Dynamic Cell Structures: Radial Basis Function Networks with Perfect Topology Preservation

Jörg Bruske and Gerald Sommer

Institut für Informatik und Praktische Mathematik
Christian-Albrechts-Universität Kiel
Preusserstraße 1-9
D-24105 Kiel

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Abstract

Dynamic Cell Structures (DCS) represent a family of artificial neural architectures suited both for **unsupervised** and **supervised** learning. They belong to the recently [Martinetz94] introduced class of **Topology Representing Networks** (TRN) which build **perfectly topology preserving feature maps**. DCS employ a modified **Kohonen learning rule** in conjunction with **competitive Hebbian learning**. The Kohonen type learning rule serves to adjust the synaptic weight vectors while Hebbian learning establishes a dynamic **lateral connection structure** between the units reflecting the topology of the feature manifold. In case of supervised learning, i.e. function approximation, each neural unit implements a **Radial Basis Function**, and an additional layer of linear output units adjusts according to a **delta-rule**. DCS is the first RBF-based approximation scheme attempting to concurrently learn and utilize a perfectly topology preserving map for improved performance.
Simulations on a selection of CMU-Benchmarks indicate that the DCS idea applied to the **Growing Cell Structure** algorithm [Fritzke93b] leads to an efficient and elegant algorithm that can beat conventional models on similar tasks.