MFI 2015 Workshop on
Large-Scale Bayesian Data Fusion and Consensus
Monday September 14, 2015
ESC 210, 0900-1700
Website: https://sites.google.com/a/mst.edu/mfi-2015-workshop/

Intelligent dependable sensor networks and dynamic distributed information processing systems have drawn considerable interest for applications such as environmental monitoring, surveillance, search and rescue, and scientific exploration. To operate autonomously in the face of real world uncertainties, individual sensor platforms in such networks typically rely on perception and planning algorithms that combine local and network-wide reasoning. This type of system architecture not only permits intelligent local decision-making amid noisy data and complex dynamics, but also enables efficient information-sharing and gathering, which greatly improves perceptual robustness and task performance. As computing power and hardware continue to improve, demand will also grow for these systems to process more diverse kinds of information for increasingly complex dynamical processes and to communicate within larger networks at very high rates for real-time/online decision-making.

This workshop will explore theoretical connections and novel large-scale applications of two frameworks popular in the robotics and controls communities for meeting these challenges: Bayesian distributed data fusion (DDF) and network-based consensus. Recent developments in the consensus literature suggest potentially deeper connections to Bayesian DDF that have not yet been explored. Such connections could provide valuable insight for developing robust tightly integrated decentralized decision-making and information processing algorithms for networks of intelligent sensing agents in large-scale problem spaces (as characterized by high data volume, high-dimensional processes, and/or large numbers of sensors/agents).

Short talks on new/ongoing work in the following topics will be the focus of the workshop sessions:

I. Fundamental Connections between Bayesian DDF and Consensus Techniques
II. Fusion in High-dimensional and Functional Spaces
III. Future Steps and Challenges for Large-scale Data Fusion (expert panel discussion)

See table below and workshop link above for details on schedule and contributed talks

Invited Speakers (confirmed)

Dr. Ronald Mahler, Founder and President, Random Sets, LLC
Dr. Simon Julier, Senior Lecturer in Computer Science, University College of London

Invited Expert Panelists

Dr. Frederica Darema, Program Manager, Air Force Office of Scientific Research (AFOSR)
Dr. Michael Ouimet, Engineer at the Space and Naval Warfare Command (SPAWAR)

Workshop Organizers

Dr. Nisar Ahmed, Assistant Professor, Univ. Colorado Boulder, USA
Dr. David Casbeer, Research Engineer, Aerospace Systems Directorate, AFRL, USA
Dr. Daniel Clarke, Lecturer in Communications and Electronic Warfare, Cranfield University, UK
Dr. William Whitacre, Senior Technical Staff, Strategic Navigation Group, Draper Laboratory, USA
Dr. Tansel Yucelen, Assistant Professor, Missouri University of Science and Technology, USA

Workshop Schedule

9:00 am **Welcome, overview, opening remarks**

Session 1: Fundamental Connections between DDF and Consensus

9:20 am **Invited Speaker #1: Ronald Mahler**
"Unified multi-target track-to-track fusion via Kullback-Leibler consensus "

10:00 am Q&A with audience

10:10 am **Coffee Break**

10:30 am Contributed Talks (3 talks, 10 mins each)

"An Overview of Active-Passive Dynamic Consensus Filters for Situational Awareness", D. Peterson and T. Yucelen (Missouri Univ. of Science and Technology)

"Distributed Non-Bayesian Learning: Network/Node Independent and Accelerated Convergence Rates", A. Nedic, A. Olshevsky, C. Uribe (UIUC)

"Developing a Hybrid Distributed Kalman Filter", He Bai (Oklahoma State University)

11:00 am Session recap/group discussion ("public whiteboard time")

12:00 pm **Lunch Break**

Session 2: Fusion in High-dimensional and Functional Spaces

1:30 pm **Invited Speaker #2: Simon Julier**

2:10 pm Q&A with audience

2:20 pm Contributed Talks (3 talks, 10 mins each)

"Robust Multi-target Localisation for Measurements with Unknown Correlation", Daniel Clarke (Cranfield University)

"Event-Based Control and Estimation in Multi-agent Systems", David Casbeer and Eloy Garcia (Air Force Research Laboratory)

"Fusion Strategies for Unequal State Vectors in Distributed Kalman Filtering", Benjamin Noack (Karlsruhe Institute of Technology)

2:50 pm Session recap/group discussion ("public whiteboard time")

3:40 pm **Coffee Break**

Session 3: Future Steps and Challenges for Large-scale Data Fusion

4:00 pm **Panel discussion with government/defense experts**
Dr. Frederica Darema (AFOSR),
Dr. Michael Ouimet (SPAWAR)

5:00 pm Closing thoughts, next steps

5:30 pm **Adjourn**