

Bonn, October 15 – 17, 2019



# 13<sup>th</sup> Symposium *Sensor Data Fusion: Trends, Solutions, and Applications*

## Technical Program

Prior to its technological realization or the scientific reflection on it, sensor data fusion is an omnipresent capability. The result is a mental model of their individual environment, the basis of behaving appropriately. SDF Symposium 2019, the 13<sup>th</sup> in a row of annual conferences, addresses numerous application aspects of sensor data fusion, as well as methodology oriented topics. Its 23 presentations are grouped into 7 sessions. Particular emphasis is placed on advances in the theory of estimation and tracking, emitter localization, ground surveillance, resource 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: [www.fkie.fraunhofer.de/sdf2019](http://www.fkie.fraunhofer.de/sdf2019).

**Location:** Universitätsclub Bonn e.V., Konviktstr. 9, 53113 Bonn, Germany. [www.uniclub-bonn.de](http://www.uniclub-bonn.de)

## Organisation

*Executive Chairs:* **Wolfgang Koch**, Fraunhofer FKIE and University of Bonn, [w.koch@ieee.org](mailto:w.koch@ieee.org);

**Peter Willett**, University of Connecticut, USA, [p.willett@ieee.org](mailto:p.willett@ieee.org).

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## Technical Program Committee

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## Day 1 – Tuesday October 15<sup>th</sup>

### Start of SDF Symposium 2019

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12:30 – 13:30      Registration

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#### Session #1: *Automotive Applications*

**Daniel Svensson**  
13:30 – 14:00      *Derivation of the Discrete-Time Constant Turn Rate and Acceleration Motion Model*

**Muhammad A. Khan**  
14:00 – 14:30      *Comparison of Track to Track Fusion Methods for Nonlinear Process and Measurement Models*

**Stefan Haag, Bharanidhar Duraisamy, Felix Govaers, Wolfgang Koch, Martin Fritzsche, and Jürgen Dickmann**  
14:30 – 15:00      *Extended Object Tracking Assisted Adaptive Clustering for Radar in Autonomous Driving Applications*

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#### Session #2: *Anomaly Detection and Traffic Estimation*

**Kennedy J. Offor, Peng Wang, and Lyudmila Mihaylova**  
15:30 – 16:00      *Multi-Model Bayesian Kriging for Urban Traffic State Prediction*

**Martina Brötje, Giulia Batistello, and Martin Ulmke**  
16:00 – 16:30      *Verification of Sensor Data in a Maritime Multi-Sensor Network*

**Yifan Zhou, James Wright, and Simon Maskell**  
16:30 – 17:00      *A Generic Anomaly Detection Approach Applied to Mixture-of-Unigrams and Maritime Surveillance Data*

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**Guided Tour**  
17:30              *Guided tour through the city of Bonn to the icebreaker reception at Brewery Machold at Heerstr. 52.*

**Icebreaker Reception**  
18:30              *Brewery Machold*



## Day 2 – Wednesday October 16<sup>th</sup>

### Session #3: *Extended Target Tracking*

- 09:00 – 09:30 **Julian Böhler, Tim Baur, Stefan Wirtensohn, and Johannes Reuter**  
*Stochastic Partitioning for Extended Object Probability Hypothesis Density Filters*
- 09:30 – 10:00 **Hosam Alqaderi, Felix Govaers, and Raymond Schulz**  
*Spacial Elliptical Model for Extended Target Tracking Using Laser Measurements*
- 10:00 – 10:30 **Felix Govaers**  
*On Independent Axes Estimation for Extended Target Tracking*
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### Session #4: *Localization Methods and Robust Navigation*

- 11:00 – 11:30 **Luisa Still, Macarena Varela, Wulf-Dieter Wirth, and Marc Oispuu**  
*Shooter Localization with a Microphone Array Based on a Linearly Modeled Bullet Speed*
- 11:30 – 12:00 **Josef Steinbaeck, Norbert Druml, Thomas Herndl, Stefan Loigge, Nadja Marko, Markus Postl, Georg Kail, Reinhard Hladik, Gerhard Hechenberger, Herbert Fuereeder, Christian Steger, Eugen Brenner, and Christian Schwarzl**  
*ACTIVE – Autonomous Car to Infrastructure Communication Mastering Adverse Environments*
- 12:00 – 12:30 **Markus Krestel, Folker Hoffmann, Hans Schily, Alexander Charlish, and Sven Rau**  
*Passive Emitter Direction Finding Using a Single Antenna and Compressed Sensing*
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### Session #5: *Deep Learning for Data Fusion*

- 13:30 – 14:00 **Mahed Javed and Lyudmila Mihaylova**  
*Leveraging Uncertainty in Adversarial Learning to Improve Deep Learning Based Segmentation*
- 14:00 – 14:30 **Karsten Schwalbe, Alexander Groh, Frank Hertwig, and Ullrich Scheunert**  
*Data Fusion Strategy to Improve the Reliability of Machine Learning Based Classifications*
- 14:30 – 15:00 **Florian Particke, Jiaren Zhou, Markus Hiller, Christian Hofmann, and Jörn Thielecke**  
*Neural Network Aided Potential Field Approach for Pedestrian Prediction*
- 15:00 – 15:30 **Felix Nobis, Maximilian Geisslinger, Markus Weber, Johannes Betz, and Markus Lienkamp**  
*A Deep Learning-Based Radar and Camera Sensor Fusion Architecture for Object Detection*
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## Session #6: *E/O Sensors and Video Processing*

	<b>Mark Campbell and Daniel E. Clark</b>
16:00 – 16:30	<i>Joint Stereo Camera Calibration and Multi-Target Tracking Using the Linear-Complexity Factorial Cumulant Filter</i>
	<b>Peng Wang, Yueda Lin, and Lyudmila Mihaylova</b>
16:30 – 17:00	<i>Computer Vision Methods for Automating High Temperature Steel Section Sizing in Thermal Images</i>
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17:30	<b>Get Together</b> <i>Piano recital and Dinner</i>



## Day 3 – Thursday October 17<sup>th</sup>

### Keynote Talk

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09:00 – 10:30

#### **Fredrik Gustafsson**

*Fusion Theory for Positive Noise*

There is a variety of sensors for distance measurements such as radar, sonar, lidar, UWB and various radio measurements such as round trip times and signal strength decay. They all suffer from multi-path, that causes the signal propagation to get a stochastic delay. In other words, the distance measurement suffers from positive noise. We will overview elementary results from estimation theory for how order statistics improve multiple distance measurements from the same sensor one order of magnitude, compared to classical moment (mean, variance, etc) matching techniques. These results are then applied to sensor data fusion algorithms for localisation and target tracking.



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### Session #7: *Estimation Theory and Target Tracking*

11:00 – 11:30

#### **Stefano Coraluppi and Craig Carthel**

*Track-Oriented MHT with Unresolved Measurements*

11:30 – 12:00

#### **Sebastian Thomas Handke and Joshua Gehlen**

*Randomized Evolution Model for Multihypothesis Kalman Filter*

12:00 – 12:30

#### **André Fischer and Wolfgang Konle**

*Trajectory Generation from Radar Data*

12:30 – 13:00

#### **Roy Streit**

*Future Directions for Analytic Combinatorics in Tracking and High Level Fusion*

13:00

**End of SDF Symposium 2019**

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