



universität  
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Fakultät für Mathematik

## Mathematisches Kolloquium

Mittwoch, 24. Oktober 2018

HS 13, 2. Stock

### EINLADUNG

**Michael Unser**

(EPFL, Lausanne Switzerland)

**"New representer theorems: From compressed sensing to deep learning"**

## **"New representer theorems: From compressed sensing to deep learning"**

**Abstract:** Regularization is a classical technique for dealing with ill-posed inverse problems; it has been used successfully for biomedical image reconstruction and machine learning. In this talk, we present a unifying continuous-domain formulation that addresses the problem of recovering a function  $f$  from a finite number of linear functionals corrupted by measurement noise. We show that depending on the type of regularization---Tikhonov vs. generalized total variation (gTV)---we obtain very different types of solutions/representer theorems. While the solutions can be interpreted as splines in both cases, the main distinction is that the spline knots are fixed and as many as there are data points in the former setting (classical theory of RKHS), while they are adaptive and few in the case of gTV. Finally, we consider the problem of the joint optimization of the weights and activation functions in a deep neural network subject to a second-order total variation penalty. The remarkable outcome is that the optimal configuration is achieved with a deep-spline network that can be realized using standard ReLU units. The latter result is compatible with the state-of-the-art in deep learning, but it also suggests some new computational/optimization challenges.

**15.45 Uhr: Kaffeejause**

**16.15 Uhr: Vortrag**

**vinum cum pane im Anschluss**

Otmar Scherzer  
Christian Krattenthaler