Plane Wave Expansions, Optimal Local Radiation Boundary Conditions, and Propagation Algorithms

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We discuss the representation of solutions of hyperbolic systems in the time-domain using translating exact or approximate solutions: plane waves, curvelets, and what we call complete plane waves. The latter are half-space representations which both propagate and decay. We show that they lead to highly efficient local radiation boundary condition sequences satisfying optimal complexity estimates. Precisely, an auxiliary variable formulation with $O\left(\ln\frac{1}{\epsilon}\cdot\ln\frac{cT}{\delta}\right)$ degrees-of-freedom per boundary point suffices to achieve an error less than ϵ up to time T assuming sources are separated by δ from the artificial boundary. We also consider the direct use of all three expansions in algorithms to propagate waves to remote locations.