Spatial Organization of Neural Networks: A Probabilistic Modeling Approach

Authors:

Andreas Stafylopatis, Marios Dikaiakos, D. Kontoravdis

Abstract:

The aim of this paper is to explore the spatial organization of neural networks under Markovian assumptions, in what concerns
the be(cid:173) haviour of individual cells and the interconnection mechanism. Space(cid:173) organizational properties of neural nets are very relevant in
image modeling and pattern analysis, where spatial computations on stocha(cid:173) stic two-dimensional image fields are involved. As a first approach
we develop a random neural network model, based upon simple probabi(cid:173) listic assumptions, whose organization is studied by means of
dis(cid:173) crete-event simulation. We then investigate the possibility of ap(cid:173) proXimating the random network's behaviour by using an analytical ap(cid:173)
proach originating from the theory of general product-form queueing networks. The neural network is described by an open network of
no(cid:173) des, in which customers moving from node to node represent stimula(cid:173) tions and connections between nodes are expressed in
terms of sui(cid:173) tably selected routing probabilities. We obtain the solution of the model under different disciplines affecting the time
spent by a sti(cid:173) mulation at each node visited. Results concerning the distribution of excitation in the network as a function of network topology and external stimulation arrival pattern are compared with measures ob(cid:173) tained from the simulation and validate
the approach followed.