Numerical Analysis and Scientific Computing Seminar

Can Compressed Sensing Accelerate High-Resolution Photoacoustic Tomography?

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Abstract: The acquisition time of current high-resolution 3D photoacoustic tomography (PAT) devices limits their ability to image dynamic processes in living tissue (4D PAT). In our work, we try to overcome this limitation by combining recent advances in spatio-temporal sub-sampling schemes, variational regularization and convex optimization with the development of tailored data acquisition systems. We first show that images with good spatial resolution can be obtained from suitably sub-sampled PAT data if sparsity-constrained image reconstruction techniques such as total variation regularization enhanced by Bregman iterations are used. A further increase of the dynamic frame rate can be achieved by exploiting the temporal redundancy of the data through the use of sparsity-constrained dynamic models. While simulated data from numerical phantoms will be used to illustrate the potential of the developed methods, we will also discuss the results of their application to different measured data sets. Furthermore, we will outline how to combine GPU computing and state-of-the-art optimization approaches to cope with the immense computational challenges imposed by 4D PAT..
Joint work with Marta Betcke, Simon Arridge, Ben Cox, Nam Huynh, Edward Zhang and Paul Beard.

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