Image restoration based on the $p(x)$-biharmonic operator

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Abstract

Image restoration plays an important role in various fields and aims to obtain a regularized versions of a noisy or corrupted image. It is a very challenging task mainly in medical imaging and in particular in ultrasound images which are usually highly corrupted with multiplicative noise which affects image analysis methods by making important features hard to detect. In this work, we propose a nonstandard high-order variational model for ultrasound image denoising and we prove its well-posedness. The model is solved via a system of Euler Lagrange equations which give rise to a nonlinear$p(x)$-biharmonic PDE. We use an iterative scheme based on the semi-implicit method in order to linearise the obtained fully nonlinear PDE. Then, in order to preserve the important features of the image, we consider a variable exponent function p chosen adaptively based on the map furnished by edge-detector which is constructed form high-order derivatives. Finally, some numerical results and comparison with other models are presented in order to illustrate the effectiveness of our approach.

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