November 27 – 29
2023

Combined SDF and MFI Conference 2023

Technical Program

This year the combined IEEE 2023 Symposium Sensor Data Fusion and International Conference on Multisensor Fusion and Integration (SDF-MFI) will take place in Bonn, Germany. We are happy to announce the collaboration of two great conferences on robotics, data fusion, automation and intelligent systems in combined one-track conference. The Uniclub Bonn next to the Rhine river at the center of the former capital provides a great venue. This year’s conference addresses numerous application aspects of sensor data fusion, as well as methodology oriented topics. Its 37 presentations are grouped into two tracks and in total 12 sessions. Particular emphasis is placed on advances in the field of robotics, theory of estimation and tracking, emitter localization, ground surveillance, resources management, and selected aspects of higher-level fusion. The contributions from industry, academia, and research institutions let us expect an exchange of ideas, lively discussions, and mutual cross-fertilization. For more detailed information see: https://www.fkie.fraunhofer.de/en/events/sdf2023.html.

Location: Universitätsclub Bonn e.V., Konviktstr. 9, 53113 Bonn, Germany. www.uniclub-bonn.de

Organisation

Executive Chairs:

Wolfgang Koch, Fraunhofer FKIE and University of Bonn, w.koch@ieee.org;
Uwe D. Hanebeck, Karlsruhe Institute of Technology KIT, uwe.hanebeck@kit.edu.

Technical Program Chairs:

Florian Pfaff, Karlsruhe Institute of Technology KIT, pfaff@kit.edu
Felix Govaers, Fraunhofer FKIE, Germany, felix.govaers@fkie.fraunhofer.de

Technical Program Committee

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Day 1 – Monday November 27th

8:00 – 9:00 Registration

Morning session

**Tutorial 1:** Bridging theory and applications with possibility theory
Jeremie Housineau

09:00 – 12:00

**Tutorial 4:** Emerging trends in sensing capabilities and their integration with underwater robotics
Corina Barbalata, Katherine A. Skinner, Jinwei Ye

**Tutorial 5:** Multiple Extended Object Tracking for Automotive Applications
Marcus Baum, Jens Honer

Afternoon session

**Tutorial 3:** Statistical and information-theoretic methods for multi-sensor multi-target estimation
Daniel Clark

13:00 – 16:00

**Tutorial 6:** Human-made Space Object Characterization over Large Distances
Carolin Frueh

Icebreaker (non-hosted)

18:00 –

Dinner at “John Barleycorn”, Heerstraße 52, 53111 Bonn
Day 2 – Tuesday November 28th

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<tbody>
<tr>
<td>8:00 – 9:15</td>
<td>Registration</td>
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<tr>
<td>9:15 – 9:30</td>
<td>Opening remarks</td>
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**Keynote Talk**

**Henk Blom**

*Title:* Machine Learning and AI in Future Air Transportation Design – Early Identification of Safety Issues and Feedback to Design

*Abstract:* Commercial air transport makes use of a complex socio-technical system, which involves dynamic interactions under uncertainties between distributed human decision makers, dynamical systems and infrastructure. Machine Learning and AI (artificial intelligence) developments hold great potential for the design and implementation of significant changes in this socio-technical system. Due to dynamic interactions between distributed system entities, such changes may trigger unforeseen and rare emergent behavior. From a safety perspective, this asks for early identification, and feedback to design, of such behavior. Established safety methods, currently in use in aviation and air transportation, fall short in identifying novel emergent behavior. This talk will explain the use of methods from complexity science in advanced safety analysis of future air transport designs.

*Chair:* Wolfgang Koch

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<tr>
<td>10:30 – 11:00</td>
<td>Coffee</td>
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Session 1a: Estimation I

Chair: TBD

11:00 – 11:30
Daniel Frisch, Uwe Hanebeck
Deterministic Von Mises-Fisher Sampling on the Sphere Using Fibonacci Lattices

11:30 – 12:00
Jiri Ajgl, Ondrej Straka
On Visualisation of Linear Estimation and Fusion: From Equations to Ellipses

12:00 – 12:30
Dominik Prossel
Progressive Particle Filtering Using Projected Cumulative Distributions

Session 1b: Data fusion for cameras

Chair: TBD

11:00 – 11:30
Je Sean Tan, Suthiphong Srigarom
Air-to-ground Targets Re-identification from Non-aligned and Partially Overlapped Cameras by Homography Transfer and Iterative Closest Point with Huber Loss Function

11:30 – 12:00
Jeong Min Kang, Zoran Sjanic, Gustaf Hendeby
Optical Flow Revisited: how good is dense deep learning based optical flow?

