Liouville Equations and Hamiltonian Systems with Discontinuous Hamiltonians: Computation of High Frequency Waves in Heterogeneous Media

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We introduce Eulerian methods that are efficient in computing high frequency waves through heterogeneous media. The method is based on the classical Liouville equation in phase space, with discontinous Hamiltonians (or singular coefficients) due to the barriers or material interfaces. We provide physically relavant interface conditions consistent with the correct transmissions and reflections, and then build the interface conditions into the numerical fluxes. This method allows the resolution of high frequency waves without numerically resolving the small wave lengths, and capture the correct transmissions and reflections at the interface. We will extend this method to deal with diffractions and quantum barriers.