April 2016) for introductory/advanced course: 4000 SEK Late registration fees for introductory/advanced course: 5000 SEK

Prerequisites On the introductory track no previous knowledge is required except from extremely basic notions of programming and automation compatible with most higher education curricula in engineering.

For the advanced track the participants are expected to have a more solid knowledge of programming and automation acquired for example by having participated in the first edition of the course.

Aim The 4th industrial revolution offers a vision of a smart and cyber-physical factory which is composed by many intelligent components that constantly adjust their operation depending on the production requirements and context. They will be able to understand and communicate and take over each other's roles dynamically in case of faults and failures. They will constantly collect system information which used later to improve and adjust their own operation. The technology for creating such a factory is being developed today. The students have a unique opportunity to learn about: the design principles, the current state of development and the challenges in developing these systems.

Teachers/tutors The course is examined by Luis Ribeiro, Lecturer at Linköping University which is also one of the main teachers at the course. However the course will also be taught by well-known international scientists, scholar and researchers. As of 01/02/2016 the confirmed lecturers are:

Luis Ribeiro received his PhD in Electrical and Computer Engineering from the New University of Lisbon in 2012 and he is currently a Lecturer at Linköping's University, Sweden, at the Department of Management and Engineering/Division of Manufacturing Engineering. He has participated in several international research projects from the 6th, 7th and H2020 European Research Programmes, and several Portuguese national projects focusing in intelligent automation and plug and produce systems. He is currently the principal investigator from LiU in the H2020 project OpenMos – Open Dynamic Manufacturing Operating System for Smart Plug and-Produce Automation

Components. His main research areas include: design, development and implementation of intelligent manufacturing systems based in cyber-physical components, distributed architectures to support intelligent systems (MAS and SOA) and self-organization and emergence in manufacturing. His interests in these areas are in monitoring/diagnosis, control and reconfiguration. He is a member of the IEEE Technical Committee on Industrial Agents (IEEE Industrial Electronics Society), IEEE Technical Committee on Cybernetics for Intelligent Industrial Systems and a member of the expert group on flexible processes of

the Swedish Production 2030 initiative. He has more than 50 publications in high impact Journals and Conference proceedings and has served several times as an IPC member of several international conferences.

José Barata is a professor at the Department of Electrical Engineering of the New University of Lisbon and a senior researcher of the UNINOVA Institute. He has a PhD degree in Robotics and Integrated Manufacturing since 2004 from the New University of Lisbon. Dr. Barata has participated in more than 15 International Research projects involving different programmes (NMP, IST, ITEA, ESPRIT). Since 2004 he has been leading the UNINOVA participation in EU projects, namely EUPASS, Self-Learning, IDEAS, PRIME, RIVERWATCH, ROBO-PARTNER and PROSECO. His main research interests are in the area of Intelligent Manufacturing with particular focus on Complex Adaptive Systems, involving intelligent manufacturing devices. In the last years, Dr. Barata has participated actively researching SOA based approaches for the implementation of Intelligent Manufacturing Devices (e.g. within the Inlife project). He has published over 100 original papers in international journals and international conferences. He is a member of the IEEE technical committees on Industrial Agents (IES), Self-Organisation and Cybernetics for Informatics (SMC), and Education in Engineering and Industrial Technologies (IES). He is also a member of the IFAC technical committee 4.4 (Cost Oriented Automation).

Paulo Leitão is Professor at IPB and head of the Department of Electrical Engineering of that institute. He is member of the International Program Committee (IPC) of several international scientific events, has published more than 150 papers in high-ranked international scientific journals and conference proceedings (per-review), and co-author of three patents. He received four paper awards at INCOM'06, BASYS'06 and IEEE INDIN'10 and INFOCOMP'13. He served as co-chair of several international conferences, namely IFAC IMS'10, HoloMAS'11 and SOHOMA'16.

He has participated in several national and international research projects (such as EU FP 7 ARUM, EU FP7 GRACE and H2020 PERFoRM), and Networks of Excellence. His research interests are in the field of intelligent and collaborative production systems, multi-agent systems, holonic control, reconfigurable factory automation, cyber-physical systems and bio-inspiration engineering.

He was chair of the IEEE IES Technical Committee on Industrial Agents (2010-2015).

José Barbosa has a PhD in Automation and Computer Science from the University of Valenciennes and Hainaut-Cambrésis (France) and a MSc in Industrial Engineering at

IPB. He is a senior researcher at Polytechnic Institute of Bragança, Portugal, participating in several European funded projects, namely in the EU FP7 ARUM, in the EU FP7 GRACE project and in the EU H2020 PERFoRM. He is also an invited professor at the Department of Electrical Engineering of the Polytechnic Institute of Bragança. José Barbosa has more than 30 papers published at international journals and proceedings of international conferences. His main research topics focus on the development of self-organizing and evolvable manufacturing control architectures following the holonic and multi-agent system paradigms enriched with biological inspired mechanisms, particularly applied into Cyber-Physical Systems. He is also member of the IEEE Technical Committee on Industrial Agents.

Thomas Strasser earned a PhD in mechanical engineering with a focus on automation and control theory and a master's degree in industrial engineering with a focus on production and automation systems from the Vienna University of Technology.

For several years, he has been a senior scientist in the Energy Department of the AIT Austrian Institute of Technology. His main responsibilities involve strategic development of smart grid research projects and mentoring and advising junior scientist and PhD candidates. Before joining AIT, Dr. Strasser spent more than 6 years as a senior researcher investigating advanced and reconfigurable automation and control systems at PROFACTOR. He is active as a lecturer at the Vienna University of Technology and as guest professor at the University of Applied Sciences in Salzburg.

