
Eran Treister
**A fast Multigrid approach for solving the Helmholtz
equation with a point source**

408-3515 Wesbrook Mall
UBC
Vancouver
BC

Canada V6T1Z4
`eran@cs.technion.ac.il`
Eldad Haber

Solving the discretized Helmholtz equations with high wave numbers in large dimensions is a challenging task. However, in many scenarios, the solution of these equations is required for a point source. In this case, the problem can be reformulated and split into two parts: one is a solution of the eikonal equation for the travel time, and the second is a solution of a complex-valued advection-diffusion-reaction (ADR) equation for the amplitude. The eikonal equation for the travel time can be solved efficiently by several existing solvers in the literature. Given the travel time, the ADR equation for the amplitude can be efficiently solved by standard multigrid methods, since the solution for the amplitude is typically smooth in this case. The only difference between our numerical solution and a solution of the original discretized Helmholtz equations is due to discretization and roundoff errors. Numerical results show that this is an efficient solution algorithm for a wide range of frequencies.