WAVELETS

from MATH to PRACTICE

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Abstract. Wavelets represent a new class of functions, which are characterized by some common properties. They are called waves due to their oscillatory nature, and diminutive is used because they have compact supports. Wavelets generate new approximate space bases that fit better in the least-square sense functions with a variable frequency content.

The most important novelties that wavelets bring to the least-square approximation technique are:

- The wavelet representation is given in the space-frequency domain, opposite to the Fourier analysis that enables only the frequency representation. Compact supports of wavelets insure space, and their oscillatory nature insure frequency representation of a transformed function. It is clear that such representation is essential for the non-stationary signal processing, which is prevailing in applications.

- The wavelet representation of a function has the multiresolution property, which means that it is given on several resolution scales. Details defined on various refinement levels (fine meshes) are added to the rough approximation determined on a coarse mesh. If we make a good choice of a basis so that it matches the given function well, corrections (details) mostly can be neglected as they will be small. The dimension of the data set that store information about our function is considerably decreased while the most important information is not lost. This is basic for a good compression that saves storage and time. Data compression is fundamental for the development of information and communication technologies, but also for efficient mathematical modelling of large-scale processes.

Modern wavelet theory defines outlines for construction of wavelets and transformations using them. It gives rules that one has to obey to get a wavelet basis with desired properties, meaning that everyone can create a wavelet adequate for the given task. This course will give some mathematical and signal processing aspects of this theory.

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