Quantum Computing and Quantum Physics Inspired Algorithms: Introduction and Data Fusion Examples

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Form

The tutorial will cover a half-day slot. All registered participants can obtain the slides as a download link when requested by email.

Intended Audience

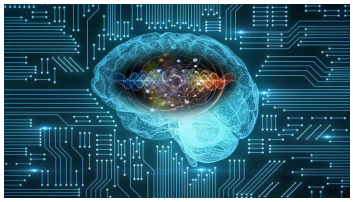
The intended audience are engineers, PhD students, or interested people who are working in the field of data fusion and target tracking. Some basic background knowledge on quantum physics can help but is not required. The interest of the audience should be in both, quantum computing and quantum inspired algorithms for data fusion. Problems, questions and specific interests are welcome for an open discussion.

Description

Quantum algorithms for data fusion may become game changers as soon as quantum processing kernels embedded in hybrid processing architectures with classical processors will exist. While emerging quantum technologies directly apply quantum physics, quantum algorithms do not exploit quantum physical phenomena as such, but rather use the sophisticated framework of quantum physics to deal with "uncertainty". Although the link between mathematical statistics and quantum physics has long been known, the potential of physics-inspired algorithms for data fusion has just begun to be realized. While the implementation of quantum algorithms is to be considered on classical as well as on quantum computers, the latter are anticipated as well-adapted "analog computers" for unprecedentedly fast solving data fusion and resources management problems. While the development of quantum computers cannot be taken for granted, their potential is nonetheless real and has to be considered by the international information fusion community.

Prerequisites

Participants should have some background knowledge on basic operations in stochastic theory, complex numbers, and linear algebra.



Bio of the Presenters

Felix Govaers received his Diploma in Mathematics and his PHD with the title “Advanced data fusion in distributed sensor applications” in Computer Science, both at the University of Bonn, Germany. Since 2009 he works at Fraunhofer FKIE in the department for Sensor Data Fusion and Information Processing where he was leading the research group “Distributed Systems” for three years. Since 2017 he is the deputy head of the department “Sensor Data and Information Fusion”. The research of Felix Govaers is focused on data fusion for state estimation in sensor networks and non-linear filtering. This includes track-extraction, processing of delayed measurements as well as the Distributed Kalman filter and track-to-track fusion. Felix Govaers is a senior member of the IEEE, where he serves for the IEEE Transactions on Aerospace and Electronic Systems and as an Associate Editor since 2014. He is member of the ISIF Board of Directors, and since 2020 Felix Govaers is a Distinguished Lecturer for the IEEE.

Martin Ulmke received the Diploma degree and the Ph.D. (Dr. rer. nat.) degree in physics from the Aachen Technical University (RWTH), Germany, in 1991 and 1995, respectively. He has been employed as a Scientist with Fraunhofer FKIE (former FGAN), Department Sensor Data and Information Fusion (SDF), since 2001. He is head of the research group “Distributed Sensor Systems” at SDF. From 1995 to 1998, he was a Research Associate in condensed matter theory with the University of California, Davis, CA, and the University of Augsburg, Germany. From 1998 to 2001, he has been employed as a Systems Engineer with MTU Aero Engines, Munich.

Wolfgang Koch studied physics and mathematics at the Aachen Technical Universität, Germany, where he earned a Dr. rer. nat. degree in theoretical physics. For many years, he has been head of the Department of Sensor Data and Information Fusion at Fraunhofer FKIE, an institute of the Fraunhofer Society, the largest institution for applied research in Europe. On various topics within the area of sensor data and information fusion, he has published a well-referenced textbook on target tracking and sensor data fusion, 16 handbook chapters, and well above 200 journal and conference articles. He is one of the coeditors of the two volume handbook Novel Radar Techniques and Applications. Wolfgang Koch is a fellow of the IEEE, where he serves for the IEEE Transactions on Aerospace and Electronic Systems and as a member of the board of governors of the Aerospace and Electronics Systems Society. In 2015, he was appointed an IEEE Distinguished Lecturer and chairman of the German IEEE AESS chapter. In 2013, he served as president of the ISIF. In his areas of expertise, he has been active in the NATO Science and Technology Organization for many years. At Bonn University, he holds a habilitation degree in applied computer science and regularly gives lecture series on sensor data and information fusion. In 2016, he was general co-chair of the IEEE ISF International Conference on Information Fusion, Heidelberg, Germany.