Francescopaolo Sica (Senior Member, IEEE) is Deputy Head of the Chair of Earth Observation at the University of the Bundeswehr Munich, Germany. He received his Ph.D. in Information Engineering in 2016 and has held research positions at the German Aerospace Center (DLR) and the European Space Agency (ESA). His work focuses on SAR signal and image processing, with an emphasis on integrating deep learning methods for enhanced data processing and analysis. Dr. Sica serves as Co-Chair of the Benchmarking Working Group of the IEEE GRSS IADF Technical Committee.

Lecture 1: Machine learning for SAR image analysis

Abstract:

An introduction is provided to machine learning techniques for analyzing Synthetic Aperture Radar (SAR) data. The unique characteristics of SAR imagery, including geometric distortions, radiometric and statistical properties, are discussed, along with the preprocessing steps required for integration into deep learning workflows. A range of methods, from classical machine learning to deep neural networks, is presented and applied to tasks such as classification, segmentation, and change detection. Real-world examples are used to illustrate how data-driven approaches can be embedded throughout the SAR processing chain.

Lecture 2: Integrating deep learning into SAR processing: from reconstruction to interpretation

Abstract:

The integration of deep learning across the SAR processing chain is explored. Learning-based methods are examined at three key levels: image formation, image enhancement, and semantic interpretation. Representative examples are presented to illustrate how traditional algorithms can be enhanced or replaced by data-driven approaches. Current trends, open challenges, and future directions for deep learning in SAR are also discussed.

Lecture 3: SAR representation learning: from supervised to self-supervised approaches and their synergies

Abstract:

SAR representation learning can enhance the performance of downstream tasks on both single-channel and multi-channel SAR data, including applications such as above-ground biomass estimation. In this lecture, SAR image restoration is introduced as a pretext task to learn meaningful and transferable representations. Both supervised and self-supervised learning approaches are examined, with a focus on their ability to extract robust features under the challenges of SAR-specific noise, geometric distortions, and limited labeled data. The complementarity between the two paradigms is discussed, showing how their integration can lead to more generalizable and effective feature embeddings. Case studies highlight the benefits of combining restoration and representation learning within the SAR processing pipeline.