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FAKULTÄT FÜR MATHEMATIK
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Einladung zur öffentlichen Defensio von

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Thema der Dissertation:

Elastography as a Hybrid Imaging Technique

Abstract: While classical imaging methods, such as ultrasound, computed tomography or magnetic resonance imaging, are well-known and mathematically understood, a host of physiological parameters relevant for diagnostic purposes cannot be obtained by them. This gap is recently being closed by the introduction of hybrid, or coupled-physics imaging methods. They connect more than one physical modality, and aim to provide quantitative information on optical, electrical or mechanical parameters with high resolution. Central to this thesis is the mechanical contrast of elastic tissue, especially Young's modulus or the shear modulus. –

Different methods of qualitative elastography provide interior information of the mechanical displacement field. From this interior data the nonlinear inverse problem of quantitative elastography aims to reconstruct the shear modulus. –

In this thesis, the elastography problem is seen from a hybrid imaging perspective; methods from coupled-physics inspired literature and regularization theory have been employed to recover displacement and shear modulus information. –

The overdetermined systems approach by G. Bal is applied to the quantitative problem, and ellipticity criteria are deduced, for one and several measurements, as well as injectivity results. Together with the geometric theory of G. Chavent, the results are used for analyzing convergence of Tikhonov regularization. Also, a convergence analysis for the Levenberg Marquardt method is provided. –

As a second mainstream project in this thesis, elastography imaging is developed for extracting displacements from photoacoustic images. A novel method is provided for texturizing the images, and the optical flow problem for motion estimation is shown to be regularized with this texture generation. The results are tested in cooperation with the Medical University Vienna, and the methods for quantitative determination of the shear modulus evaluated in first experiments. –

In summary, the overdetermined systems approach is seen to have powerful connections to the theoretical analysis of the elastography problem, and a novel method for photoacoustic elastography was developed for the qualitative and quantitative imaging problem.

Prüfungssenat:

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