MODERN CHALLENGES IN IMAGING

Research talks on the 100th birthday of Tufts Nobel Laureate Allan Cormack

Thursday, April 18 & Friday, April 19

IN THE FOOTSTEPS OF ALLAN CORMACK - DYNAMIC (COMPUTERIZED) TOMOGRAPHY

Bernadette Hahn, Universität Stuttgart

Thursday, April 18 3:00pm, JCC 502 | Tea at 2:45pm in JCC 501

ABSTRACT: Cormack's original work on X-ray CT assumed that the searched-for quantity is stationary during X-ray data acquisition. However, this is violated in many modern applications, e.g. due to physiological motion of a patient or scanner movement. Such dynamic behavior leads to inconsistent data sets and standard algorithms do not work. We will use microlocal analysis to analyze the problem, and we derive numerical schemes to reduce artefacts in the reconstructed image and to improve the overall image quality.. We further present an alternative strategy that treats the dynamic behavior as uncertainty in the forward model. Both reconstruction approaches are evaluated on simulated and real CT-data with different dynamic behavior.

A DATA-DRIVEN APPROACH ENHANCED BY NEURAL NETWORKS TO ADDRESS MODEL INEXACTNESS AND MOTION IN IMAGING

Gaël Rigaud, Universität Stuttgart

Friday, April 19 3:30pm, JCC 260 | Tea at 3:00pm in JCC 501

ABSTRACT: Dynamic inverse problems (when the object changes while being scanned) cause artifacts if standard reconstruction methods are used. This motion causes model inexactness. For instance, in computerized tomography (CT), the movement of the patient alters the nature of the data and, intrinsically, the model itself. Since the motion is in general unknown, it implies that the model is not exactly known. This also occurs for different reasons in Compton CT, where we also have to account for large measurement noise. To tackle these issues, we study two data-driven techniques, namely the regularized sequential subspace optimization and a Bayesian method based on the generalized Golub-Kahan bidiagonalization. We then explore the possibilities to mimic and improve the stochastic approach with deep neural networks. The results are illustrated by simulations.

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