

SEMINAR ANNOUNCEMENT

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
COLLEGE OF DESIGN AND ENGINEERING
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Area: Microwave & Radio Frequency

Host: Professor Guo Yong Xin

Jointly Organized By:
IEEE MTT/AP, EMC, AES/GRSS chapters and
ECE Department, NUS

TOPIC	:	Quantum Computing for Earth Observation
SPEAKER	:	Professor Mihai Datcu German Aerospace Center (DLR) and University POLITEHNICA of Bucharest (UPB)
DATE	:	Tuesday, 26 July 2022
TIME	:	2:00PM to 3:30PM
VENUE	:	E1-06-01 SEMINAR ROOM College of Design and Engineering, NUS

ABSTRACT

At present, quantum computing and AI are the key technologies in the digital era. The progress and transfer of quantum resources for use in practical applications is in constant acceleration. Quantum computing, quantum annealing, quantum circuits, or simulators for quantum computing are currently easily accessible. The exploitation of quantum physics effects such as superposition and entanglement opens new, still unexplored perspectives. Yet, with very limited capacities, hundreds of qubits, they draw the attention stimulating the new area of quantum machine learning.

In this context the presentation will focus on relevant aspects of quantum technologies for earth observation (EO). With the goal to identify if a quantum algorithm may bring any advantage compared with classical methods, will be firstly analysed the data complexity (i.e. data as prediction advantage). Secondly, it will be presented the classes of complexity of the algorithms. Thirdly, it will be identify major challenges in EO which could not yet be solved by classical methods, as for instance the causality analysis.

Data embedding is of key importance. Non-quantum data are many times “artificially” encoded at the input of quantum computers, thus quantum algorithms may not be efficient. For instance the polarimetric SAR data are represented on the Poincare sphere which maps in a natural way to the qubit Bloch sphere. Thus, PolSAR data will not be any more processed as “signal” but directly as a physical signature. Further will be discussed the advantages of quantum annealing (D-Wave) for solving local optimization for non-convex problems. Also, the potential and advantage of the recent TensorFlow Quantum and the implementation of parametrized quantum circuits (PQC). The presentation will address the entire EO data cycle encompassing the particular features from data acquisition, understanding and modelling of the EO sensor, followed by information extraction. The quantum ML techniques are practically implemented using the open access to various quantum computers, as D-Wave, IBM, or Google. Hybrid methods will be discussed for EO, i.e. managing the I/O of the data and maximally use the resources of quantum computers and quantum algorithms.

BIOGRAPHY



Mihai DATCU received the M.S. and Ph.D. degrees in Electronics and Telecommunications from the University Politehnica 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. Since 1981 he has been Professor with the Department of Applied Electronics and Information Engineering, Faculty of Electronics, Telecommunications and Information Technology (ETTI), UPB, working in image processing and Electronic Speckle Interferometry. Since 1993, he has been a scientist with the German Aerospace Center (DLR), Oberpfaffenhofen. He is developing algorithms for model-based information retrieval from high complexity signals and methods for scene understanding from Very High-Resolution Synthetic Aperture Radar (SAR) and Interferometric SAR data. He is engaged in research related to information theoretical aspects and semantic representations in advanced communication systems. Currently he is Senior Scientist and Image Analysis research group leader with the Remote Sensing Technology Institute (IMF) of DLR, Oberpfaffenhofen.

Since 2011 he is also leading the Immersive Visual Information Mining research lab at the Munich Aerospace Faculty and he is director of the Research Center for Spatial Information at UPB. His interests are in Bayesian inference, information and complexity theory, stochastic processes, model-based scene understanding, image information mining, for applications in information retrieval and understanding of high-resolution SAR and optical observations. He has held Visiting Professor appointments with the University of Oviedo, Spain, the University Louis Pasteur and the International Space University, both in Strasbourg, France, University of Siegen, Germany, University of Innsbruck, Austria, University of Alcalá, Spain, University Tor Vergata, Rome, Italy, Universidad Pontificia de Salamanca, campus de Madrid, Spain, University of Camerino, Italy, the Swiss Center for Scientific Computing (CSCS), Manno, Switzerland. From 1992 to 2002 he had a longer Invited Professor assignment with the Swiss Federal Institute of Technology, ETH Zurich. Since 2001 he has initiated and led the Competence Centre on Information Extraction and Image Understanding for Earth Observation, at ParisTech, Paris Institute of Technology, Telecom Paris, a collaboration of DLR with the French Space Agency (CNES). He has been Professor holder of the DLR-CNES Chair at ParisTech, Paris Institute of Technology, Telecom Paris. He initiated the European frame of projects for Image Information Mining (IIM) and is involved in research programs for information extraction, data mining and knowledge discovery and data understanding with the European Space Agency (ESA), NASA, and in a variety of national and European projects. He is a member of the ESA Big Data from Space Working Group.

He and his team have developed and are currently developing the operational IIM processor in the Payload Ground Segment systems for the German missions TerraSAR-X, TanDEM-X, and the ESA Sentinel 1 and 2. He is the author of more than 200 scientific publications, among them about 60 journal papers, and a book on number theory. He has served as a co-organizer of International Conferences and workshops, and as guest editor of special issue on IIM of the IEEE and other journals. 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 representative of Romanian in the ESA Industrial Policy Committee (IPC) and Earth Observation Program Board (EO-PB). He is IEEE Fellow.

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