Hybrid numerical-asymptotic methods for wave scattering problems

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Linear wave scattering problems (e.g. for acoustic, electromagnetic and elastic waves) are ubiquitous in science and engineering applications. However, conventional numerical methods for such problems (e.g. FEM or BEM with piecewise polynomial basis functions) are prohibitively expensive when the wavelength of the scattered wave is small compared to typical lengthscales of the scatterer (the so-called "high frequency" regime). This is because the solution possesses rapid oscillations which are expensive to capture using conventional approximation spaces. In this talk we outline recent progress in the development of "hybrid numerical-asymptotic" methods, which incur significantly reduced computational cost. These methods use approximation spaces containing oscillatory basis functions, carefully chosen to capture the high frequency asymptotic behaviour. In particular we discuss some of the interesting challenges arising from nonconvex, penetrable and three-dimensional scatterers.