Neural network construction using GA defined Voronoi dissections

Richard Stewart
Dept. of Information Systems & Computing
Brunel University
Uxbridge, UB8 3PH, UK
Richard.Andrew.Stewart@brunel.ac.uk

Paul L. Rosin
Dept. of Information Systems & Computing
Brunel University
Uxbridge, UB8 3PH, UK

1 INTRODUCTION

It has been shown that growing (constructing) neural networks and splitting a network into different processing regions (modularisation) can produce more powerful and adaptable solutions (Quartz and Sejnowski 1997, Gardner 1993, Calabretta *et al.* 1997). This paper will outline a new technique that combines the two techniques of network construction through connection growth and network modularisation through the use of a guiding foundation (substrate) layer dissected into regions. The parameters of the technique will be optimised using a simple GA with an initial random population of 100 genomes. The resultant neural networks will be tested on a visual tracking task.

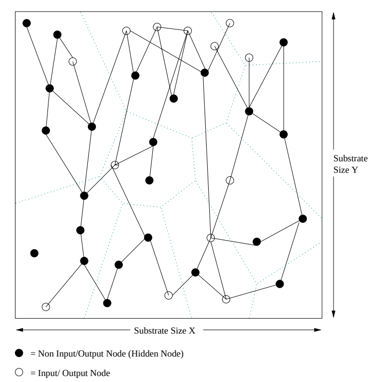

Figure 1: A Developed Neural Network

2 DESIGN

Each neural network is associated with a composite genome comprising of three chromosomes. The substrate layer is divided into regions using a Voronoi dissection which is based on a series of x-y coordinates encoded in the *Substrate Chromosome*. The *Nodes Chromosome* encodes the location, bias and the number of connections for each node. The *Connections Chromosome* encodes the preferred direction of growth, the maximum length, the weight and a probability value that determines how easily the connection can cross from one substrate region to another for each connection for each node.

A genome is developed into a neural network by first decoding the Substrate Chromosome to give a substrate divided into regions. The Nodes Chromosome is then decoded to place the nodes at the appropriate locations in the different substrate regions. Using the information encoded in the Connections Chromosome, the connections for each node grow in their preferred direction until they reach and connect to another node, or they reach their maximum growing length. The border crossing probability value for a connection is used to determine if the connection can cross over to another region. Once the network has been constructed the inputs and outputs to the network are connected. An example of a substrate divided into ten regions, using ten control points, is shown in Figure 1.

3 RESULTS & CONCLUSIONS

It was shown that the resultant networks are quicker to process, quicker to design with regions than without, perform better on the task that they have been designed to solve and are more resistant to network destruction.

References

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