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Connecting Integral Equation and Unified Transform Methods for Wave Scattering

Friday, February 5, 2016 9:00 AM (35 minutes)

In this talk we discuss the application of the unified transform method, due to A.S. Fokas and co-authors, to interior and exterior problems for time harmonic waves. Like integral equation methods, the method reduces to the solution of a problem on the boundary of the domain in question. We discuss numerical implementations, restricting the solution space to a finite-dimensional subspace, and explain how some implementations can be interpreted as Galerkin methods, the convergence of which can be established by standard arguments. We focus particularly on implementations that are based on approximation by plane waves (and generalised, evanescent plane waves), and explain that these can be implemented in such a way that the numerical solution is precisely the best approximation from the plane wave subspace. In the case of scattering by diffraction gratings we note that this particular unified transform method is in fact precisely the SS* method proposed previously (though with a less precise analysis) in Arens, Chandler-Wilde and De Santo (2006), where it is derived as a first kind integral equation formulation. Further details can be found in [1,2].

[1] Acoustic scattering: high frequency boundary element methods and unified transform methods. S N Chandler-Wilde & S Langdon, in "Unified Transform for Boundary Value Problems: Applications and Advances", A S Fokas & B Pelloni (editors), SIAM, 2015.

[2] When all else fails, integrate by parts" - an overview of new and old variational formulations for linear elliptic PDEs. E A Spence in "Unified Transform Method for Boundary Value Problems: Applications and Advances", A S Fokas & B Pelloni (editors), SIAM, 2015.

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