Feedback Controlled Computational Structures for Vision

Roger W. Brockett

At the peak of their popularity neural networks were thought to be computational structures that could learn to respond effectively to a wide range of inputs and back propagation was thought to be able to account for any required learning. However, in the subject of computer vision, for example, neural networks have not proven to be especially successful. A deeper study of neural circuitry found in nature suggests that feedback on short time scale plays a significant role. In this paper we adopt the point of view that visual processing can be best thought of as being carried out by a parametrized family of algorithms whose parameters are adjusted in real time by a feedback rules that drive the parameters to values that result in a suitably simple representation of the current image. From this point of view, one would not look for the best edge detection algorithm but rather look for a feedback law that would set the parameters in a parametrized family of edge detection algorithms. We will give a wide variety of examples based on scaling Fourier transforms, scaling texture, adjusting segmentation, scaling Radon transforms, etc. The resulting conceptual picture is that of a computational structure that is highly opportunistic in that for a fixed input it uses feedback to adjust itself on the basis of the results of speculative computations and which is capable of rapid readjustment when the input changes.