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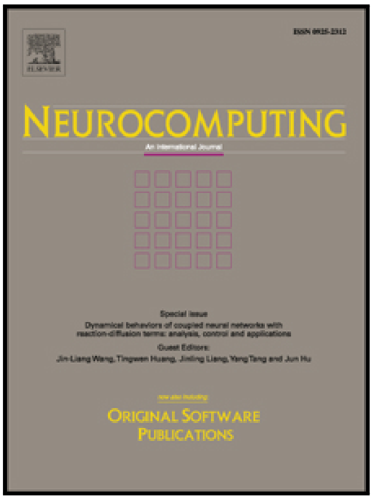

Non-Functional Regression: A New Challenge for Neural Networks

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Non-Functional Regression: A New Challenge for Neural Networks

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Abstract

This work identifies an important, previously unaddressed issue for regression based on neural networks – learning to accurately approximate problems where the output is not a function of the input (i.e. where the number of outputs required varies across input space). Such non-functional regression problems arise in a number of applications, and can not be adequately handled by existing neural network algorithms. To demonstrate the benefits possible from directly addressing non-functional regression, this paper proposes the first neural algorithm to do so – an extension of the Resource Allocating Network (RAN) which adds additional output neurons to the network structure during training. This new algorithm, called the Resource Allocating Network with Varying Output Cardinality (RANVOC), is demonstrated to be capable of learning to perform non-functional regression, on both artificially constructed data and also on the real-world task of specifying parameter settings for a plasma-spray process. Importantly RANVOC is shown to outperform not just the original RAN algorithm, but also the best possible error rates achievable by any functional form of regression.

Keywords: non-functional relationships, regression, Resource Allocating Network, radial basis functions

1. Introduction

While neural networks offer a flexible and powerful approach to regression (see for example [1, 2, 3]), conventional neural net architectures can not be successfully applied to problems where the output is not a function of the input. However the ability to learn mappings from input to output variable(s) which are non-functional in nature may be required in some applications. As a motivating example, consider the work of Choudhury et al. [4]. Data gathered from experimental evaluation of a plasma spray process was used to train a multi-layer network to predict in-flight particle characteristics of the spray given the values of the power and injection parameters of the device. The mapping from device parameters to in-flight characteristics is functional in nature –