



Center for High-Frequency Technologies and Applications

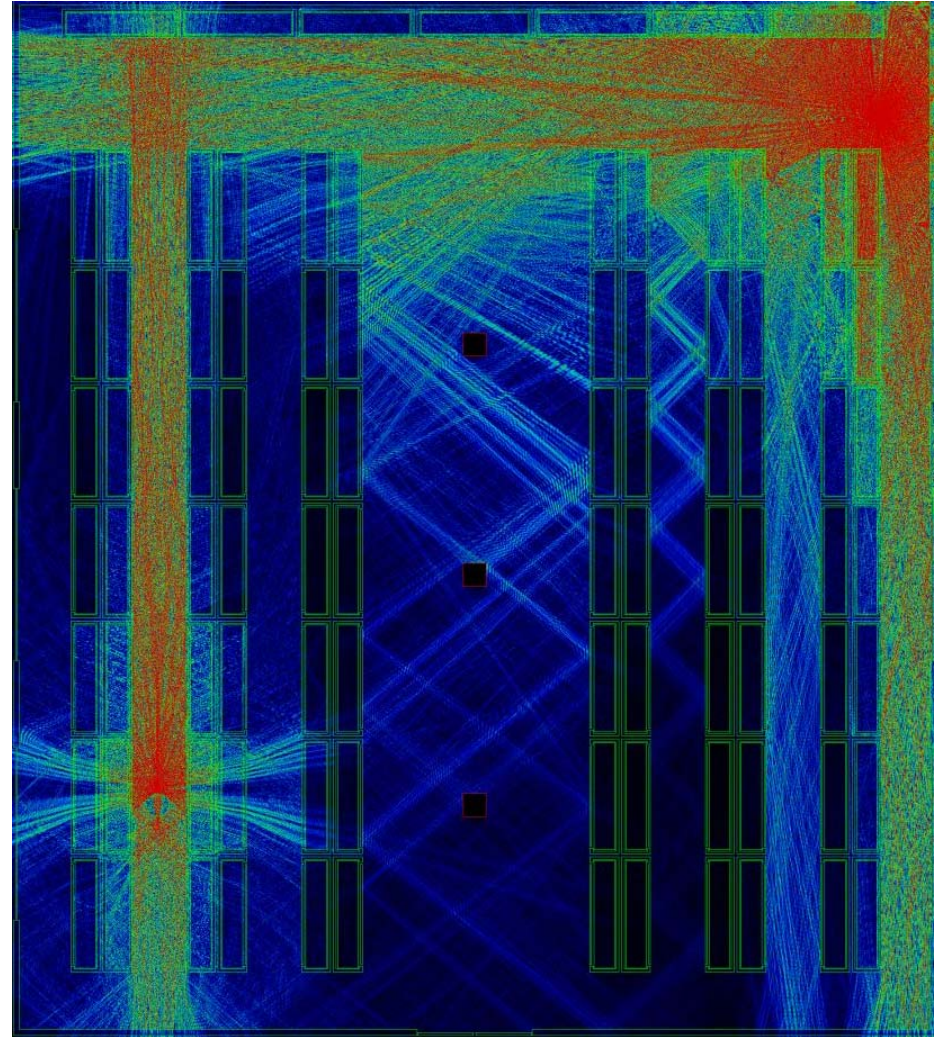
Efficient Modeling of Large Structures

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Technology Developer

- Electrically large problems: very high computational resources
- Methods of Moments (MoM): discretization in N unknowns, with N typically between 10 to 20 per wavelength
Accurate, but memory and computational complexity scale unfavorably with N , namely both of order $O(N^2)$
- Improving MoM with Multilevel Fast Multipole Algorithm (MLFMA) reduces memory requirements and solving time drastically. Complexity is now of order $O(N \log N)$.
- Several MLFMA and descendants are (being) developed:
 - **2D and 3D piecewise homogeneous materials in the frequency domain**
 - **Large planar microwave structures (2.5D) such as antenna arrays**
 - **Modeling of hysteresis phenomena on a microscopic scale**
 - **Parallelization of the algorithms over multiple processors**

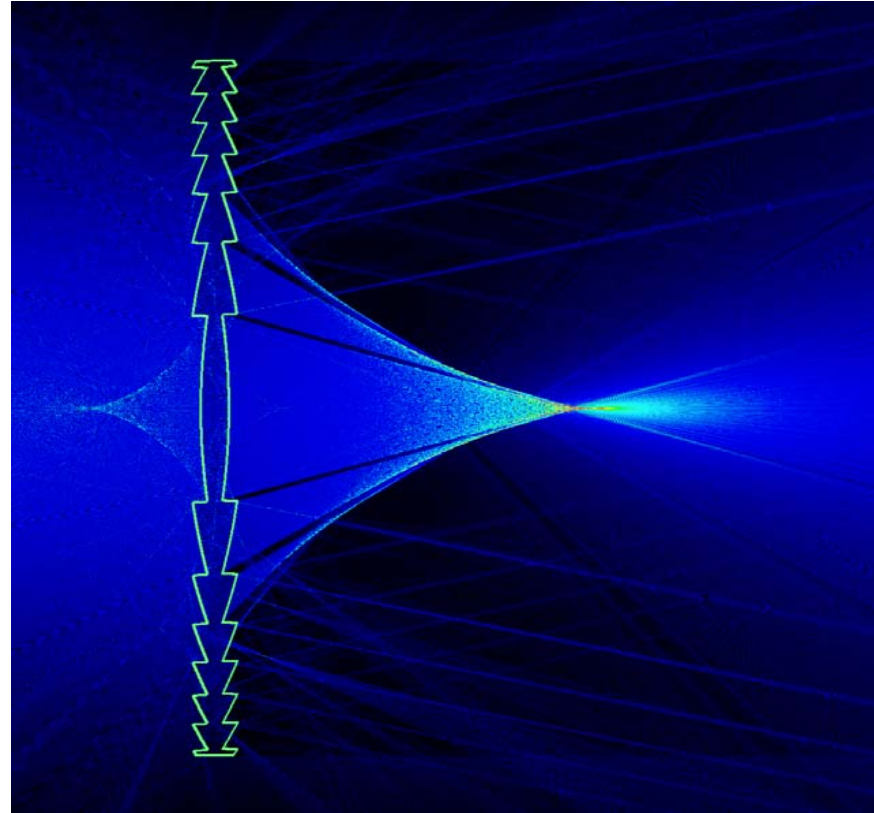
Indoor propagation:

- Fictitious library shelving (18 m x 16 m)
- Two line sources at 40 GHz (1 A and 0.5 A)
- ca. 8 million unknowns
- classical approach: not feasible
- parallel MLFMA (24 CPUs at 2 GHz)
- Solving time: ca. 5.5 hours



Fresnel lens:

- incident Gaussian beam at 230 nm
- ca. 3 million unknowns
- classical approach: not feasible
- parallel MLFMA (12 CPUs at 2 GHz)
- Solving time: ca. 6 hours



“Open FMM”: collection of **open source electromagnetic software** for scattering at very large objects → <http://openFMM.intec.UGent.be/>

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