Computer Modeling of Modern Antenna Arrays
Marinos N. Vouvakis
Obtain Transfer Fn of Building Block (FETI)

Problem Partitioning in Domains*

Adaptive Mesh Refinement on Building Blocks

Obtain Transfer Fn of Building Block (FETI)

Construct Domains Using Building Blocks*

Connect Domains using “cement” technique & Outer Loop DDM Iteration

Extract Engineering Info. Antenna Pattern, Impedance, Q Factors, etc

Recover Fields from Reduced Surface Unknowns for Each Domain

*Domain is a translation invariant instance of a Building Block.
Finite Arrays of Vivaldi Tapered Slot Antennas
Simulation over 900 million unknowns of very complicated geometry

Single Polarized

Dual Polarized

300×300

16×16×2

1 billion FEM unknowns on a PC in 1 day.

Good agreement with commercial simulators
24×12 RADAR Sub-array Module
Domain Decomposition FEM vs. Measurements

G₀=23.31dBi (Simulated)
G₀=23.44dBi (Measured)

Good agreement with measurements (impedance too)
Scattering of Patch Arrays on Finite Dielectric
Parametric Studies

Geometry

Effect of Array Size

Effect of Array Shape

Effect of Element Loading

≈17dB

≈22dB

≈12dB
Finite Patch Arrays on Truncated Cylinders

DD-FEM for Curved Structures (Rotational Symmetry)

Near & Far Fields

0° scan

Active Reflection Coeff.
Planar vs. Cylindrical Finite Patch Arrays
For Small Radius Radiation by Planar and Cylindrical Arrays is Different

Finite Planar Array

60° H-scan

Finite Cylindrical Array
Finite Arrays of Ferrite Loaded CBS Arrays
DD-FEM for anisotropic non-reciprocal materials

Geometry.

Near & Far Fields

Active Reflection Coeff.

Arrays involving complex material simulated in PCs within few hours
Monopole Radiation over EBG
Simulation of 39 million unknowns

Top View — 1.5λ away

Back View — 1.5λ away

PEC Ground Plane

AMC Ground Plane

Top View — 1.5λ away

Back View — 1.5λ away
Metamaterial Plano-concave Lens
3D simulation of 50 million unknowns, Very challenging geometry

Geometry (Top View)

Teflon Lens

Negative Refraction Lens

Split Ring Lens
Scattering by Battleship
Domain Decomposition FEM-BEM Hybrid

Memory=4.5 Gb
Electric size $\approx 60\lambda \times 12\lambda \times 8\lambda$
Initial $h=\lambda/6$
h-AMR steps 3
Iterations=39
#Unkowns=3,838,554
Solution Time- 7.6 hours