Thursday, 26/2/98	**14.00 – 14.45**

Wavelet analysis of functional images of the brain

Michael Unser
Swiss Federal Institute of Technology (EPFL), CH-1015 Lausanne

While there are many possible choice of wavelets, splines have some clear advantages for biomedical imaging. First, unlike most other wavelet bases, they provide a continuous image representation that is easily computable at any spatial location — this property is crucial for implementing geometrical transformations. Second, they have the best approximation properties among all popular wavelet families. We will substantiate this latter claim by presenting an exact formula for the asymptotic L_2-approximation error as the scale (or sampling step) gets sufficiently small. In particular, we will show that splines at half the resolution can provide a better approximation than Daubechies' wavelets at twice the rate. In fact, the equivalent spline subsampling factor is better than two: it converges to π as the order gets sufficiently large !

We will apply multiresolution splines and wavelets to develop efficient techniques for the analysis of series of functional magnetic resonance images of the brain. First, we will consider the problem of movement compensation and describe an iterative image registration algorithm that uses a coarse-to-fine refinement strategy. Images (or volumes) are represented in a multiresolution spline pyramid that also provides a perfect basis for performing rotations and translations. Second, we will describe a wavelet-based solution to the detection and localization of significant patterns of brain activity. The advantage over the traditional pixel-based approach is two-fold : improvement of the signal-to-noise ratio, and a drastic reduction in the number of statistical tests.