DIGITAL IMAGE RESTORATION USING LINEAR PDE-BASED FILTERING MODELS

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Rezumat. *Modelele de filtrare a zgomotului Gaussian bazate pe ecuații cu derivate parțiale (PDE) liniare sunt discutate în această lucrare. Soluțiile de restaurare a imaginilor digitale bazate pe ecuații de difuzie liniare sunt mai întâi descrise. În continuare, propriile noastre contribuții în acest domeniu al procesării de imagini, reprezentând modele PDE liniare de filtrare eficiente bazate pe ecuații diferențiale hiperbolice și stocastice, sunt prezentate. Rezultate ale experimentelor noastre de filrare sunt de asemenea oferite în acest articol.*

Abstract. *The linear partial differential equation (PDE) - based models for Gaussian noise removal are discussed in this paper. The digital image denoising and restoration solutions based on linear diffusion equations are surveyed first. Then, our own contributions in this image processing domain, representing some effective linear PDE-based filtering models based on hyperbolic and stochastic differential equations, are presented. The results of our denoising experiments are also provided in this article.*

Keywords: image denoising and restoration, Gaussian noise, unintended effects, linear diffusion, equation, hyperbolic PDE model, stochastic equation.
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1. Introduction

Partial differential equation (PDE) - based models have been applied successfully in the digital image processing and analysis domain in the last 35 years, because the conventional techniques have many drawbacks and cannot solve properly some important tasks related to this field [1]. Such a task is the preservation of the essential details during the denoising and restoration processes.

Second-order nonlinear PDE-based filtering schemes, like the Perona-Malik anisotropic diffusion model [2], TV-ROF Denoising [3] and other diffusion-based and variational methods [4], outperform the classic 2D filters [1], since they remove the additive Gaussian noise, overcome the blurring effect and preserve the essential features, like the edges and corners. Unfortunately, these nonlinear diffusion-based filters may generate the unintended effects, like the staircasing.

Some improved nonlinear PDE variational models that alleviate this undesired effect, such as the Adaptive TV denoising [5], TV-L1 model [6], anisotropic

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