Analysis of Seismic Activity using the Growing SOM for the Identification of Time Dependent Patterns

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Abstract—**The Growing Self Organizing Map (GSOM), a variant of the Self Organizing Map, is a dynamic feature map model used for knowledge discovery in high dimensional datasets. It has been used mainly to identify hidden patterns in static data in an unsupervised manner. Several extensions to the GSOM that enable dynamic data analysis have been proposed. In this paper we discuss such an extension and its capabilities in discovering time variant patterns in datasets of seismic activity. The results obtained by processing clusters generated by the GSOM using the Data Skeleton Model and Spread Factor extensions, emphasize the usability of the GSOM in dynamic data analysis.**

Keywords—**Growing Self Organizing Map, Time Variant Patterns, Seismic Activity Analysis**

I. INTRODUCTION

Natural disasters have been afflicting mankind throughout history. Powerless to control the wrath of nature, humans have resorted to evasion. In most cases, continuous monitoring and analysis of natural phenomena along with effective contingency planning have made it possible to avoid large scale catastrophes. However methods of forecasting and prediction are yet to be perfected. Surveillance of seismic activity is one such debacle. In spite of advances in seismology, proper methods of prediction are yet to realise. The high level of randomness involved in seismic activity and the actual occurrence being unreachable are couple of the root causes. The surplus of multi dimensional data on seismic activity and the lack of comprehensible theories represent an opportunity for the application of unsupervised classification algorithms for the task of prediction. This paper assesses the viability of *Growing Self Organising Maps* in seismic activity investigations.

II. THE ALGORITHM

Growing Self Organising Maps (GSOM) are categorised under self organising neural networks. Clustering, the underlying concept in all self organising neural networks, is useful when dealing with complex multi dimensional data sets with unknown internal structures. Being an improvisation over Kohonen self organising maps, the GSOM ensures proper topology preservation with dynamic network growth [1]. The spread out factor bounds this growth as per the problem space involved. The original GSOM involves three stages – initialisation, growing and smoothing. The generic algorithm of the GSOM is as follows.

Initialisation Phase:

Initialise weight vectors (usually four) with random weights.

Calculate the Growth Threshold (GT) for given dataset according to user requirements

Growing Phase:

Input data to the network.

Determine the weight vector that is closest in Euclidean distance to the input vector.(Similar to the Kohenon SOM)

Adapt the weight vectors of the neighbourhood of the winner and the winner itself. The neighbourhood is a set of neurons around the winner, the amount of adaptation (learning rate) is reduced exponentially over the iterations

Calculate the error value, the difference between the input vector and the weight vectors

Increase the error value of the winner

If the total error of a node is greater than the growth threshold, grow nodes if is a boundary node.

Else, distribute weights to neighbours if a non boundary node.

Initialize the new node weight vectors to match the neighbouring node weights.

Initialize the learning rate to its starting value

Repeat b) to k) till all inputs are presented and node growth in at a minimum.