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An Enhanced Tree-shaped Adachi-like Chaotic Neural Network Requiring Linear-time Computations

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The Adachi Neural Network (AdNN) [1{5], is a fascinating Neural Network (NN) which has been shown to possess chaotic properties, and to also demonstrate Associative Memory (AM) and Pattern Recognition (PR) characteristics.
Variants of the AdNN [6,7] have also been used to obtain other PR phenomena, and even blurring. A significant problem associated with the AdNN and its variants, is that all of them require a quadratic number of computations. This is essentially because all their NNs are completely connected graphs. In this paper we consider how the computations can be significantly reduced by merely using a linear number of computations. To do this, we extract from the original complete graph, *one* of its spanning trees. We then compute the weights for this spanning tree in such a manner that the modified tree-based NN has approximately the same input-output characteristics, and thus the new weights are themselves calculated using a gradient-based algorithm. By a detailed experimental analysis, we show that the new linear-time AdNN-like network possesses chaotic and PR properties for different settings. As far as we know, such a tree-based AdNN has not been reported, and the results given here are novel.

Keywords: Chaotic Neural Networks, Chaotic Pattern Recognition, Adachi Neural Network.