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A Convectively Filtered Regularization of Multi-Dimensional Burgers Equation GREGORY NORGARD, KAMRAN MOHSENI, University of Colorado, Boulder — Multi-dimensional Burgers equation, $\mathbf{u}_t + \mathbf{u} \cdot \nabla \mathbf{u} = \nu \triangle \mathbf{u}$, can be considered as a simplified model of fluid dynamics. By sharing the convective nonlinear terms, it exhibits characteristics similar to those in the Euler and Navier-Stokes equations, particularly shocks and turbulence. Shocks and turbulence can both be attributed to the accumulation of energy in the high frequency wave modes, caused by the nonlinear term $\mathbf{u} \cdot \nabla \mathbf{u}$. Typically this energy cascade is halted by introducing viscosity, balancing the nonlinearity with dissipation. An alternative solution is replacing the convective velocity with a low pass filtered velocity, $\bar{\mathbf{u}}$. The filtering reduces the energy in the higher wave modes, reducing the rate of the energy cascade. This method has been shown to regularize shocks in one-dimensional inviscid Burgers, $u_t + \bar{u} u_x = 0$. This research extends this result into multiple dimensions with the equation, $\mathbf{u}_t + \bar{\mathbf{u}} \cdot \nabla \mathbf{u} = 0$. The existence and uniqueness of a continuously differentiable solution is proven for a general class of filters. This regularization is then compared and contrasted with viscous Burgers in areas such as constants of motion, energy decay, shock thickness, and spectral energy decompositions.

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