

It is often noted that the Helmholtz equation is extremely difficult to solve, in particular, for high-frequency solutions in heterogeneous media. Since stability for second-order discretization methods requires to choose at least 10-12 grid points per wavelength, the discrete problem on the possible coarsest mesh is huge. In realistic simulation, it is required to choose 20-30 points per wavelength for a reasonable accuracy; it is hard to solve. This article is concerned with the high-frequency asymptotic decomposition of the wavefield for an efficient and accurate simulation for the high-frequency numerical solution of the Helmholtz equation. It has been numerically verified that the new method is accurate enough even when one chooses 4-5 grid points per wavelength.