Newsletter of the IFAC Technical Committee on Human-Machine-Systems

Issue 2017_1, January 2017 (Newsletter of IFAC TC 4.5 available on: http://tc.ifac-control.org/4/5/newsletter)

The new IFAC TC Human-Machine System chair and co-chair team wish you all the best for 2017!

Do not hesitate to transmit this newsletter to your colleagues and networks, and to invite them to participate to our TC. Thanks.

This first 2017 newsletter contains:

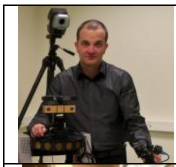
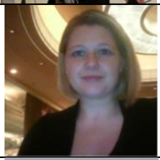
1. The presentation of the new chair and co-chair team
2. The tutorial and workshop proposals on Human-Machine Systems for IFAC World Congress 2017
3. Calls for papers to special issues on Cognition Technology & Work journal
4. Remote training program on railway engineering and guided systems

(To publish your TC4.5 related information to the next newsletter, send your proposal by email to Frédéric Vanderhaegen: frederic.vanderhaegen@univ-valenciennes.fr*)*

1. The presentation of the new chair and co-chair team

After the IFAC WC, the new chair and co-chair team will take in charge the IFAC TC HMS. Here is a reminding of this new team:

	*TC 4.5 Chair:* Prof Jianhua Zhang, Head of Intelligent Systems Group, School of Information Science and Engineering, East China University of Science and Technology, Shanghai 200237, P.R. China
	*TC 4.5 Co-Chair:* Prof Frédéric Vanderhaegen, University of Valenciennes, France
	*TC 4.5 Co-Chair:* Prof Tetsuo Sawaragi, Kyoto University, Japan

<table>
<tr><td></td><td>TC 4.5 Co-Chair:
Dr Sven Nõmm, Tallinn University of Technology, Estonia</td></tr>
<tr><td></td><td>TC 4.5 Co-Chair:
Dr Tamsyn Edwards, San Jose State University/ NASA Ames Research Center, USA</td></tr>
<tr><td></td><td>Mr. Kenichi Tanaka, Mitsubishi Electric Company, Japan</td></tr>
</table>

For your information, the last list of our IFAC TC HMS members is available on our web site and was transmitted in the previous newsletter. Do not hesitate to have a look, verify your affiliation and email and contact Frédéric Vanderhaegen if there is any modification to be done. Thanks.

2. The tutorial and workshop proposals on Human-Machine Systems for IFAC World Congress 2017

More than 35 regular papers were proposed to IFAC WC2017 in Toulouse by our Human-Machine Systems for IFAC WC2017 in Toulouse.

Several tutorials and workshops related to Human-Machine Systems topics were also proposed. Do not hesitate to invite your colleagues and students to attend these interesting meetings.

Two tutorials are organized jointly with several national and international research groups on Human-Machine Systems (i.e., IFAC TC HMS; Research Network on Modeling, Analysis, and Control of Dynamic Systems, Thematic Group on Automation of Human-Machine systems – GDR MACS, GT ASHM; International Research Network on Human-Machine Systems in Transportation and Industry - GDRI HAMASYTI; Joint Scientific Interest Group on Integrated Automation and Human-Machine Systems - GIS GRAISyHM):

- Oliver CARSTEN, University of Leeds, UK: What should be the process of testing and approving automated vehicles for operation on the road? Abstract: “This workshop focuses on how to test highly and fully automated vehicles in order to ensure that they operate safely on the roads. The approval of aircraft for civil operation may provide an analogue, but automated road vehicles will be required to operate in much more varied and often unstable conditions, and in encounters with manually driven vehicles as well as vulnerable road users. Another analogue is the driving test that human drivers have to pass before obtaining a driving license. This workshop examines the challenge of creating an approval process and of carrying out human-in-the-loop testing, for example of situations where the human driver would have to resume control. The workshop consists of three main elements: 1. Relevant human factors theory on interaction with automation and with automated vehicles;

2. A review of recent discussion in Europe and North America on possible processes for approval (certification). 3. Group exercises to propose testing procedures that could address the challenges."

- Yann MORERE, University of Lorraine, France: 3D simulator and Multimodale interface : theory and practice. Abstract: "This courses aims to give pieces of advice, methods when you start to develop a "serious" simulator based on a real life device using differentes types of input/outputs (modalities). After presenting some theoritical aspects of the multimodal interfaces, virtual reality and 3D simulation, we'll some good practices to build your own 3D simulator. This courses aims to be very practical and close to the development, even if we don't give source code. We will give example based on different software. We will answer some questions like: Low Polygon? Baked Texture? Loops simulation and Threading? What about scripting? How to get the data from such device? Which 3D engine? How to connect the device to the 3D engine? What about performance of the system?"

