Abstract

Solar cycle prediction is difficult and important task. This prediction is difficult because it shows chaotic behaviour and has 11-years cycle approximately.Then, this prediction is important because its impact to earth like satelite, weather, telecommunication system, and electric transmition.

Embedding's Taken theorem is imprtant tool to analyse chaotic system by tranforming it into phase space. in phase space, chaotic system shows deterministic and unfolds hidden information. So, it makes solar cycle is easy to predict.

Evolving Recurrent Neuran Networks (ERNN) is proposed method to find optimum Elman-RNN model by using optimation algorithm of Evolutionary Programming to predict solar cycle. in recent years, Elman-RNN has showed good result in prediction. It caused Elman-RNN can find dinamycal of system through unit called context layer. On the other hand, EP is one of optimation algorithm of Evolutionary Algorithms (EAs) that its chromosome length can be different size. So, EP is good to find proper weights and proper Elman arsitecture.

The best Elman-RNN model has one neuron in hidden layer mostly. The proposed method yields NMSE for training $2{,}6\times10^{-3}$ *and testing* $6{,}5\times10^{-4}$.

Keywords*: prediction, solar cycle, Evolutionary Programming, Elman Neural Networks, sunspot, Taken's embedding theorem, chaotic, time series.*