

Scientific Workshop

Title: Open-source electromagnetic modelling tools

Abstract: As the use cases for electromagnetics within communications and sensing continue to expand, there is a consistent need for model-based approaches to the design, integration, and simulation of complex systems and environments. This workshop will introduce the wide range of open-source packages for electromagnetics, antenna design, and complex simulation problems. After introducing the range of available packages, the landscape for transferable data standards, and their applicability to both open-source and commercially available modelling software will be discussed. A range of examples using packages including HERAS, LyceanEM, and gprMax will be introduced, and the different use cases for each package explored. Included amongst the examples will be reflector antennas, large antenna array design and modelling for communications and sensing, and ground penetrating radar.

Workshop outline:

Contributor	Title	Main topics
All speakers	Introduction on open-source EM modelling tools	Overview of the available open-source EM modelling tools
Antonis Giannopoulos University of Edinburgh, UK a.giannopoulos@ed.ac.uk	gprMax (www.gprmax.org)	Short overview of the FDTD method gprMax capabilities, limitations, and basic usage with application examples for antenna and GPR modelling.
Francesco Lisi Heriot-Watt University, UK F.Lisi@hw.ac.uk	HERAS: Heriot-Watt Reflector Antenna Solver (www.github.com/Microwave-Antenna-Engineering-Group-HWU/HERAS)	<ul style="list-style-type: none">• Physical and geometrical optics theory review.• HERAS Matlab live demo through examples.
Timothy G. Pelham University of Bristol, UK T.G.Pelham@bristol.ac.uk	LyceanEM (documentation.lyceanem.com)	Overview of LyceanEM, capabilities, limitation, and use cases. <ul style="list-style-type: none">• Rapid Virtual Prototyping• Beamforming• Wireless Power Transfer• Spatial Intelligence• Radar Models

Short CV of Speakers

Antonios Giannopoulos received the B.Sc. degree in geology from the Aristotle University of Thessaloniki, Thessaloniki, Greece, in 1991, and the D.Phil. degree in electronics from The University of York, York, U.K., in 1997. He is the Chair of Applied Geophysics and Computational Electrodynamics in the School of Engineering, The University of Edinburgh, Edinburgh, UK. His research interests include computational electrodynamics and in particular the application and development of the Finite Difference Time Domain (FDTD) method and the numerical modelling of ground penetrating radar. He has over 25 years of experience in the development and application of advanced ground penetrating radar and other geophysical techniques primarily for infrastructure sensing applications but also for applications to other areas of near surface geophysics. He created gprMax, a freely available open-source FDTD full-wave electromagnetic simulator used by many GPR researchers and practitioners worldwide, and he is directing its continuous development and enhancement. He was the General Chair of the 9th International Workshop on Advanced Ground Penetrating Radar, Edinburgh, 2017. He is a Fellow of the Geological Society of London and member of SEG and EAGE.

Francesco Lisi received the bachelor's degree (cum laude) in electronics and telecommunications engineering from the University of Florence, Italy, in 2019, and the master's degree (cum laude) in telecommunications engineering from the University of Pisa, Italy, in 2021. From April to September 2021, he was a Student Intern at the Université Paris-Saclay, CNRS, CentraleSupélec, Laboratoire des Signaux et systèmes (L2S), Paris, France, working on his master thesis project on the development of a reinforcement learning-based algorithm for massive MIMO radar systems. From November 2021 to December 2022, he joined the Microwave and Radiation Laboratory, University of Pisa, to work on near-field arrays and wireless power transfer systems. He is currently pursuing a Ph.D. degree in Electrical Engineering at Heriot-Watt University, Edinburgh, U.K., with a focus on novel resource allocation techniques for array-fed reflector satellites in collaboration with the European Space Agency and Thales Alenia Space. His research interests include antenna arrays, beamforming, near-field focusing, wireless power transfer systems, and reinforcement learning algorithms.

Timothy G. Pelham received the M.Phys. degree (Hons.) in physics from the University of Surrey, in 2009, and the Ph.D. degree from the University of Bristol, in 2018, with research into conformal antenna array design. He worked with the Oak Ridge National Laboratory, TN, USA. In 2011, he joined MBDA, as a Systems Engineer, before becoming a Senior Systems Engineer. He is currently working as a Research Fellow at the University of Bristol. He has over 13 years of experience in antennas, propagation, radar, and electromagnetics, primarily for radar and communications, but also for the application of spatial mapping techniques to onboard channel models using novel computational electromagnetics. He created LyceanEM and is currently leading the Scalable Open Electromagnetics for Solar Power (SCOPES) project, extending LyceanEM to support the design and modelling of giga scale antenna arrays for space based solar power. He has recently released an open source dataset in collaboration with Cardiff University and Spirent combining LIDAR, Computer Vision, multichannel IQ recording, and reference

GNSS position and time (GNSS Combined Vehicular Measurements [A](#) & [B](#)). This dataset has applications to autonomous navigation, GNSS interference and jamming mitigation, and digital twins for combined spatial and radio domains.