Other tutorial and workshop proposals are as follows:

- Guy Boy, Florida Institute of Technology, USA: Human-Centered Design for Human-Systems Integration. Abstract: "Mechanical engineering flourished during the 20th century enabling manufacturing of complex mechanical systems such as washing machines, cars, aircraft and nuclear power plants. They were made of tangible pieces that were assembled together. Their structures were incrementally designed, developed and tested. At the end of the century, they started to include more advanced functions that were previously handled by people. This functionalization process is commonly called automation. We moved from hardware to software. Since the beginning of the 21st century, we are doing the exact opposite. We start designing systems on computers as virtual prototypes whose functions can be tested very early. As such virtual engineering process progresses, virtual prototypes have to become more tangible to end up being real systems. This structuring process is called "tangibilization." We are moving from software to hardware. Instead of talking about automated systems, we then now talk about tangible interactive systems (TISs). Such systems can interact among each other as well as with people. This tutorial presents a historical perspective of the evolution of automation toward TIS's elaboration, as well as methods and tools that enable the making of integrated TISs toward human-systems integration (HSI). This evolution deals with automation, data science and energy. Human factors and ergonomics evaluation methods and tools that were used after systems were almost fully developed, evolve toward human-centered design (HCD) where technology, organizations and people are taken into account from the early stages of design and development processes. HCD is strongly based on human-computer interaction (HCI), modeling and simulation, complexity analysis, organization design and management, and cognitive engineering approaches. HCD methods and tools will be presented using examples in aeronautics, space and nuclear energy domains."
    - Kecai Cao, Nanjing University, China, and YangQuan Chen, University of California, USA. Abstract: "Catastrophic events have raised numerous issues concerning how to best understand, analyze and control the movement of the crowds when an emergency occurs. One of the most widely applied methods of evaluating evacuation environments and management is microsimulation modeling based on observations and experiments. Even in these microsimulation modeling based studies, they do not address individuals with different disabilities in their simulated populations or simulate a 'standard' individual with disabilities, giving little emphasis to the largest minority demographic of evacuating populations. From the viewpoint of complex systems, model and control problem of large crowds of pedestrians has also been conducted in Integer Order Calculus where each pedestrian has been treated as physical particles that are same as molecules of liquid or gases. Some phenomena in movement and decision of human beings have not been included such as memory effects, inverse power-law distribution in time and spatial scale of pedestrian's movement and even long-range interactions. All the effects that have been neglected can be fitted very well using the framework of Calculus of Fractional Order. This tutorial will prepare the IFAC WC audience with 1) Microscopic Modeling of Crowds involving Individuals with Physical Disability: From Automated Data Collection to Modeling and Analysis and Validation; 2) New Fractional Modeling and Analysis of Crowds of Pedestrians in Micro scale, Mesco scale and Macro scale; 3) Management and Exploration in Modeling and Control of Crowds for Future Work."
- Kecai Cao, Nanjing University, China, and YangQuan Chen, University of California, USA. Abstract: "Catastrophic events have raised numerous issues concerning how to best understand, analyze

and control the movement of the crowds when an emergency occurs. One of the most widely applied methods of evaluating evacuation environments and management is microsimulation modeling based on observations and experiments. Even in these microsimulation modeling based studies, they do not address individuals with different disabilities in their simulated populations or simulate a 'standard' individual with disabilities, giving little emphasis to the largest minority demographic of evacuating populations. From the viewpoint of complex systems, model and control problem of large crowds of pedestrians has also been conducted in Integer Order Calculus where each pedestrian has been treated as physical particles that are same as molecules of liquid or gases. Some phenomena in movement and decision of human beings have not been included such as memory effects, inverse power-law distribution in time and spatial scale of pedestrian's movement and even long-range interactions. All the effects that have been neglected can be fitted very well using the framework of Calculus of Fractional Order. This tutorial will prepare the IFAC WC audience with 1) Microscopic Modeling of Crowds involving Individuals with Physical Disability: From Automated Data Collection to Modeling and Analysis and Validation; 2) New Fractional Modeling and Analysis of Crowds of Pedestrians in Micro scale, Mesco scale and Macro scale; 3) Management and Exploration in Modeling and Control of Crowds for Future Work."

