TEMPLE UNIVERSITY
Department of Mathematics

Applied Mathematics and Scientific Computing Seminar

Wednesday, 15 April 2015, 4:00 p.m.
Room 617 Wachman Hall

(refreshments and social at 3:45 p.m)

Filtering and Uncertainty Quantification for Image Deblurring

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Abstract. Images recorded by cameras or medical imaging devices are usually contaminated by blur and noise that come from factors such as the motion of the camera or the object, lens imperfections, or atmospheric turbulence. The restoration of such images is challenging since the problem is ill-posed. Even if the blur is known (e.g., due to the motion or defocus), the noise is unknown and random.

We assume that the noise-free problem satisfies the Picard condition and define and estimate the Picard parameter, the index beyond which the data, expressed in the coordinate system of the singular value decomposition, is dominated by noise. Having this parameter available allows us to estimate the mean and standard deviation of the noise and drop noisy components, thus making filtered solutions much more reliable. We show how to compute a near-optimal choice of filter parameters for any filter. This includes the Tikhonov filter, the truncated singular value decomposition (TSVD) filter, and several new filters which we define, including a truncated Tikhonov filter, a Tikhonov-TSVD filter, a Heaviside filter, and a spline filter. We demonstrate the usefulness of these filters and of our near-optimal choice of parameters for restoring blurred images and for uncertainty quantification of the error in the reconstruction.

This is joint work with Viktoria Taroudaki.