universität wien

FAKULTÄT FÜR MATHEMATIK
Dekan Univ.–Prof. Dr. Harald Rindler

Einladung zur öffentlichen Defensio von

Mag.rer.nat Thomas Glatz

Thema der Dissertation:

Photoacoustic Inversion Based on In-depth Wave Models

Abstract: Photoacoustic tomography (PAT) is an emerging coupled physics imaging modality. Its potential applications embrace clinical and pre-clinical diagnosis, as well as non-destructive testing in industrial processes. In PAT, a laser-light induced ultrasonic wave that encodes parameters of physiological interest, is measured outside the object. The photoacoustic problem consists of reconstructing these parameters from the measurements. In cases of one or even two varying acoustic parameters, the standard reconstruction procedure is time reversal. It consists in solving a time-reversed wave equation on a bounded domain. In contrast, in this work the photoacoustic problem is formulated as an operator equation. A Landweber iteration allows to stably reconstruct a regularized solution giving convergence in cases where photoacoustic inversion is ill-posed, like in the presence of noise or when the underlying speed of sound is trapping. A second aim is to enhance the quality of the reconstructed image by a non-equidistant arrangement of the detection sensors. On a planar domain and for constant speed of sound, there exists an exact frequency domain reconstruction formula. The key to a feasible realization of this formula lies in the efficient evaluation of the data's Fourier transform at non-equispaced points in temporal frequency domain, which is done by the use of a non-uniform fast Fourier transform. A concluding example treats Photoacoustics as imaging modality in elastographic imaging. A sequence of photoacoustic images displays the mechanical deformation of the features of interest in a simulated elastographic experiment. Photoacoustic imaging is considered to be not ideally suited for elastography, since its high-contrast images often contain large homogeneous areas. In contrast to the standard approach, we consider the use of band-limited data, which we prove to encode certain additional texture. We show that this band-limitation serves as regularization within the reconstruction procedure, and experimentally verify that for the hereby obtained speckle-prone images, the deformation can be more reliably estimated.

Prüfungssenat:

Univ.-Prof. Dr. Josef Hofbauer (Vorsitz)
(Universität Wien)

Univ.-Prof. Dipl.-Ing. Dr. Otmar Scherzer
(Universität Wien)

Univ.Prof. Dipl.-Ing. Dr. Barbara Kaltenbacher
(Universität Klagenfurt)

Univ.-Prof. Ilaria Perugia, PhD
(Universität Wien)

Zeit: Donnerstag, 07. April 2016, 11:00 Uhr

Ort: Fakultät für Mathematik, Besprechungsraum 09. Stock, Oskar-Morgenstern-Platz 1