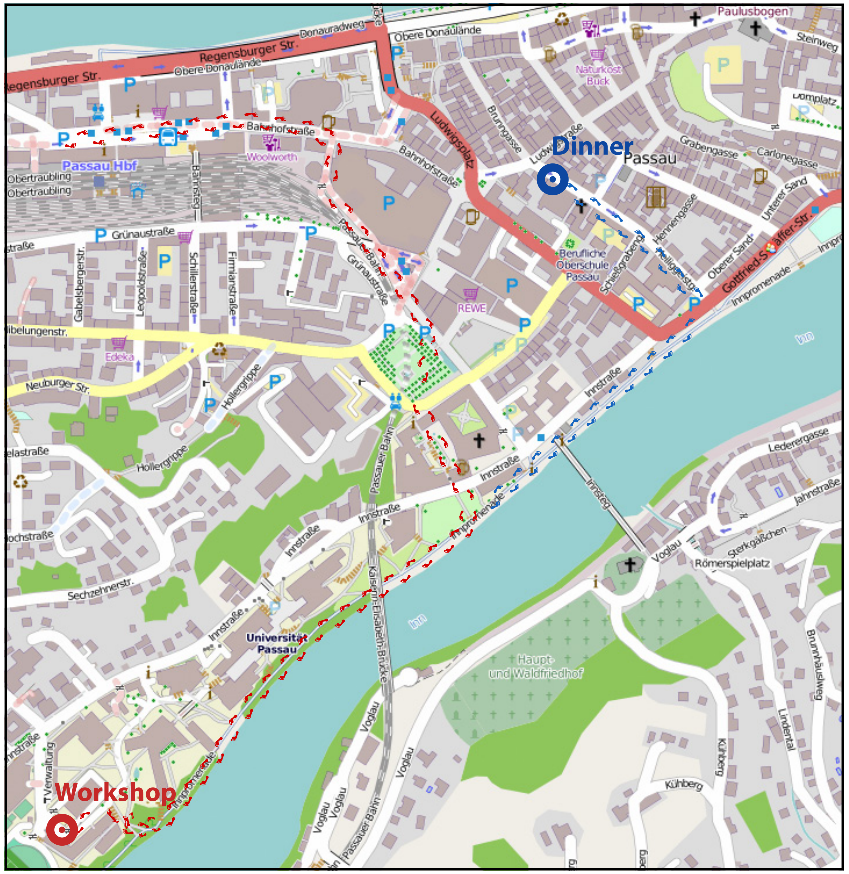

3rd Workshop Donau-Isar-Inn 2016

Approximation Theory and Applications

July 15, 2016
Room: ITZ SR 004

14:30
Hans G. Feichtinger, Universität Wien
Irregular Sampling and Wiener Amalgam Spaces

15:30
Björn Bringmann, TU München
Solution Paths of ℓ^1-Regularizations

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16:00 – Coffee break

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16:45
Hartmut Führ, RWTH Aachen
Wavelet Approximation Theory in Higher Dimensions

17:45
Thomas Takacs, JKU Linz
Approximation Properties of B-Splines and their Application to Isogeometric Analysis

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19:00 – Dinner

Session I

Hans G. Feichtinger, Universität Wien

Irregular Sampling and Wiener Amalgam Spaces

The so-called irregular sampling theorem is a good example if one wants to illustrate the use of function spaces, Banach frames, Riesz projection bases etc. in action, and not just in an abstract Hilbert space setting.

The starting point is usually the famous Shannon sampling theorem, which allows to show that a band-limited signal, whose spectrum is supported on some interval of the frequency domain, can be recovered from equidistant samples, as long as they gap size is at most the inverse of the length of the spectral interval, i.e. if samples are taken at the Nyquist rate or at a higher sampling rate. Variants of this theorem allow to formulate this results, which in its original form is just an orthogonal expansion of a band-limited functions, in the context of weighted L^p-spaces. The theory of irregular sampling, established in the early 90th, demonstrates that recovery is possible, usually in an iterative way, if only the maximal gap size is strictly less than the Nyquist rate.

For the proof it is very helpful to make use of so-called Wiener amalgam spaces, i.e. spaces which allow to control local and global properties of a function or a measure kind of independently. The talk will give hints, how such spaces can be easily understood and put to good use in order to settle the problem.

Björn Bringmann, TU München

Solution Paths of ℓ^1-Regularizations

To reconstruct a signal from a few linear measurements, one often computes the minimizers of energy functionals with a quadratic data fidelity term and an ℓ^1-regularization. The data fidelity term captures how closely we fit the measured data, while the ℓ^1-regularization imposes prior information about the signal to be reconstructed. The choice of the regularization parameter t, which determines the trade-off between fitting the data and satisfying the prior information, is often a delicate issue. Instead of solving the problem for a fixed regularization parameter t, I will explain how to compute a solution for every nonnegative parameter, i.e., a solution path.

Session II

Hartmut Führ, RWTH Aachen

Wavelet Approximation Theory in Higher Dimensions

The success of wavelets in applications such as signal and image processing is to a large degree based on their approximation theoretic properties. The central mathematical statement that summarizes these properties is the characterization of smoothness spaces such as Besov spaces in terms of summability conditions on the wavelet coefficients. In more modern terminology, the elements of a Besov space can be understood as the sparse signals with respect to the wavelet systems.

In higher dimensions, an increasing variety of generalized wavelet systems becomes available, each of which inducing its own spaces of sparse signals. In this talk, the methodology of *coorbit spaces*, developed by Feichtinger and Gröchenig, is introduced as a very general and flexible means of describing spaces of sparse signals over generalized wavelet systems. The method depends crucially on Wiener amalgam estimates, and it provides very general consistency and discretization results for the wavelet systems under review. Here consistency refers to the important property that, for any two analysing wavelets within a well-understood class of functions, the spaces of sparse signals coincide.

Thomas Takacs, JKU Linz

Approximation Properties of B-Splines and their Application to IGA

Isogeometric Analysis (IGA) is a numerical method, which uses the B-spline or NURBS based representation of CAD models to discretize PDE problems. To analyze the methods one has to study the approximation and stability properties of piecewise polynomial function spaces.

Here, we restrict ourselves to B-spline spaces of maximum smoothness and arbitrary degree over a uniform mesh. For this configuration, we present approximation error bounds and inverse estimates of optimal order, independent of the polynomial degree. We develop all results in Sobolev spaces.

To conclude, we discuss the application of the obtained results in the context of IGA for partial differential equations and present possible extensions.