12:00 – 12:30
Maxime Roedelé, Tor Arne Johansen, Kjetil Vasstein
GNSS-Independent Maritime Navigation Using Monocular Camera Images with Digital Elevation Map

12:30 – 13:30 Lunch
## Session 2a: Estimation II

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<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Authors</th>
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</thead>
<tbody>
<tr>
<td>13:30 – 14:00</td>
<td>Classification of Uncertainty Sources for Reliable Bayesian Estimation</td>
<td>Jindrich Dunik, Ondrej Straka, Benjamin Noack</td>
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<tr>
<td>14:00 – 14:30</td>
<td>On Statistics based Prediction of Decomposed Tensor Probability Density Functions</td>
<td>Felix Govaers</td>
</tr>
<tr>
<td>14:30 – 15:00</td>
<td>Event-based Colored-Noise Kalman Filtering for Improved Resource Efficiency</td>
<td>Eva Schmitt, Benjamin Noack</td>
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## Session 2b: Automotive applications

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<th>Authors</th>
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<tbody>
<tr>
<td>13:30 – 14:00</td>
<td>Friction and Road Condition Estimation using Dynamic Bayesian Networks</td>
<td>Björn Volkmann, Karl-Philipp Kortmann</td>
</tr>
<tr>
<td>14:00 – 14:30</td>
<td>Optimizing Autonomous Vehicle Sensor Setups: A Framework for Coverage Analysis</td>
<td>Philipp Hafemann, Markus Lienkamp, Simon Hahn</td>
</tr>
<tr>
<td>14:30 – 15:00</td>
<td>Towards Adaptive Environment Perception and Understanding for Autonomous Mobile Robots</td>
<td>Christian Hofmann, Franca Taliercio, Jonas Walter, Jörg Franke, Sebastian Reitelshöfer</td>
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<tr>
<td>15:00 – 15:30</td>
<td>Coffee</td>
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Session 3a: Estimation III
Chair: TBD

15:30 – 16:00
Serkan Zobar, Mehmet Caydem, Ozgul Salor, Charles Toth, Alper Yilmaz
2D-HASAP: Two-Dimensional Heading-Aided Single-Anchor Positioning via Hidden Markov Model Map-Matching

Kouji Murakami

16:00 – 16:30
Estimation of connector insertion state based on phase spectrum of waves transmitted between robot fingers

Simon Steuernagel, Aaron Kurda, Marcus Baum

16:30 – 17:00
Point Cloud Registration based on Normal Distribution Sets and the Gaussian Wasserstein Distance

Session 3b: Odometry
Chair: TBD

15:30 – 16:00
Martin Michaelis, Philipp Berthold, Thorsten Luettel, Hans-Joachim Wünschel
Generating Odometry Measurements from Automotive Radar Doppler Measurements

Jacob M. Harter, Srikanth Saripalli

16:00 – 16:30
Online Multi-IMU Calibration Using Visual-Inertial Odometry

Kolja Thormann, Marcus Baum

16:30 – 17:00
Single-Frame Radar Odometry Incorporating Bearing Uncertainty

17:45 – 18:00
Best Paper Awards

18:00 – 19:00
Piano recital from Julia Rinderle

19:00 –
Gala dinner
Day 3 – Wednesday November 29th

Keynote Talk

Jörg Stückler

Title: From Visual SLAM to Embodied AI: Self-Supervised Learning of Action-Conditional Dynamics Models

