Modeling in Microwave Power Engineering: Methods & Applications

A Part of the Graduate Course "*Electromagnetismo Aplicado a la Industria*" / "*Electromagnetics Applied to the Industry*"

UNIVERSIDAD POLITECNICA DE VALENCIA

Polytechnic University of Valencia, Valencia, Spain

20-29 September, 2005

Instructor: Vadim Yakovlev*)

Profile – The course deals with fundamental and practical aspects of computer modeling of systems and processes in microwave power engineering and shows what modern advanced simulation can bring to engineers and designers working in the field. The emphasis is made on the advantages of the 3D conformal Finite Difference Time Domain method and its implementation in *QuickWave-3D*. After comprehensive introduction to the subject, the students work with computers (on which *QuickWave-3D* is installed for the duration of the course) and learn how to build *QW* models, run simulations and interpret the results. Several models of typical microwave systems and applied industrial applicators are analyzed and developed in the course projects and homework assignments (HWA). Upon completing this intensive 20 hour program containing condensed and concentrated material, the students will be able to apply *QW* modeling pursuing the goals of sophisticated research and make efficient contributions to CAD of real-life applied systems of microwave thermal processing.

Syllabus & Schedule

Tuesday, 20th September option

1. 10:00-14:00 Introduction to computer modeling of microwave systems: *why*'s, *what*'s, *how*'s. Related theoretical topics. Numerical methods; FEM vs conformal FDTD. Modeling software.
2. Computational strategy of time-domain simulation. Examples of industrial CAD projects. Modern options in modeling of coupled (electromagnetic + thermal) problems and optimization. HWA No 1

Wednesday, 21st September

3. 10:00-14:00 Basics of *QuickWave-3D* modeling: underlying electromagnetic, mathematical, computational concepts, modal templates, elements, objects, library of objects, mesh control, etc.
4. *QW-Editor* & *QW-Simulator* – main functions and commands. Key components of a model: media properties, input/output parameters. Principles of interpretation of the results. HWA N 2.

Friday, 23rd September

5. 10:00-14:00 Building *QW* models via the *Element Approach*. Pulse excitation. *Project No 1*: Thin diaphragm in a rectangular waveguide. Computation of *S*-parameters. HWA No 3.
6. Sinusoidal excitation. *Project No 2*: Loaded microwave oven excited by a slotted waveguide. Computation of the electric field and dissipated power and their visualization. HWA No 4.

Monday, 26th September

7. 10:00-14:00 Building *QW* models via the *Object Approach*. *Project No 3*: Parameterized model of a big microwave oven – modification of a library object. HWA No 5
8. UDO language and files. *Project No 4*: Parameterized model of a waveguide power window – combination of series of library objects. Concept of "manual" optimization. HWA No 6.

Wednesday, 28th September

9. 10:0-14:00 *Project No 5*: Parameterized model of a multi-fed cavity for microwave thermal processing. Simulation and analysis of the results. HWA No 7.
10. Avanced topics: open problems, import/export of files, control over *QW* operations from *MATLAB*, modeling of moving objects.

Thursday, 29th September

11. 10:00-14:00 Review of the projects and HW problems, concluding remarks, general discussion.

*) Industrial Microwave Modeling Group, Center for Industrial Mathematics & Statistics, Department of Mathematical Sciences, Worcester Polytechnic Institute, 100 Institute Rd., Worcester, MA 01609, USA, Tel.: +1 (508) 831 5495, e-mail: vadim@wpi.edu

WPI CIMS Center for Industrial Mathematics and Statistics IMMG Industrial Microwave Modeling Group