Fusion 2023
Tutorial Proposal Form

Title of the tutorial	**High-Level Information Fusion Theory meets AI**
Organisers contact details *name, email address, affiliation*	Erik Blasch erik.blasch@gmail.com AFRL
Duration of tutorial	Half Day
Keywords, and scope or objectives	Situation/Threat Assessment, Situational Awareness. Measures of Performance, Measures of Effectiveness, Design, Information Management
Abstract *A brief description of the tutorial, suitable for inclusion in the conference registration brochure.* *Brief abstract summarizing the course content.*	Over the past decade, the explosion of Artificial Intelligence (Machine, Deep, and Reinforcement Learning) has expanded the directions of sensor data fusion (SDF). These SDF-AI approaches are mainly focused on low-level information fusion (LLIF) object assessment; however there is a need to consider the directions of AI aligned with high-level information fusion (situation/impact assessment and sensor, user, and mission management). This tutorial brings together the contemporary concepts, models, and definitions to give the attendee a summary of the state-of-the-art in HLIF. HLIF theories (operational, functional, formal, and cognitive) are mapped to representations (semantics, ontologies, axiomatics, and agents) with contemporary issues of AI modelling, testbeds, evaluation, and human-machine interfaces. Discussions with examples of scenario assessment, cyber analysis, and battlefield awareness are presented. The attendee will gain an appreciation of HLIF through the topic organization from the perspectives of numerous authors, practitioners, and developers of SDF systems. The tutorial builds on these texts (among others): E. P. Blasch, E. Bosse, and D. A. Lambert, *High-Level Information Fusion Management and Systems Design*, Artech House, April 2012. E. Blasch, T. Pham, C-Y. Chong, W. Koch, H. Leung, D. Braines, T. Abdelzaher, "Machine Learning/Artificial Intelligence for Sensor Data Fusion–Opportunities and Challenges," *IEEE Aerospace and Electronic Systems Magazine*, vol. 36, no. 7, pp. 80-93, 1 July 2021.
Objective *Brief statement of the learning goals for the student.*	This tutorial will be valuable for researchers, developers, and practitioners, while primarily intended for: • **Researchers** in basic science exploring high-level information fusion theory and applied applications towards demonstrations in laboratory simulations and operational field studies for situation awareness. • **System engineers** and developers of information fusion and command and control systems who are required to specify, develop, integrate, test, and evaluate high-level information fusion capabilities. • **Technical managers** who oversee data and command and control developments; for these managers the tutorial will serve as a valuable technical discussion on the terminology, concepts, and implementation challenges of high-level information fusion. • **Graduate level students** studying advanced information fusion theory, representations, techniques, and technologies.
Target Audience	Researchers in industry, government, or academic settings seeking to appropriately explain and design test and evaluation strategies for Fusion System transitions.
Potential Students *Brief statement of the education, background, and career interests for the successful student.*	Successful students include those who currently work with or are interested in verifying and validating information fusion approaches within a complex systems consider the use of SDF-AI including. (1) HLIF theories, (2) HLIF representations in information fusion testbeds, and (3) HLIF supporting elements of human-system interaction, scenario-based design, and HLIF evaluation.

	No prerequisites are needed for the course.
Detailed Outline *This should address the following:* *Why the topic is of interest for FUSION 2011 attended and the expected benefit to the participant, depth and scope of the exposed topics, exercises, software demonstrations etc.*	**OUTLINE:** **Lesson 1:** Introduction – What is HLIF DFIG Levels 1 – 5 going from LLIF (Assessment) to HLIF (Awareness) HLIF Models HLIF Grand Challenges Comparisons of theories, representations, and implementations **Lesson 2:** Situation Awareness (SAW) Models Process, interpreted, and State Transition models SAW projection/prediction Approaches of AI to support SAW **Lesson 3:** Information Management Management of Information as an architecture User Issues (models, displays, interaction) Concerns of AI in SDF designs **Lesson 4:** Fusion System Design/Evaluation Scenario based design HLIF Evaluation (metrics) Examples of SDF AI for Human-Machine Teaming
Course Material *Brief statement on the materials such as books, course notes, or software that will be provided with the course.*	A CD will be provided with the tutorial notes, relevant papers, and slides. Book copies with registrations. Current trends in HLIF papers exploring AI techniques (e.g., XAI)
Instructor Biography *A brief resume of the organiser(s), highlighting the background in the proposed special session area.*	**Erik Blasch** is a founding member of the International Society of Information Fusion (ISIF) in 1998. He was on the ISIF Board of Governors from 2000-2010 and the 2007 President. He was recognized with the 2014 *Joseph Mignogna Data Fusion Award* from the U.S. Department of Defence Joint Directors of Laboratories (JDL) Data Fusion Group. Dr. Blasch served on the IEEE Aerospace and Electronics Systems Society (AESS) Board of Governors (2011-2016), contributed to two tech panel awards (avionics), and is currently a Distinguished Lecturer. He has focused on information fusion, target tracking, pattern recognition, and robitcs research compiling 158 jounral, and 1000+ scientific papers and book chapters. He holds 51 patents, presented over 52 tutorials, authord 11 books, and is an associate editor of three academic journals. His relevant books include *High-Level Information Fusion Management and Systems Design* (Artech House, 2012) and *Context-Enhanced Information Fusion* (Spriner, 2016), and *Multispectral Image Fusion and Colorization* (SPIE, 2018). *Deep Learning for Radar and Communications Automatic Target Recognition* (Artech, 2020). From 2000-2010, Dr. Blasch was the information fusion evaluation tech lead for the Air Force Research Laboratory (AFRL) Sensors Directorate—COMprehensive Performance Assessment of Sensor Exploitation (COMPASE) center. From 2010-2012. Dr. Blasch was an exchange scientist to Defence R&D Canada at Valcartier, Quebec in the Future Command and Control (C2) Concepts group. Form 2012-2017, he was with the AFRL Information Directorate and currently is a Program Officer at the Air Force Office of Scientific Research (2017-). Other positions include adjunct professor at five universities, Air Force Reserve officer (Col, ret), and consultant at MOVEJ Analytics. Dr. Blasch received his B.S. in Mechanical Engineering from the Massachusetts Institute of Technology in 1992 and Master's Degrees in Mechanical ('94), Health Science ('95), and Industrial Engineering (Human Factors) ('95) from Georgia Tech and attended the University of Wisconsin for a MD/PhD in Neurosciences/Mech. Eng until being called to military service in 1996 to the United States Air Force. He completed an MBA ('98), MSEE ('98), MS Econ('99), and a PhD ('99) in Electrical Engineering from Wright State University and is a graduate of Air War College ('08). He is the recipeint of the IEEE Bio-Engineering Award (Russ-2008), IEEE AESS

	Magazine Best Paper Award (Mimno-2012), Military Sensing Society (MSS) Ledaership in Data Fusion Award (Mignogna-2014), MDPI Best Paper of the year (Computers-2019), AIAA Information Systems Award (2020), and IEEE AESS Avionics Award (Resnik-2022). He is a Fellow of AIAA, IEEE, MSS, and SPIE.