Abstract: Beyond localization and mapping, intelligent robots require the ability to learn their action capabilities in the environment. In this talk, I will present my recent research on learning action-conditional models of robot and environment dynamics. I will detail self-supervised and physics-informed approaches that learn the action-conditional dynamics of objects and the robot and approaches that adapt online with state estimation. I will report on experimental results which demonstrate that such action-conditional dynamics models can be useful for action planning and also improve state estimation. Chair: Uwe Hanebeck

09:00 – 10:00

10:00 – 10:30 Coffee
Session 4a: Target Tracking I

Chair: TBD

10:30 – 11:00
Tim Baur, Johannes Reuter, Uwe Hanebeck
On Runtime Reduction in 3D Extended Object Tracking by Measurement Down-sampling

11:00 – 11:30
Masaki Yoneda, Karl-Magnus Dahlén, Takashi Ogawa
Extended Object Tracking with Doppler velocity-based Point Registration

11:30 – 12:00
Jens Honer, Hauke Kaulbersch
First-Order Approximation of the Random Set Cluster Process for Extended Target Tracking

Session 4b: Distributed estimation

Chair: TBD

10:30 – 11:00
Jonas Rockbach, Isabel Schlangen, Bennewitz Maren
Self-organising, Hierarchical, and Extending Distributed Sensor Fusion for Swarm Control

11:00 – 11:30
Igor Tchouchenkov, Florian Segor
Groups of heterogeneous autonomous systems in area reconnaissance

11:30 – 12:00
Amelia Samandari, Andreas Willig
Distributed Time Slot Allocation For Transmission of Sensor Data in UAV Formations

12:00 – 12:30
Conor Rosato, Alessandro Varsi, Joshua Murphy, Simon Maskell
An $O(\log_2 N)$ SMC$^2$ Algorithm on Distributed Memory with an Approx. Optimal L-Kernel

12:30 – 13:30 Lunch
Session 5a: Target Tracking II
Chair: TBD

Patrick Hoher, Johannes Reuter, Felix Govaers, Wolfgang Koch
13:30 – 14:00
Extended Object Tracking and Shape Classification using Random Matrices and Virtual Measurement Models
Alexander Scheible, Thomas Grieble, Martin Herrmann, Charlotte Herrmann, Michael Buchholz
14:00 – 14:30
Track Classification for Random Finite Set Based Multi-Sensor Multi-Object Tracking
Philipp Berthold, Bianca Forkel, Martin Michaelis, Hans-Joachim Wuensche
14:30 – 15:00
Joint Multi Extended Object Tracking by Optimizing the Global Coherence

Session 5b: Machine learning for data fusion I
Chair: TBD

Thomas Henderson
13:30 – 14:00
Geolocating and Grading Crosswalks using Deep Learning
Yan Wang
14:00 – 14:30
Localization and classification of partial occluded deformable objects with application on the downs and feathers
Joshua Gehlen, Felix Govaers, Martin Ulmke, André Fischer
14:30 – 15:00
Architecture and design of AI based air situation assessment

15:00 – 15:30 Coffee
Session 6a: Data fusion with range / direction of arrival measurements
Chair: TBD
15:30 – 16:00
Alberto Ortiz
*UWB Nodes Auto-Calibration through a Bias-Aware Two-Stage Methodology*

16:00 – 16:30
Jannik Springer, Marc Oispuu, Wolfgang Koch, Peter Knott
*Joint Emitter Localization and Calibration for Moving Array Sensors*

16:30 – 17:00
Macarena Varela, Wulf-Dieter Wirth, Marc Oispuu
*Wideband Direction-Of-Arrival Estimation Using Microphone-Arrays*

Session 6b: Machine learning for data fusion II
Chair: TBD
15:30 – 16:00
Elizabeth P. de Benedictis, Florian Drews, Florian Faion, Claudius Glaeser
*Improving object detection for truck-related classes by removing label inconsistencies*

16:00 – 16:30
Markus Walker, Uwe Hanebeck, Marcel Reith-Braun
*Identifying Trust Regions of Bayesian Neural Networks*

16:30 – 17:00
Robert Logiewa, Folker Hoffmann, Felix Govaers, Wolfgang Koch
*Dynamic Pursuit-Evasion Scenarios With a Varying Number of Pursuers Using Deep Sets*