Why set up a modelling SME when you are student?

- the economic impact of QuickWave software

Malgorzata Celuch

QWED Sp. z o.o.

Abstract

"An entrepreneur knows that setting up in business is a risk. They need a robust business plan (..) and competitor analysis and a good knowledge of the market." [1] - I knew none of this, when I was a Ph.D. student - or more precisely, a student on a maternity leave. When my studies on electromagnetic modelling methods [2] began to contradict the then-established dogmata, and journal submissions were hindered by never-ending reviews, my supervisor suggested proving our concepts on the market. The delayed paper [3] was published when a beta-version of QuickWave was already being tested at four universities, and in 1997 we founded QWED to supervise its futher commercial developments. This talk will present selected (non-confidential) examples of **how QuickWave modelling has impacted**:

1. **QWED** (www.qwed.eu) - grown first on licence sales, and then also on software-based consulting and measurements; now a company of 10 persons successfully competing with corporations of 10 thousand in the field of EM simulations and material test fixtures;

2. our **projects**, from Eureka E!2602 [4] to the on-going H2020 MMAMA [5];

2. our **partners** in material research, from improving the safety of reheated frozen foods [4] to reducing the energy consumption in mineral rock comminution [6];

3. our **first users** in US space labs, who became our great marketing force by publishing their QuickWave results in such famous project as the Atacama Large Millimeter Array [7];

4. our **industrial customers**, e.g. a leading supplier of domestic microwave ovens, who found QuickWave "not only as the best but also very significantly better than the contenders" and reported "a drastic improvement in our possibilities to model the whole microwave system".

I focus on **bilaterally coupled** EM-thermal modelling of materials [8], which distinguishes QuickWave from its competitors on the EM simulations market. **QWED seeks collaborations to develop new materials models for QuickWave**, enhancing its industrial relevance.
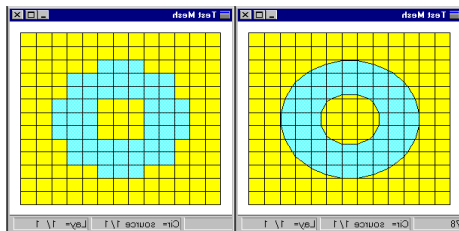
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# QuickWave conformal FDTD modelling: electromagnetics and beyond

Malgorzata Celuch and Marzena Olszewska - Placha

QWED Sp. z o.o.

QuickWave software was launched onto the market in 1997, by a team of enthusiasts who believed it possible to induce microwave enginners to use computer modelling in place of simple but approximate design formulae, and to trust it as much as hardware prototyping. The software solves **Maxwell** equations with the in-house **conformal FDTD** method [1,2], which emulates the physical processes directly in the time domain (TD) and retains the numerical efficiency of the classical finite-difference (FD) approach, while approaching the geometrical fidelity of finite elements with natural immunity to spurious modes [2]. Different types of **materials** [3-6] and **interfaces** [7,8] are modelled, and **coupling** to thermal [9], kinetic [10] and optical [8] effects is provided. QWED team **seeks collaborations** to extend QuickWave system with the modelling of **new media types and physical phenomena**, to further proliferate the modelling in industry and increase its relevance to material science.

Standard stair-case FDTD meshing versus conformal FDTD in *QuickWave*.
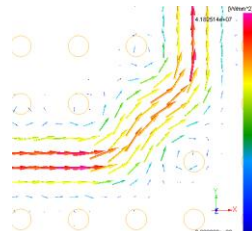
Poynting vector distribution in a photonic crystal structure.
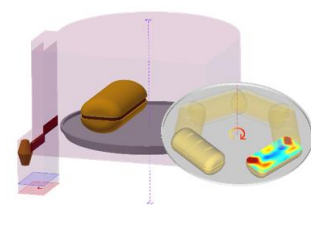
Multiphysics modelling of enthalpy distribution in Whirlpool max oven.

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