One Open Invited Track entitled "Adaptive User Interfaces for Industrial Applications" was proposed by Valeria Villani and Cesare Fantuzzi from the University of Modena, Italy. Abstract: Abstract: "Nowadays manufacturing systems are increasing in sophistication and complexity, thus embodying always more complex human-machine interfaces (HMIs). In this scenario, human operators experience many difficulties to interact efficiently with modern automatic machines and robotic cells. In particular, elderly people, although having great experience in the industrial process, feel uncomfortable in the interaction with a complex computerized system. Additionally, a complex HMI creates a barrier to young inexperienced or disabled people preventing an effective management of the production lines. These problems can be tackled through the introduction of adaptive human-centred HMIs that complement the cognitive capabilities and emotional condition of users by compensating their limitations. This open invited track aims at bringing together and presenting the last innovative advances in the development of adaptive HMIs, ranging from methods to measure worker's capability and skills and profile users to solutions for adaptation."

Thanks to all of you for your contributions. Feedback about the reviewing process of these proposals will be sent to the organizers and authors soon. Have a look on the future final program on: http://www.ifac2017.org/.

Hoping to see all of you in Toulouse during IFAC WC 2017!

3. Calls for papers to special issues on Cognition Technology & Work journal

The following calls for papers are open for special issues on Cognition Technology & Work. Do not hesitate to distribute them to all of your colleagues and networks and submit papers:

- Franck Flemish, RWTH Aachen University/Fraunhofer, Germany and David Abbink, TU Delft, NL: **Towards a Common Framework of Shared and Cooperative Control of Human and Machines**. Shared and cooperative control of situations affects homo-sapiens already much longer than human-machine systems exist. Anthropologists describe not only how the human cognition evolved, but how the ability to have a shared intentionality and to cooperate towards common goals shaped homo sapiens and enabled his rise to one of the most dominant species on this planet. Many thousands of years later, the interplay between humans and technology has become even more important. Machines have become more capable not only to extend our physical power, but also to develop cognitive capabilities and to act automatically. Automation is already prevailing e.g. in aviation, but also in other domains like ground vehicles, cognitive capabilities of machines are increasingly used e.g. in form of assistance systems or automated driving. While assistance points towards a role of the machine that is only trying to support the human, and automation points towards a solution where mainly the machine is taking over the main task, there are situations where both the human and the machine act together at the same time. This has been described so far with at least two different phrases that have so many aspects in common that they should be analyzed and developed together. One phrase is Shared Control that stresses the fact that human and machine share tasks and control a situation together. The other phrase is cooperative control or cooperative automation, that stresses the fact that human and machines cooperate on a task and control a situation cooperatively. This special issue will discuss a couple of examples of shared and cooperative control from the aviation and automotive domain. Moreover, it will sketch a common framework of shared and cooperative control that sees the two phrases not as different concepts, but as slightly different perspectives or foci on a common design space of shared intentionality, control and cooperation between humans and machines. One working hypothesis which the session will explore is that shared control can be understood as cooperation on the control level, while cooperative control can include shared control, but also extend the cooperation towards higher levels e.g. of guidance and navigation, of maneuvers and goals.

- Oliver Carsten, University of Leeds, UK and Klaus Bengler, Technical University of Munich, Germany: **Automated and Cooperative Driving: Designing the Systems to Work with People**. The potential automation or partial automation of driving is not only more of the same but a radical qualitative and quantitative change in the paradigm of individual and collective mobility as well as of freight transport. But while promising new possibilities and new freedoms in transport, automated driving also poses new challenges especially in the areas of human research and human-vehicle interaction. Not the least of these challenges is how to deal with a driver population that is highly varied in skills, training and motivation as opposed to the professional crew in, for example, aviation. The remarkable technological innovations will change the users' perspective on the driver workplace and the criteria of usability and user experience that are currently highly influenced by the primary driving task. The layout of the driver workplace and the design of the vehicle's interface with the human operator will have to consider this. Many of the concepts under discussion right now are rather vague and ill-structured in their definition which renders reflective judgment, appropriate operationalization and quantification, and finally good decision-making a great challenge. All the same issues that have arisen in other domains such as aviation apply here: the potential for mode errors, the possible need for training, calibration of trust, problems with supervisory control, operator readiness when there is only one crew member, etc. But there are also particular challenges related to road driving, such as the complexity of the road environment, the need for interaction with manual drivers and vulnerable road users and the typically small safety margins in everyday driving. This issue of CTW welcomes contributions that address these challenges, as well as those that focus on new interaction concepts for automated driving and their evaluation. Research on cognitive modelling in the area of driver behaviour, interaction and cooperation between traffic participants is highly welcome.
- Jianhua Zhang, East China University of Science and Technology, China, and Tamsyn Edwards, NASA, USA: **Modelling and Analysis of Human-Machine Systems in Transportation**. Safety and efficiency within the transportation domain is dependent on the human-machine system: the human operator, the technology, and the effective interaction between human and machine. Technology must not only perform effectively and reliably, but must also be designed to be usable and acceptable to the human operator. The human operator must be able to maintain a high level of performance in order to sustain safety. The interaction between these elements must be effective for the optimal functioning of a transportation system. For example, within the air traffic control domain, Air Traffic Controllers are responsible for the safety and efficiency of all air traffic. As there are no physical barriers that protect aircraft in flight, it is essential that controllers maintain a consistently high standard of human performance in order to maintain flight safety. Controllers work in a technological and somewhat automated environment. Each individual component, plus the interaction between these elements can affect the overall functioning of the transportation system. Similar interactions are also observed in the rail and road domains, such as the challenge to investigate human performance in association with operating automated vehicles. This special issue aims to further scientific understanding relating to enhancing safety and efficiency in transportation. We therefore call for papers that contribute to this goal by presenting research that advances knowledge in the areas of modeling, analysis and practical techniques for increasing safety and efficiency in transportation systems. Topics of interest include (but are not limited to): 1) Technological designs; 2) Measurement of human performance; 3) Practical applications that aim to address specific issues or problems; 4) Analysis of human-machine interactions. Contributions should address safety and performance issues associated with human machine systems in transportation, and should also contribute to advances in methodologies, measurement or analysis of human-machine system. By presenting research on these topics across transport systems, we hope to facilitate the sharing of knowledge, highlighting similarities and differences to further enhance understanding of human machine systems across all transportation domains.

