

Domain Decomposition Methods for Computational
Electromagnetics
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Abstract

This short course will introduce students into recent developments in domain decomposition methods for solving large electromagnetic problems such as large finite antenna arrays, frequency selective surfaces (FSS), metamaterials, and antenna arrays on large platforms etc. With patience in creating the problem geometries, it is now possible to solve electromagnetic problems with hundreds or even billions of finite element unknowns on simple PCs without compromise of the solution accuracy.

There will be four lectures in this short course: Introduction to domain decomposition methods, hybridization of different numerical methods, geometric non-conforming domain decomposition method, and a broadband antenna array design.

Course Description

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There will be four lectures in this short course:

1. Lecture 1: Introduction to the Domain Decomposition Methods.
Topics include – the Cement Method, Finite Element Tearing and Interconnecting Technique, Higher order Absorbing Boundary

- Conditions in vector Finite Element Methods, and High Order Transmission Conditions. Numerical Examples include simple large finite antenna arrays, frequency selective surfaces, and metamaterials.
2. Lecture 2: Hybridization of FEM and BEM through DDM and FETI Algorithm for Modeling Large Platform/Environment Effects. Many electromagnetic problems involve devices being tested under the same external environment. For example: antenna arrays on aircraft/ship, cell phone next to human head, and reflector antenna with different feeds. These types of problems can be effectively addressed by computing the numerical Green's functions through the FETI algorithm and reused repeatedly.
 3. Lecture 3: Geometric Non-Conforming DDM for Problems with Different Periodicity. The geometric non-conforming DDM is very suitable for modeling various electromagnetic problems with different periodicities at different portion of the domain. We shall demonstrate its application through antenna arrays with frequency selective surfaces that are of different periodicity.
 4. Lecture 4: Designing a Broadband Array using DDM. This lecture, we will demonstrate the power of DDM and FETI by designing a broadband antenna array. The design will be first carried out using a periodic array code. The final design, a large finite array, will then be verified through the DDM code and the edge effects being characterized.