

Human-AI Teaming: A Human Systems Integration Perspective

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Topics. 1.1. Complexity; 15. Oil and Gas; 2. Aerospace; 3. Automotive; 4.1. Human-Systems Integration; 4.4. Resilience; 4.6. System Safety; 6. Defense;

Abstract. How can humans and machines driven by artificial intelligence (AI) become partners? What are the principles of future human-AI systems? Human Systems Integration (HSI) currently investigates the evolution of human roles, responsibilities and capabilities within our growing digital world. Complexity and interconnectivity are increasing exponentially. How technology, organizations and human activities can be designed and developed for improved safety, security, efficiency, resilience and comfort? How maturity of organizations for the fourth industrial revolution can support these issues? Autonomy and flexibility have become real issues, not only on machine side, but also foremost on human side. The concept of virtual assistant makes emerge several crucial issues such as trust, collaboration and control. Panelist will discuss these interdependent topics toward a possible synthesis.

Biography

Guy Andre Boy (CentraleSupélec (Paris Saclay University) & ESTIA Institute of Technology)
Guy A. Boy is FlexTech Chair Institute Professor at CentraleSupélec (Paris Saclay University) and Chair of ESTIA Science Board, Fellow of the Air and Space Academy and Chair of the Human-Systems Integration Working Group of International Council on Systems Engineering (INCOSE). He was University Professor and Dean, Human-Centered Design Institute and HCD Ph.D. & Master's Programs at the Florida Institute of Technology (2009-2017), and a Senior Research Scientist at the Florida Institute for Human and Machine Cognition (IHMC). He was Chief Scientist for Human-Centered Design at NASA Kennedy Space Center (2010-2016). He was member of the Scientific Committee of the SESAR program (Single European Sky for Air Traffic Management Research) from 2013 to 2016. He was Chair of 2012 ISU (International Space University) SSP (Space Studies Program) FIT/NASA-KSC local organizing committee. He was President and Chief Scientist of the European Institute of Cognitive Sciences and Engineering (EURISCO, a research institute of Airbus and Thales). He co-founded EURISCO in 1992, and managed it since its creation to its closing in 2008. He is a senior member of the ACM-Association for Computing Machinery (Executive Vice-Chair of ACM-SIGCHI 1995-1999) and Chair of the Aerospace Technical Committee of IEA (International Ergonomics Association).

Position Paper

Human-AI teaming is a drastic evolution of human-automation cooperation: could we go from automation rigidity to flexible autonomy

Automation brought safety, efficiency and comfort benefits and issues for the last five decades. It also introduced rigidity, especially in emergency and unexpected situations. In such situations, procedure following, whether performed by people or machines, does not always work properly, and problem solving is at stake. Does artificial intelligence (AI) help in such situations? How people and AI systems could work together to bring correct solutions in such situations? More generally, how could people trust and collaborate with AI systems? The issue of autonomy relies on competence, skills and availability when needed. Could AI bring more autonomy to people in emergency and unexpected situations? In such situations, flexibility is required to handle uncertainty and even the unknown. Human systems integration focuses on function allocation among people and machines not only in a procedural way, but also in problem-solving way. How can we formulate such function allocation? These questions deserve deeper discussions that I propose to entertain during the panel.

Nancy Cooke (Arizona State University)

Nancy J. Cooke is a professor of Human Systems Engineering at Arizona State University and directs ASU's Center for Human, AI, and Robot Teaming. She received her PhD in Cognitive Psychology from New Mexico State University in 1987. Dr. Cooke is a past President of the Human Factors and Ergonomics and recently chaired a study panel for the National Academies on the Enhancing the Effectiveness of Team Science. Dr. Cooke was a member of the US Air

Force Scientific Advisory board from 2008-2012. Dr. Cooke's research interests include the study of individual and team cognition and its application to the development of cognitive and knowledge engineering methodologies, human-AI-robot teaming, cyber security, intelligence analysis, remotely-piloted aircraft systems, healthcare systems, and emergency response systems. Dr. Cooke specializes in the development, application, and evaluation of methodologies to elicit and assess individual and team cognition. Her work is funded primarily by DoD.

Position Paper

Artificial intelligence could be to assist in putting the right teammates together

A team is a heterogeneous group of individuals that are interdependent and that come together to work toward a common goal. This holds for human-machine teams as well. Therefore, a team is a small system and can be imbedded in a larger system of multiple teams and organizations that make up a complex sociotechnical system. Human Systems Integration (HSI) is well positioned to assess, model, and intervene in such systems. However, as system size and complexity increases there is need for assistance. One role of artificial intelligence could be to assist in putting the right teammates together for a given task, developing the team, and coordinating team process.

Michael Boardman (Ministry of Defence)

Michael Boardman is a Principal Ergonomist within the UK Defence Science and Technology Laboratory (Dstl) Human and Social Sciences Group. He graduated in 1999 from the University of Birmingham with a BEng in Mechanical Engineering and in 2000 with an MSc in Work Design and Ergonomics. His career to date has included commercial consultancy, applied research, support to operations, acquisition project support, systems engineering, and the development of Defence, British and International Standards. In his current role he provides Science and Technology (S&T) advice to the UK MOD research programme in the fields of: Ergonomics, Human Machine Interaction, Human Machine Teaming, Human Centred Design and Human Factors/Systems Integration within capability acquisition. Michael's current research interests include Human Machine Teaming and Adaptive Autonomy, the application of human factors within systems engineering and novel human centred design approaches.