Papers have to be submitted to the CTW journal website (i.e., https://www.editorialmanager.com/ctwo) by selecting the required special issue. The organizers will manage the reviewing process directly from this web site.

4. Remote training program on railway engineering and guided systems

The University of Valenciennes proposes a Small Private Online Course for a semester of the Master of Science on Transports Motilities Networks (TMR MSc), option Railway Engineering and Guided Systems (InerSyG option). This remote training program consists in a semester of training (i.e., 30 ECTS) by selecting and validating 6 modules upon this list:

- Norms for the software development in transport domain (5 ECTS). Based on European norms in transport domain, this module consists in discovering and controlling the software design conformity constraints in the course of a development project. Practical examples related to real development environments will be studied by the candidates.
- Communication and localization systems for railway and guided transports (5 ECTS). This module presents the techniques and the systems of localization and communication used in transport domain whatever the environment (countryside, tunnel, stations, etc.). Examples are presented in order to discuss on their limits and propose new innovations. Several practical problems have to be solved by the candidates.
- Functional analysis, retro-engineering and design of guided systems (5 ECTS). The module uses the SADT method for developing a functional analysis of a system such as a railway or a guided transport. The MissRail® platform is used in order to discover some functions of a railway or guided system, and then retro-engineering consists in specifying and implementing one of these functions by the candidates.
- Interactive system development applied to railway flow control (5 ECTS). This module consists in developing interactive system by using the JAVA language. The specification and the implementation of a practical application dedicated to the train flow supervision have to be done by the candidates.
- Railway risk analysis and mechanical engineering (5 ECTS). This module concerns railway risk analysis as collisions or derailments with the Fault Tree method. Some mechanical engineering principles are presented in order to analyze some scenarios of accident. A tangible game sent to the candidates is used by them for implementing and explaining such scenarios.
- Design and management of a railway maintenance strategy (5 ECTS). This module focuses on strategies, indicators and objectives of maintenance operations in railway. The candidates will use a serious game for applying such concepts.
- Diagnosis of human-machine systems applied to guided and railway systems (5 ECTS). This module presents principles of diagnosis of human-machine systems on human reasoning models (i.e., inductive reasoning, deductive reasoning, abductive reasoning, dissonance discovery and control). Examples on railway transports and guided systems are discussed. The dissonance concept is studied for discovering and controlling conflicts of knowledge. The corresponding algorithms have to be specified, implemented and tested by the candidates.

The InerSyG course is open to people who have professional experience on railway, guided systems or other domains of application, with the minimum level of the 1st Year of a Master of Sciences or equivalent level.

It aims at obtaining the TMR MSc diploma of the University of Valenciennes.

Each module is supervised and validated by Assistant Professors or Professors from the University of Valenciennes.

Language: French

Prize: 13000€ (reduced prize over 4 persons from the same society or organism; prize for one module with the deliverance of a certificate of competences: 2500€).

For more information, take a look on: https://pod.univ-valenciennes.fr/video/0179-presentation-du-parcours-inersyg-du-master-tmr/ or on http://www.univ-valenciennes.fr/inersyg.

Contact: Frédéric Vanderhaegen (frederic.vanderhaegen@univ-valenciennes.fr)