

An efficient method for solving quasi-periodic problems of thermal diffusion

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In this talk we are concerned with transient thermal diffusion problems involving quasi-periodic source terms, and large scale factors in space and time. Typically, we consider a microelectronic device of some micrometers thickness and some centimeters length. We then inject a peak of power every ten microseconds, for a simulation interval length of some seconds.

Commonly used methods like Finite Elements Method (FEM) are not able to properly account the thermal behavior in this kind of problems. We first show that the Boundary Elements Method (BEM) with transient heat kernel permits to obtain the physically expected results. Then a partial application of Fast Multipoles Method (FMM) permits us to reduce CPU time and memory storage making the method efficient for industrial medium-sized problems.

Finally, the phenomenon being quasi-periodic, we don't need to calculate it for every power peak. In order to exploit this property, we propose to consider the BEM system as an integrated dynamical system in time. We write in fact the representation formula for the temperature and the flow to obtain a system where appears clearly an identity and an operator acting on the same spaces. After a primary capture on some microseconds using the modified BEM describe above, we reproduce the simulation on the remaining time using a Karhunen-Love technic. As all the power peaks are not exactly the same, the decomposition base is enriched at every iteration.