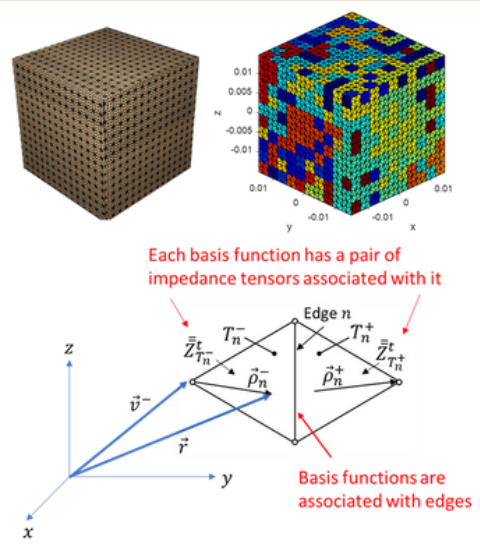
SC08-Integral Equation Based Synthesis of Metasurfaces



Abstract

This course will provide a solid foundation of numerical modelling of metasurfaces based on integral equations. Numerical design, analysis, and synthesis techniques for metasurfaces will be built up starting from Maxwell's equations. Both 2D and 3D algorithms will be presented. Rapid optimization schemes based on the Adjoint variable technique will also be presented. The student will leave with the ability to write their own integral equation based codes for metasurface design.

Recommended prerequisites

The course will require basic knowledge of mathematics, radiation, electromagnetic theory, matlab programming.

Learning objectives

1. Understand integral equation modelling of metasurfaces.
2. Solve integral equations via the method of moments in 2D and 3D
3. Write a Matlab code for the design of metasurfaces via integral equations and the method of moments
4. Understand optimization techniques for metasurface design

Course outline

1. Impedance boundary condition describing homogenized sheet impedances
2. Construction of integral equations for modelling of impedance sheets
3. Solution of integral equations via the method of moments
4. Metasurface design via integral equations in 2D
5. Metasurface design via integral equations in 3D
6. Optimization techniques for metasurface design

Students should bring a laptop with Matlab installed if they want to follow along in real time. An example recording of a similar workshop presented by the proposer of this short course can be found on my YouTube page:
https://www.youtube.com/watch?v=4wODcAIlWxg&t=2s

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Jordan Budhu received his M.S. degree in electrical engineering from the California State University, Northridge, California, USA, in 2010, and the Ph.D. degree in electrical engineering from the University of California, Los Angeles, California, USA, in 2018.

He is currently Assistant Professor in the Bradley Department of Electrical & Computer Engineering at Virginia Tech. From 2019 to 2022, he was a Postdoctoral Research Fellow in the Radiation Laboratory and a Lecturer in the Department of Electrical Engineering and Computer Science at the University of Michigan, Ann Arbor, Michigan, USA. In 2011 and 2012, he was a Graduate Student Intern at the NASA Jet Propulsion Laboratory. In 2017, he was named a Teaching Fellow at the University of California, Los Angeles. His research interests are in metamaterials and metasurfaces, computational electromagnetics algorithms for metamaterial and metasurface design, nanophotonics and metamaterials for the infrared, 3D printed inhomogeneous lens design, CubeSat antennas, reflectarray antennas, scattering from inhomogeneous, anisotropic materials, and antenna theory.

Dr. Budhu's awards and honors include the 2010 Eugene Cota Robles Fellowship from UCLA, the 2012 Best Poster award at the IEEE Coastal Los Angeles Class-Tech Annual Meeting, the 2018 UCLA Henry Samueli School of Engineering and Applied Science Excellence in Teaching Award, and the first place award for the 2019 USNC-URSI Ernst K. Smith Student Paper Competition at the 2019 Boulder National Radio Science Meeting.

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