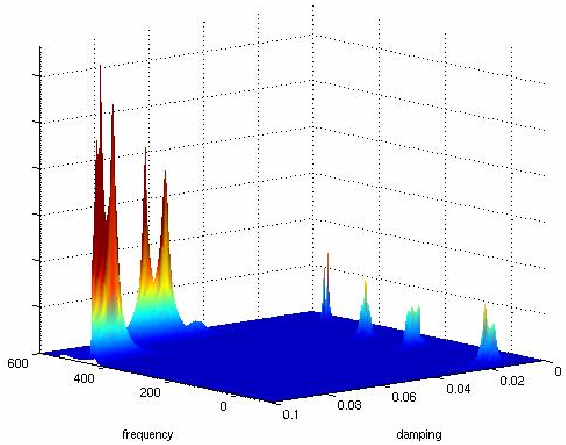
UPPSALA UNIVERSITET

Spectral Analysis

Spectral Analysis is the Rainbow of Signal Processing !

Spectral Analysis (SA) applications are omnipresent. Learn tools that can be used to find the cycles of the sunspots or of the stock market, to monitor the vibrations of a mechanical structure, to derive the period of a quasar, to image a human brain, to determine the composition of a chemical or biological compound, to estimate the pitch frequency of a speech signal, to use radar imagery for mapping the surface of Venus, to uncover buried landmines by using a ground penetrating radar, and (most important of all...) to use your mobile phone more efficiently.

This course will teach you the set of tools required to perform SA in any of the above applications (and the list never ends). SA determines how the power of a signal varies over frequency (temporal SA) or over space (spatial SA). You see results of temporal SA every day: the screen of your CD player shows the power of the played sounds in various frequency bands. You use spatial SA every day, too, when you locate sound sources around you by means of your ears (an array of two sensors). The rainbow and the color spectrum are also results of SA. So you are already a subconscious user of SA. Following the course you will become a conscious spectral analyzer.



The first picture on this page shows the results of a magnetic resonance spectroscopy experiment, which relies on temporal SA. The frequency and damping values of the peaks tell us which substances exist in the compound under analysis, and the peak heights tell the concentrations of those substances.

The second figure shows an image of Uppsala obtained by using a radar system that makes use of spatial SA. The building number 2 in Polacksbacken, where the SA group is located, is visible in the image - try to find it.

Prerequisites: Senior (4th year) engineering students should have the necessary knowledge (e.g. Fourier analysis and statistics) to understand the basics of SA.

Goal: To teach methods that can be used to solve a large variety of temporal and spatial SA problems, and show that SA of signals is not easy but can be fun.

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