Towards symbiotic and cooperative automation, autonomy in human-machine systems: Layers of cooperation

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Session abstract:

The speed-up of the increase of system abilities is such that the integration of autonomous systems may not be accompanied by well identified framework to arm Humans against uncontrollable situations, and inacceptable lack of respect for ethic, social and legal rules. Numerous questions have been raised concerning systems autonomy and their impact on society. This evolution may bring real advances for Human but caution must be taken regarding the allocation of roles between humans and machines, paying special attention to the management of human and machine organization, authority and responsibility.

Many studies deal with such questions in the design of assistance, defined according to degrees, stages and levels of automation, and levels of autonomy. Some address the notion of human-machine symbiosis, when others prefer the notion of cooperation. Some focus on human-In-the-loop design, when others highlight human-On-the-loop interest. The objective of this session would be the identification, clarification and alignment of these notions in order to share the same vocabulary for the same objective.

First step has been done at the last IFAC HMS organized in Kyoto, with fruitful discussions and the writing of articles in a special issue of Cognition, Technology and Works journal (F. Flemisch, D. Abbink, M. Itoh, M-P. Pacaux-Lemoine, G. Weßel (2018) Joining the blunt and the pointy end of the spear: Towards a common framework of joint action, human-machine cooperation, cooperative guidance & control, shared-, traded- and supervisory control). One of the common point between the different approaches and works has been the definition of *layers of cooperation* and the objectives to design *layered cooperation systems*. One human, as one system, are not alone anymore to perform their functions, but they are part of a more global human-machine system which has to achieve more complicated and complex functions. Layers of cooperation propose the beginning of a framework to support cooperation on one layer, but also cooperation between layers taking into account levels of abstraction of functions, from the low control level close to commands, to the high control level close to high decisional level.

Definitions, design and evaluation methods will be discussed with different domains of application, such as:

- Transportation: From autonomous aircraft and cars to cooperative traffic systems
- Production: From fully autonomous plants to cyber-physical human systems and a cooperative internet of production
- Defense: From Automation and Autonomy to Cooperativeness and Controllability
- Human-assistive robotics: From dependability to cooperative rehabilitation system and adaptive/assistive systems