

Journal of Advances in Information Fusion

A semi-annual archival publication of the International Society of Information Fusion

Special Issue for Journal of Advances in Information Fusion

Estimation Involving Directional Quantities

Guest editors:

Gerhard Kurz
 Karlsruhe Institute of Technology (KIT)
 Germany
 E-mail: gerhard.kurz@kit.edu

Igor Gilitschenski
 Swiss Federal Institute of Technology Zurich
 Switzerland
 E-mail: igilitschenski@ethz.ch

Brief summary of the special issue

Estimation involving directional quantities is a problem relevant in many applications that range from signal processing, robotics, and aerospace to bioinformatics and geosciences. This special issue will focus on information fusion and estimation methods based on directional statistics, a subfield of statistics that considers probability distributions on manifolds rather than on real vector spaces. The special issue will extend the scope and results of the special session "SS15-DE – Directional Estimation" at the 17th International Conference on Information Fusion (2014) as well as the special session "SS4: Directional Estimation" at the 18th International Conference on Information Fusion (2015), which received a lot of positive feedback from submitting authors. Extended versions of the results presented there will be the cornerstone of the special issue.

Guest editors' bibliographical information

Gerhard Kurz received his diploma in computer science from the Karlsruhe Institute of Technology (KIT), Germany, in 2012. He finished his PhD in 2015 at the Intelligent Sensor-Actuator-Systems Laboratory, Karlsruhe Institute of Technology (KIT), Germany. His research interests are in the field of medical data fusion, nonlinear estimation, and directional filtering.

Igor Gilitschenski is currently a postdoctoral researcher at the Autonomous Systems Laboratory, ETH Zurich. He obtained his PhD degree at the Intelligent Sensor-Actuator-Systems Laboratory, Karlsruhe Institute of Technology (KIT) in 2015. Before joining the KIT, he obtained his diploma degree in mathematics from the University of Stuttgart, Germany. His research interests include stochastic filtering theory and dynamic state estimation with a focus on nonlinear systems and nonlinear domains.

Special Issue on
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Initial Submission
 Deadline:
 October 31, 2015

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Motivation for the special issue and a general call for contributed papers to the special issue

Many estimation problems of practical relevance include the problem of estimating directional quantities, for example angular values or orientations. However, conventional filters such as the Kalman filter assume Gaussian distributions defined on \mathbb{R}^n . This assumption neglects the inherent periodicity present in directional quantities. Consequently, more sophisticated approaches are required to accurately describe the circular setting. Many state-of-the-art methods try to avoid the use of directional statistics using linear approximations, but these tend to fail if large uncertainties are involved.

In the past few years, methods based on directional statistics have gained a lot of interest in a number of communities, particularly in signal processing and robotics. One of the reasons for this newly gained popularity is the fact that methods based on directional statistics tend to have a higher computational complexity than classical methods, which has only recently become available. Also, the wide availability of cheap sensors, for example in smart phones, has increased the demands for algorithms that can deal with large uncertainties. Furthermore, researchers have been trying to push classical methods to their limits for many years now, and there is a potential of pushing beyond those limits by relying on a more sophisticated statistical foundation.

This special issue addresses fundamental techniques, recent developments, and future research directions in the field of estimation involving directional and periodic data. It is our goal to bridge the gap between theoreticians and practitioners. Thus, we welcome both applied and theoretic contributions on this topic.

Topics of interest:

- Estimation of circular or directional quantities
- Combination of periodic and linear quantities, e.g., for 6 DOF pose estimation
- Circular and directional statistics
- Statistics on the rotation group $SO(3)$ and other manifolds
- Recursive and batch filtering in a periodic setting
- Applications: tracking, robotics, medicine, biology

During the submission of the paper please clearly indicate that the submitted paper is targeted to the special issue "Estimation Involving Directional Quantities".