Universität Stuttgart

mathematik physik fakultät8

Kolloquium
des Fachbereichs Mathematik

Es spricht am Montag, 10. Dezember 2018 um 16:00 Uhr

Dr. techn. Andreas Langer
(Universität Stuttgart)

zum Thema:

"Efficient Numerical Methods for Total Variation Minimisation"

Abstract: In applications in image reconstruction (e.g. denoising, deblurring, inpainting) one is interested in restoring the original image from given corrupted measurements. This leads in general to an ill-posed inverse problem and hence regularisation is needed. A possibility to obtain a good approximation of the original image is the minimisation of a functional consisting of a data term, which enforces the consistency between the observed and reconstructed data, a regularisation term, preventing overfitting, and a parameter weighting the influence of the two terms. Since images usually contain edges and discontinuities, the total variation plays a fundamental role in imaging as a regularisation technique.

In the last decades, in the literature, there have been introduced many different approaches and algorithms for minimising the total variation. These standard techniques are iterative-sequentially formulated and therefore not able to solve large scale simulations in acceptable computational time. For such large problems we need to address methods that allow us to reduce the problem to a finite sequence of subproblems of a more manageable size, perhaps computed by one of the standard techniques. With this aim, in the first part of the talk we introduce domain decomposition methods for total variation minimisation. Thereby the crucial difficulty is the correct treatment of the interfaces of the domain decomposition patches. Due to the non-smoothness and non-additivity of the total variation, one encounters additional difficulties in showing convergence of more general subspace correction strategies to global minimisers. In particular there do exist counterexamples indicating failure of splitting techniques. Nevertheless, in this talk we propose domain decomposition algorithms for total variation minimisation with the guarantee of convergence to a minimiser of the original global problem. In particular, we present the first successful approach of a domain decomposition strategy for total variation minimisation with a rigorous convergent analysis in an infinite dimensional setting.

In the second part of the talk we discuss how to choose a proper regularisation parameter in the considered non-smooth imaging problem. In fact, badly chosen parameters either may not only remove noise but also details in images, or retain noise in homogeneous regions. Hence a good reconstruction may be obtained by choosing the parameters such that a good compromise of the aforementioned effects are made. We revisit the discrepancy principle and demonstrate how it can be used for finding suitable parameters in imaging problems. However, since images consist of multiple objects of different scales, it is expected that a spatially varying weight would give better reconstructions than a globally constant parameter. In this vein we propose an algorithm for computing distributed weights. We study the convergence behaviour of the proposed algorithms and present several numerical experiments for image reconstruction.

Der Vortrag findet im Sitzungssaal 8.122 der Fakultät Mathematik und Physik, Pfaffenwaldring 57, 70569 Stuttgart-Vaihingen statt. Interessenten sind herzlich eingeladen!

Die Dozentinnen und Dozenten des Fachbereichs Mathematik