Abstract for East Asia Section of Inverse Problems International Association (IPIA) - 7th Young Scholar Symposium (Dec 9-10, 2023)

Asymptotic Analysis for the Wave Equation with Applications

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In this talk, we show our recent results on asymptotic analysis for the wave equation, and then discuss their applications. First, we consider the time-domain wave scattering by a cluster of small sound-soft obstacles. We derive the asymptotic expansion of the solution as the size of the holes goes to zero. A rigorous justification of the asymptotic expansion is shown under natural conditions on the cluster of holes. Its application to the effective medium theory is also discussed. Second, we consider a time-domain wave equation model with small high contrast particles. We show the asymptotic expansion of the solution, and then apply it to an inverse source problem. Finally, we extend the above result to the locally variable wave speed case. By injecting high contrast particles inside the domain to image, we reconstruct not only the source function but also the variable wave speed.