

Image Enhancement and Denoising by Complex Diffusion Processes

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Abstract

The linear and nonlinear scale spaces are generalized in the complex domain, by combining the diffusion equation with the simplified Schrödinger equation. A fundamental solution for the linear case is developed. Preliminary analysis of the complex diffusion shows that the generalized diffusion has properties of both forward and inverse diffusion. An important observation, supported theoretically and numerically, is that the imaginary part can serve as an edge detector (smoothed second derivative scaled by time), when the complex diffusion coefficient approaches the real axis. Based on this observation, we develop two nonlinear complex processes: a regularized shock filter for image enhancement and a ramp preserving denoising process.

1 Introduction

The scale-space approach is by now a well established multi-resolution technique for image structure analysis (see [24],[14],[21]). Originally, the Gaussian