



# Short Course in Electromagnetic Modeling for Microwave Processing

**I M S, Morrisville, N C**

**February 18, 2003**

**Instructor: Vadim Yakovlev\*)**

**Profile** – The course briefly covers fundamental and practical issues in computer modeling of systems and processes in microwave (MW) power engineering and shows what modern advanced simulation can bring to engineers and designers of the microwave heating applications. The emphasis is made on the advantages of the Finite Difference Time Domain method and its implementation in *QuickWave-3D*, the 3D conformal FDTD EM simulator. Examples of modeling of practical applicators and their elements are presented. The participants work with their computers (on which *QuickWave-3D* is installed for the duration of the course) and thus get hands-on experience and deeper impression on the process of modeling of applied MW systems.

## **Course Syllabus**

8:30 – 9:00 am:	<b>Installation of <i>QuickWave-3D</i></b>
9:00 – 10:00 am:	<b>1. Computational Electromagnetics: Basics of Numerical Analysis</b> Introduction to the course. Related theoretical points in electromagnetics: conceptual aspects of EM modeling: <i>why's</i> , <i>what's</i> and <i>how's</i> . Maxwell's equations. Major numerical techniques. FDTD and FEM.
10:10 – 10:50 am:	<b>2. Electromagnetic Simulators &amp; Concepts of Modeling of Microwave Heating</b> Database of EM software applicable to modeling of microwave heating scenarios. Test problem solved by different simulators; recommended solvers. Strategic objectives of modeling.
11:00 – 12:10 am:	<b>3. Modeling with <i>QuickWave-3D</i> : Computational Strategy &amp; Its Practical Implementation</b> Computational strategy of FDTD modeling of microwave heating and <i>QuickWave-3D</i> . Characterization and comparison of element and object approaches in making projects. Building pro-files: mesh control, modal templates.
12:10 – 1:30 pm:	<b>B r e a k</b>
1:30 – 2:50 pm:	<b>4. Making <i>QuickWave-3D</i> Models: <i>Element Approach</i></b> Practical work with the software: creation of element models from scratch (including discretization and excitation): MW domestic oven with a food load. Computation with a pulse and sinusoidal excitation. Analysis of the software output.
3:00 – 3:40 pm:	<b>5. Making <i>QuickWave-3D</i> Models: <i>Object Approach</i></b> Practical work with the software: creation of object models from scratch: MW domestic oven or industrial batch system. Basics of the UDO language. Import of SAT files.
3:50 – 4:30 pm:	<b>6. More on Practical Modeling, Post-Processing and Optimization</b> Simulation of components and applicators: high power water loads, slotted waveguide as a radiating element; industrial modeling at FCI. System optimization: ETAC applicator and GAE 5.8 GHz dry load. Work with the <i>QuickWave User Group</i> ( <a href="http://www.wpi.edu/~qwug">www.wpi.edu/~qwug</a> ).
4:30 – 5:00 pm:	<b>General discussion</b>

\*) The Industrial Microwave Modeling Group, Dept. of Mathematical Sciences, Worcester Polytechnic Institute, 100 Institute Rd., Worcester, MA 01609, USA, [vadim@wpi.edu](mailto:vadim@wpi.edu)