

# 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, 20<sup>th</sup> September**

- 1.** 10:00-10:50 Introduction to math and computer modeling of microwave systems: *why's, what's, how's*. Related theoretical topics. Numerical methods; FEM vs conformal FDTD. Modeling software.
- 2.** 12:10-14:00 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, 21<sup>st</sup> September**

- 3.** 10:00-11:50 Basics of *QuickWave-3D* modeling: underlying electromagnetic, mathematical, computational concepts, modal templates, elements, objects, library of objects, mesh control, etc.
- 4.** 12:10-14:00 *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, 23<sup>rd</sup> September**

- 5.** 10:00-10:50 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.** 12:10-14:00 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, 26<sup>th</sup> September**

- 7.** 10:00-10:50 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.** 12:10-14:00 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: Project No 5

### **Wednesday, 28<sup>th</sup> September**

- 9.** 10:00-10:50 Project No 6: Parameterized model of a multi-fed cavity for microwave thermal processing. Simulation and analysis of the results. HWA No 7.
- 10.** 12:10-14:00 Advanced topics: open problems (Project No 7: patch antenna), import/export of files, control over QW operations from *MATLAB*, modeling of moving objects. .

### **Thursday, 29<sup>th</sup> September**

- 11.** 10:00-10:50 Hints & tips; QWUG forum. Projects & HWA – review. Concluding remarks, general discussion.

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