

Multi-valued Solution and Level Set Methods In Computational High Frequency Wave Propagation

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We review the level set methods for computing multi-valued solutions to a class of nonlinear first order partial differential equations, including Hamilton-Jacobi equations, quasi-linear hyperbolic equations, and conservative transport equations with multi-valued transport speeds. The multivalued solutions are embedded as the zeros of a set of scalar functions that solve the initial value problems of a time dependent partial differential equation in an augmented space. We discuss the essential ideas behind the techniques, the coupling of these techniques to the projection of the interaction of zero level sets and a collection of applications including the computation of the semiclassical limit for Schrödinger equations and the high frequency geometrical optics limits of hyperbolic wave equations.