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Lecture

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Earth Observation Data Science: particularities and challenges

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The volume and variety of valuable Earth Observation (EO) images as well as non-EO related data is rapidly growing. The open free data access becomes widespread and has an enormous scientific and socio-economic relevance. EO images are acquired by sensors on satellite, suborbital or airborne platforms. They extend the observation beyond the visual information, gathering physical parameters of the observed scenes in a broad electromagnetic spectrum. The sensed information depends largely on the imaging geometry, orbit, illumination and other specific parameters of the space instruments. Typical EO systems can be classified into optical or radar instruments. During the last years, both types of sensors deliver widely different images, and both have made considerable progress in spatial and radiometric resolution, image acquisition strategies, and data rates.

Therefore, the domain of EO Data Science spans from mathematical models for the satellite orbit, the physics of electromagnetic propagation and scattering, signal processing, machine learning, AI and knowledge representation. The new specific EO methods to Data Analytics and Data Mining are designed to leverage advances in physical parameters extraction and leads to AI paradigms where learning is a critical non-traditional element joining the overall EO system parameters to achieve the optimal information extraction. This involves the inclusion of machine or deep learning and reasoning tools in the EO data processing chains together with supplementary external information to analyze target characteristics, to perform classification, to search for similarities or extract semantic entities. Information-theoretic approaches are the fundament for modeling the end-2-end system behavior and analyze its performance and bounds.

Mihai Datcu received the M.S. and Ph.D. degrees in Electronics and Telecommunications from the University Politechnica Bucharest UPB, Romania, in 1978 and 1986. In 1999 he received the title *Habilitation à diriger des recherches* in Computer Science from University Louis Pasteur, Strasbourg, France. Currently he is Senior Scientist and Image Mining research group leader with the Remote Sensing Technology Institute (IMF) of the German Aerospace Center (DLR), Oberpfaffenhofen, and Professor with the Department of Applied Electronics and Information Engineering, Faculty of Electronics, Telecommunications and Information Technology, UPB. From 1992 to 2002 he had a longer Invited Professor assignment with the Swiss Federal Institute of Technology, ETH Zurich. From 2005 to 2013 he has been Professor holder of the DLR-CNES Chair at ParisTech, Paris Institute of Technology, Telecom Paris. His interests are in Data Science, Machine Learning and Artificial Intelligence, and Computational Imaging for space applications. He is involved in Big Data from Space European, ESA, NASA and national research programs and projects. He is a member of the ESA Big Data from Space Working Group. He received in 2006 the Best Paper Award, IEEE Geoscience and Remote Sensing Society Prize, in 2008 the National Order of Merit with the rank of Knight, for outstanding international research results, awarded by the President of Romania, and in 1987 the Romanian Academy Prize Traian Vuia for the development of SAADI image analysis system and activity in image processing. He is IEEE Fellow. He is holder of a 2017 Blaise Pascal Chair at CEDRIC, CNAM.