Subspace Rotation Algorithm for Implementing Restricted Hopfield Network as an Auto-Associative Memory

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Abstract : This paper introduces the subspace rotation algorithm (SRA) to train the Restricted Hopfield Network (RHN) as an auto-associative memory. Subspace rotation algorithm is a gradient-free subspace tracking approach based on the singular value decomposition (SVD). In comparison with Backpropagation Through Time (BPTT) on training RHN, it is observed that SRA could always converge to the optimal solution and BPTT could not achieve the same performance when the model becomes complex, and the number of patterns is large. The AUTS case study showed that the RHN model trained by SRA could achieve a better structure of attraction basin with larger radius(in general) than the Hopfield Network(HNN) model trained by Hebbian learning rule. Through learning 10000 patterns from MNIST dataset with RHN models with different number of hidden nodes, it is observed that an several components could be adjusted to achieve a balance between recovery accuracy and noise resistance.

Keywords : hopfield neural network, restricted hopfield network, subspace rotation algorithm, hebbian learning rule
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