2. Joint reconstruction and segmentation of tomographic data using the Potts model

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ABSTRACT. We propose a new algorithmic approach to the non-smooth and non-convex Potts problem (also called piecewise-constant Mumford-Shah problem) for inverse imaging problems. We derive a suitable splitting into specific subproblems that can all be solved efficiently. Our method does not require a priori knowledge on the gray levels nor on the number of segments of the reconstruction. Further, it avoids anisotropic artifacts such as geometric staircasing. We demonstrate the suitability of our method for joint image reconstruction and segmentation. We focus on Radon data, where we in particular consider limited data situations. For instance, our method is able to recover all segments of the Shepp-Logan phantom from 7 angular views only. We illustrate the practical applicability on a real PET dataset. As further applications, we consider spherical Radon data as well as blurred data.

This is joint work with Andreas Weinmann, Jürgen Frikel, and Michael Unser.

3. Detectable singularities in time-dependent tomographic imaging

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ABSTRACT. The acquisition of tomographic data takes a considerably amount of time. For example, in computerized tomography, the x-ray source has to be rotated around the investigated object. Temporal changes of the object during this time period lead to inconsistent data. Hence, the application of standard reconstruction methods causes motion artifacts in the images which can severely impede the diagnostic analysis.

To reduce the artifacts, the reconstruction method has to take into account the dynamic behavior of the specimen. Thus, the development of motion compensation algorithms is an important challenge in tomographic imaging. In addition, it is essential to understand how the object's deformation affect the overall information content within the data. For example, certain singularities of the specimen might not be gathered by the measured data, although they would be visible if the object was stationary during the scanning. The presented talk addresses these challenges with a special focus on computerized tomography.