

Fast solver for the heat equation in unbounded domains

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Abstract

We describe a fast solver for the heat equation. The emphasis will be on unbounded domains and moving boundaries. The new algorithm relies on several tools: the spectral approximation of the free-space heat kernel, the nonuniform fast Fourier transform, and accurate quadrature methods for the evaluation of heat layer potentials.

Unlike finite difference and finite element techniques, diffusion into an infinite medium is satisfied analytically, avoiding the need for artificial boundary conditions on a finite computational domain.

The method is explicit, unconditionally stable, and requires an amount of work of the order $O(MN \log N)$, where N is the number of discretization points in physical space and M is the number of time steps.

An example from dendritic solidification will be presented.