Approximations of Green's Functions and Fast Algorithms

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008 Kemeny Hall, 4:00 pm
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Abstract

We use separated representation of Green's functions to obtain efficient fast algorithms designed to yield any finite accuracy requested by the user. This talk provides a brief overview of the approach with an emphasis on approximations used in the construction.

We first consider separated representations of non-oscillatory free-space Green's functions via a near optimal linear combination of decaying Gaussians. We then extend the approach to Green's functions satisfying Dirichlet, Neumann or mixed boundary conditions on simple domains and briefly describe some extensions to non-convolution kernels. We also briefly elucidate some delicate theoretical issues related to the construction of periodic Green's functions for Poisson's equation.

Extending our approach to oscillatory Green's functions, we split their application between the spatial and the Fourier domains. In the spatial domain we use a near optimal linear combination of decaying Gaussians with positive coefficients and, in the Fourier domain, a multiplication by a band-limited kernel obtained by using new quadratures appropriate for the singularity in the Fourier domain. Applying this approach to the free space and the quasi-periodic Greens functions, as well as those with Dirichlet, Neumann or mixed boundary conditions on simple domains, we obtain fast algorithms in dimensions two and three for computing volumetric integrals.

This talk should be accessible to graduate students. 1323261353