Forecasting geomagnetic activity of Dst index using radial basis function networks

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The magnetosphere can be considered as a complex input-output system. For such a system, the solar wind plays the role of the input and the geomagnetic indices can be considered as outputs. The *Dst* index is used to measure the disturbance of the geomagnetic field in the magnetic storms. Numerous studies of correlations between the solar wind parameters and magnetospheric disturbances show that the product of the solar wind velocity V and the southward component of the magnetic field, quantified by Bs, represents the input that can be considered as the input to the magnetosphere. This multiplied input will be denoted by VB_s.

Many approaches have been proposed to analyse the *Dst* and other geomagnetic activity indices. Input-output observational data-based modelling approaches provides a powerful tool for forecasting geomagnetic activities, for example the prediction of the Dst index.

Radial basis function (RBF) networks, as a special class of single hidden-layer feedforward neural networks, have been proved to be universal approximators. One advantage of RBF networks compared with multi-layer perceptrons (MLP) is that the linearly weighted structure of RBF networks, where parameters in the units of the hidden layer can often be pre-fixed, can be easily trained with a fast speed without involving nonlinear optimization. Another advantage of RBF networks, compared with other basis function networks, is that each basis function in the hidden units is a nonlinear mapping which maps a multivariable input to a scalar value, and thus the total number of candidate basis functions involved in a RBF network model is not very large and does not increase when the number of input variables increases. With these attractive properties, RBF networks are an important and popular network model for function approximation, classification and pattern recognition, dynamical modelling and control.

The aim of this study is to introduce a new approach for analysing and modelling the magnetosphere system using radial basis function networks, which can be used for *Dst* index forecasting based on a limited observational input-output data.