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Control of Quantum Fluid Dynamics and Adaptive Phase Compensation for Laser Propagation in Turbulence JONATHAN GUSTAFSSON, SIVAGURU S. SRITHARAN, Air Force Institute of Technology — Equations of High Energy Laser propagation in a turbulent medium and the equations of quantum fluid dynamics are connected through a mathematical transformation. In this way the problem of adaptive phase compensation can be phrased as an initial velocity control problem for quantum fluid dynamics. The quantum hydrodynamics equation can be derived by applying the Madelung transformation to the time-dependent linear or nonlinear Schrödinger equation. The resulting equations are similar to incompressible Euler equations with an additional term denoted the quantum pressure term. The quantum hydrodynamics equation can thus be a good way to understand adaptive optics and laser propagation through the atmosphere. A Riemann solver within the Clawpack framework has been developed. An initial value optimization problem will be solved using adjoint methods. The initial phase can be controlled when the beam leaves the laser appartus. The control method can also be coupled to a Navier-Stokes solver in order to study thermal blooming where the laser heats the air and changes the index of refraction. The change in refractive index will in turn affect the propagation of the Laser beam. Using optimal control techniques, it is possible to adjust the beam in order to compensate for the heating.

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