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Geometric and Global Properties in PDE with applications.

Abstract: The theory of degenerate parabolic equations is used to analyze the process of contour enhancement in image processing. Problems with high gradients are known to occur in effective nonlinear diffusion approaches since the work of Perona and Malik. We use the evolution model of Sethian and Malladi. The front is then simplified to a 1D situation to focus on the shock formation. It turns out that the standard initial-value problem solved in this theory does not fit the present application since it does not produce image concentration. Due to the degenerate character of the diffusivity at high gradient values, a new free boundary problem with singular boundary data can be introduced, and it can be solved by means of a non-trivial problem transformation. The asymptotic convergence to a sharp front is established and rates calculated.