Topics in Mathematics of Information (M24)

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In an increasingly data driven world, there is an essential need for efficient acquisition techniques, the correct representation of signals and the ability to extract meaningful information from signals. This is an introductory course to the mathematics behind such techniques. This course will cover the following topics:

- The representation and approximation of signals, in particular, linear and nonlinear approximation in Fourier and wavelet bases.
- Efficient data acquisition by exploiting the inherent sparse structure of signals, in particular, an introduction to compressed sensing.
- Topics in inverse problems, in particular, the use of total variation regularization to exploit the geometric structures of the underlying signals.

Pre-requisites

This course assumes knowledge in analysis and linear algebra. Additional knowledge in partial differential equations, functional analysis, variational calculus is beneficial, but not mandatory.

Literature

1. Foucart, Simon and Holger Rauhut. *A mathematical introduction to compressive sensing.* Birkhuser, 2013.
2. Mallat, Stéphane. *A wavelet tour of signal processing: the sparse way.* Academic press, 2008
3. Chambolle, Antonin, et al. *An introduction to total variation for image analysis.* Theoretical foundations and numerical methods for sparse recovery 9.263-340 (2010): 227.

Additional support

Three examples sheets will be provided and three associated examples classes will be given. There will be a one-hour revision class in the Easter Term.