ParaGro: A Learning Algorithm For Growing Parallel Self-Organizing Maps With Any Input/Output Dimensions

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Self-organizing maps (SOM) have become popular for tasks in data visualization, pattern classification or natural language processing and can be seen as one of the major contemporary concepts for artificial neural networks. The general idea is to approximate a high dimensional and previously unknown input distribution by a lower dimensional neural network structure so that the topology of the input space is mapped closely. Not only is the general topology retained but the relative densities of the input space are reflected in the final output. Kohonen maps also have the property of neighbor influence. That is, when a neuron decides to move, it pulls all of its neighbors in the same direction modified by an elasticity factor. We present a SOM that processes the whole input in parallel and organizes itself over time. The main reason for parallel input processing lies in the fact that knowledge can be used to recognize parts of patterns in the input space that have already been learned. Thus, networks can be developed that do not reorganize their structure from scratch every time a new set of input vectors is presented, but rather adjust their internal architecture in accordance with previous mappings. One basic application could be a modeling of the whole-part relationship through layered architectures.

The presented neural network model implements growing parallel SOM structure for any input and any output dimension. The advantage of the proposed algorithm is in its property of processing the whole input space in one step. All nodes of the network compute their step simultaneously, and are, therefore, able to detect known patterns without reorganizing. The simulation results support the theoretical framework presented in the following sections.