Dr. Strasser has co-authored more than 120 scientific publications (editorials, book chapters, conference papers, and journal articles) and was awarded 2 patents in his areas of interest. He is an active participant in IEEE conferences and serves as an associate editor of Springer and IEEE journals. He is also a senior member of IEEE and a founding member of the 4DIAC open source initiative and involved in IEC SC65B/WG15, IEC TC65/WG17, and IEC SyC Smart Energy/WG6.

Professor Vogel-Heuser (b. 1961) conducts research on the development and system evolution of distributed intelligent embedded systems in mechatronic products and production systems, with the aim of improving product quality, the efficiency and consistency of engineering activities and operational availability. She develops methods, descriptive aids and tools for integrating the various perspectives of mechatronic systems (mechanical, electrical/electronic and software) and phases in the life cycle and their interactions. Key non-functional

requirements are real-time behavior, modularity, availability and usability. Her research projects range from fundamental research in automation technology to the derivation of requirements from industrial applications and the development of prototype tools. After graduating in electrical engineering from the Technical University of Aachen (RWTH), Prof. Vogel-Heuser earned her doctorate degree there (1990) in the area of robot programming in mechanical engineering. She acquired industrial experience over a ten year period, including a position as Engineering Director for the Siempelkamp Group (systems engineering). After various professorships (Hagen 1996; Wuppertal 2000; Kassel 2006), she assumed a professorship in the Department of Automation and Information Systems (formerly: Department of Information Technology) at TUM (2009). More information <http://www.professoren.tum.de/en/vogel-heuser-birgit/>

Armando Walter Colombo, IEEE Senior Member, is Edison Level 2 Group Senior Expert and Research and Innovation Program Manager at Schneider Electric. He is also the director of the Institute for Industrial Informatics, Automation and Robotics (I2AR) and professor at the University of Applied Sciences Emden-Leer, Germany. He received the Doctor degree in Engineering from the University of Erlangen-Nuremberg, Germany, in 1998. From 1999 to 2000 was Adjunct Professor in the Group of Robotic Systems and CIM, Faculty of Technical Sciences, New University of Lisbon, Portugal. He has extensive experience in managing multicultural research teams in multi-regional projects, participating in leading positions in several international research and innovation projects like the EU FP6 NoEIPROMS (www.iproms.org, 2004-2009), the EU FP6 Integrated Project "SOCRADES" (www.socrades.eu, 2006-2009), the EU FP7 IP IMC-AESOP (www.imc.aesop.eu, 2010-2013). Prof. Colombo is IEEE Senior member, member of the IEEE IES Administrative Committee (AdCom) and the Chair of the IEEE IES Technical Committee on Industrial Cyber-Physical Systems (2015-2016). Prof. Colombo is actively involved in several consultations at European Commission and German level dealing with "Industrie 4.0", Cyber-Physical Systems, System of Systems, Internet of Things. He is listed in Who's Who in the World /Engineering 99-00/01 and in Outstanding People of the XX Century (Bibliographic Centre Cambridge, UK). Prof. Colombo has over 200 publications and 30 industrial patent applications in scientific and technical areas related to the thematic of the course (see <http://scholar.google.com/citations?user=csLRR18AAAAJ>).

Learning outcomes

After the course the participants will be able to:

- Discuss the vision and the main challenges related to the

fourth industrial revolution (also known as Industry 4.0) and the main research initiatives in this area.

- Understand the main design and implementation principles that support cyber-physical production system and the system that motivate Industry 4.0.
- Understand what why a cyber-physical system is different from today's conventional system.
- Understand the requirements on the computational and physical infrastructures required to support such a system.
- Design a simple cyber-physical production system.
- Use at a basic level the main technologies supporting such systems:
- Understand how to use today's technologies to create an industrial cyber-physical system.
- Use Intelligent Agents as a mechanism to design the cyber part of a cyber-physical system.

Contents

The course provides, through the view of several international experts, different core subjects involved in the design, development and implementation of very intelligent productions systems. Such systems are able, by design, to take autonomous decisions as a reaction to continuously changing production environments where products being produced change frequently and the system can be seamlessly changed to cater for the new production requirements. Products and production equipment are considered individual intelligent units that have a mechanical/physical part and a cyber component (cyber-physical formulation). The cyber part ensures that the system components interpret each other's actions and needs and behave as a society of intelligent artificial being that can cater for different production disturbances and actively collect data that is further transformed in knowledge used to improve the autonomous response of the system as a whole. Such a vision has lately been put in evidence by several research agendas and in particular the German "Industrie 4.0" that coined the term Industry 4.0. However most of the contributions far precede the existence of I4.0 and all the teachers in the course of a very significant track record in these previous contributions dating back in time more than 10 years.

Organisation

Please see the scheduling here:

http://www.issiaa2016.ipb.pt/?page_id=28

The modules highlighted in green are part of the starting track of the course. The modules highlighted in orange belong to the advanced track of the course. All the other events are for both tracks.

Literature

Will be provided by the different teachers during the course. Other literature or preparation work such as set-up of

software tools will be communicated to the students shortly before the course.

Examination

- Course attendance (full course): 1,5 credits
- Approval on the practical exercises: 1,5 credits
- Final written assignment consisting on a 4000 word essay summarizing the new scientific and technical knowledge acquired: 3 credits

With support from:



STRATEGIC
INNOVATION
PROGRAMMES