SEMINARIO DE ANÁLISIS Y APLICACIONES

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11:00 h., Módulo 17 - Aula 520 (Depto. Matemáticas UAM)

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Some issues in the mathematical modeling of brain's visual cortex

Resumen:

Brain's visual cortex operates on signals, provided by the retina, which encode visual stimuli. The full visual cortex is divided in several layers, each one performing different tasks at different levels of abstraction. The activity of each layer results from the activity of neural cells as single processing units, as well as on the propagation of information in the network of axonal connectivities. In the first layer, primary visual cortex, different families of cells can be described as orbits of different Lie groups, and their activity is close to the associated wavelet transform. Propagations along connectivities can then be parametrized as diffusion processes on Lie groups. This allows to reproduce patterns of brain's activity actually observed in neurophysiological experiments. Phenomena of visual perception, such as the detection of objects in motion, can also be reproduced in terms of diffusion clustering on the graph of activated cells. Different learning strategies have been proposed to reproduce the behavior of cells on a single layer, most notably in terms of the so-called sparsity functional. On the other hand, the structure of the full visual cortex has provided the first heuristics for the construction of the currently ubiquitous algorithms of deep learning. This talk aims to present a panoramic view of these and other issues arising in the mathematical modeling of this area of the brain, and to mention in passing some currently open problems.