Position Paper

Creating Shared SA in Human-AI Teams: A Fundamental Basis for Effective Teaming

How can effective human-AI teams be created and developed? Human AI teams are currently limited by poor shared situation awareness (SSA) that undermines the ability of the team to effectively coordinate and collaborate. SSA is fundamental to supporting coordinated actions across multiple parties who are involved in achieving the same goal and who have inter-related functions. It is needed to ensure goal alignment in the human-AI team; support dynamic function allocation, with flexible levels of autonomy, as relative capabilities and states change; ensure the alignment of strategies, plans and actions across the team; and to coordinate on interdependent tasks. Future AI systems will need the ability to develop accurate computational models of the world, and to support human understanding of that model through improved transparency, as well as facilities for supporting effective team behaviors. Methods for supporting SSA in future human-AI teams to improve their safety, efficiency and resiliency will be discussed.

Avigdor Zonnenshain (TECHNION)

Dr. Avigdor Zonnenshain is currently the Senior Research Fellow at The Gordon Center for Systems Engineering and at the Neaman Institute for National Policies Research at the Technion, Haifa, Israel. He has a Ph.D. in Systems Engineering from the University of Arizona, Tucson, USA. Formerly, He held several major positions in the quality, reliability and systems engineering areas in RAFAEL & in the Prime Minister's Office. He is an active member of the Israel Society for Quality (ISQ). He was also the Chairman of the Standardization Committee for Management & Quality in the Standardization Institute of Israel. He is a Senior Adjunct Lecturer at the Technion-Israel Institute of Technology. He was a member of the Board of Directors of the University of Haifa. He is an active member of INCOSE & INCOSE_IL (past president). He is a Fellow of INCOSE.

Position Paper

How the maturity of organizations for the fourth industrial revolution can support AI-Human Teaming?

In the last decade, industries in advanced economies have been experiencing significant changes in engineering and manufacturing practices, processes, and technologies. These changes have created a resurgence in engineering and manufacturing activities. This phenomenon is often referred to as the Fourth Industrial Revolution or Industry 4.0. It is based on advanced manufacturing and engineering technologies, such as massive digitization, big data analytics, advanced robotics and adaptive automation, additive and precision manufacturing (e.g., 3-D printing), modelling and simulation, artificial intelligence, and the nano-engineering of materials. This revolution presents challenges and opportunities for the organizations and companies in effectively implementing these innovative technologies and processes. Based on our studies there is a way to assess the maturity of the organizations for the 4th industrial revolution by evaluating several capabilities of the organizations. We will discuss during the panel the following questions: (1) How to assess the maturity of the organizations for the 4th Industrial revolution? (2) How this maturity supports the implementing of HSI approach? (3) Which organizational capabilities are needed for implementing AI-Human teaming?

Ido Lev-Ran (RAFAEL)

Ido Lev-ran is Head of RAFAEL human factors department. He has over 15 years of experience in designing interfaces for highly complex systems. His academic background includes B.A. in Psychology & Communication and M.Sc. in human factors engineering with research in learning and decision making. His main areas of interest are human factors for complex systems with advanced technologies. Last and not least, he is married to Shir and they

have three wonderful kids and a lovely Shih Tzu dog, and they all reside in the wonderful city of Haifa.

Position Paper

Integrated Systems of People with AI

It is well established that Artificial intelligence (AI) technologies have the potential to dramatically disrupt markets and economies but also to design processes of systems and jobs. But it seems that technologically (and some may add also culturally), this vision of ubiquitous and flawless AI is still many years off. As a result, in the coming years, we'll see more systems where humans and AI work as a team, each bringing to the table his strengths. Such "symbiotic" teams (as head of DARPA in the 60s J.C.R. Licklider coined) have the potential to produce breakthroughs. But undoubtedly, team collaboration produces significant human factors challenges. In my part in the panel, I will focus on these challenges and share first thoughts and insights on designing optimal human-AI teams in a user-centric approach.

Mica R. Endsley (SA Technologies)

Mica Endsley is President of SA Technologies and is the former Chief Scientist for the US Air Force. She has also held the positions of Visiting Associate Professor at MIT in the Department of Aeronautics and Astronautics and Associate Professor of Industrial Engineering at Texas Tech University. She was formerly an Engineering Specialist at the Northrop Corporation. Dr. Endsley is a Fellow and Past-President of the Human Factors and Ergonomics Society. She received a Ph.D. in Industrial and Systems Engineering from the University of Southern California. Dr. Endsley is a recognized world leader in the design, development and evaluation of systems to support human situation awareness (SA) and decision-making, and the integration of humans and automation. She has authored over 200 scientific articles and is the co-author of Analysis and Measurement of Situation Awareness and Designing for Situation Awareness.

Position Paper

Effective integration of humans and artificial intelligence

Future operating environments are likely to require the effective integration of humans and artificial intelligence (AI) enabled systems within decision-making processes. As these AI-based systems are adopted it will become increasingly important to ensure that appropriate human control is maintained for big data analytics and decision support systems. Meaningful human control (MHC) can be described as the ability to make timely, informed choices to influence AI-based systems that enable the best possible operational outcomes. There are a number of factors contributing to MHC including freedom of choice and sufficient human understanding of the situation and system. We should discuss the importance of maintaining human control within military, AI enabled systems.