**Total generalized variation :**
**From regularization theory to applications in imaging**

Kristian Bredies

Total generalized variation (TGV) functionals have shown to be effective penalties for variational imaging problems which allow to selectively regularize on different levels of smoothness. In particular, they are edge-aware similar to the total variation (TV) but also incorporate higher-order information leading to the absense of typical TV-induced artifacts like staircasing. Their convexity is moreover a convenient feature for algorithm design and numerical computations.

In this talk, we start with discussing fundamental regularization properties of TGV for symmetric tensors in a functional-analytic framework. It turns out that TGV constitutes a regularizer for inverse problems in essentially the cases where it is possible to regularize with TV. We then discuss a general algorithmic framework which is suitable for the solution of TGV-regularized problems. The applicability to standard imaging problems like denoising, deblurring and compressed sensing is shown. Furthermore, we present various applications, in particular in magentic resonance imaging and image decompression, where with the help of TGV, one is able to obtain state-of-the-art high-quality reconstructions.