COMPUTATIONAL ELECTROMAGNETICS

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IIT Madras

PRE-REQUISITES : Engineering Electromagnetics

INTENDED AUDIENCE : UG and PG students

INDUSTRIES APPLICABLE TO : ISRO, DRDO

COURSE OUTLINE :

This course on Computational Electromagnetics is targetted at senior undergraduate students and beginning graduate students who have taken a first course in Engineering Electromagnetics. The course covers the mathematical formulation of the main methods currently in use by the community, namely: Integral Equations Methods (and their solution by the Method of Moments), the Finite Element Method, and the Finite Difference Time Domain method. These methods are illustrated by their use in solving scattering problems and antenna radiation/impedance calculation problems. Additional topics include introduction to inverse problems, calculating the mutual coupling between antennas, finding the electromagnetic modes of a waveguide, and techniques to hybridize the Finite Element Method with the Integral Equation Method. Programming issues faced in the implementation of these methods will also be highlighted.

ABOUT INSTRUCTOR :

Prof. Uday Khankhoje is an Assistant Professor of Electrical Engineering at the Indian Institute of Technology Madras, Chennai, India, since 2016. He received a B.Tech. degree from the Indian Institute of Technology Bombay, Mumbai, India, in 2005, an M.S. and PhD. degrees from the California Institute of Technology (Caltech), Pasadena, USA, in 2010, all in Electrical Engineering. He was a Caltech Postdoctoral Scholar at the Jet Propulsion Laboratory (NASA/Caltech) from 2011-2012, a Postdoctoral Research Associate in the Department of Electrical Engineering at the University of Southern California, Los Angeles, USA, from 2012-2013, and an Assistant Professor of Electrical Engineering at the Indian Institute of Technology Delhi from 2013-2016. His research interests are in the area of computational electromagnetics and its applications to remote sensing and inverse imaging. He received an Institute award for teaching excellence at IIT Delhi in 2015 for an undergraduate course on electromagnetism.

COURSE PLAN :

Week 1: Review of vector calculus, electromagnetic fields, and an overview of computational electromagnetics

Week 2: Numerical integration, Introduction to integral equations, and the Helmholtz equation

Week 3: Surface integral equations in 2D, Green's functions

Week 4: Solving surface integral equations by method of moments

Week 5: Solving volume integral equations by method of moments, Introduction to finite element methods

Week 6: Finite element method in 1D

Week 7: Finite element method in 2D

Week 8: Finite difference time domain method - introduction

Week 9: Finite difference time domain method - materials and boundary conditions

Week 10: Finite difference time domain method - perfectly matched layers

Week 11: Applications of CEM -- inverse problems and antenna radiation problems

Week 12: Applications of CEM -- antenna radiation problems and hybrid methods