Cognitive Networks and Long-range Forecast of Rainfall

Parallel to the dynamical modelling of atmosphere and climate, a research programme, based on a DST sponsored project, was initiated for use of artificial neural networks (NN) for simulation and prediction of complex meteorological processes. NNs are useful as alternative modelling tool. They are especially useful in situations where a clear dynamical scenario is not available. The development of a hybrid prediction system based on an NN-dynamical model was reported earlier (C-MMACS Annual Report 1995). This was developed as a general methodology to improve the accuracy and the range of the (dynamical) prediction. Subsequently, the use of NN for modelling of a specific process was taken up. In particular, an NN model for all India mean summer monsoon rainfall (ISMR) was explored. However, a large number of experiments revealed that the conventional NN are inadequate for simulating and predicting rainfall patterns. A generalization of NN was proposed and found to be much more effective in predicting ISMR. These generalized networks, termed as cognitive networks (CN), attempt to model human cognitive faculty in contrast to NN, which model the neuronal processes. A more stringent statistical evaluation of the performance of CN was carried out by generating 72 predictions (hindcasts) for the period 1921-1994. A typical result is shown in Fig. 22, which compares the observed (solid line) rainfall with one year prediction (dashed line) for the corresponding year.

As can be seen from these results, the statistical performance of a CN is quite good. In fact, such large-sample evaluation is often not available for most statistical models of rainfall prediction. A strict comparision of this model with conventional statistical models is not possible as most of the latter focus on seasonal forecast. A very significant aspect of this approach that needs emphasis is that in this model rainfall is modelled only in terms of past rainfall.

For a more objective evaluation of this model, an experimental forecast of ISMR for 1996 has been generated. In particular, the all India monsoon rainfall for 1996 is predicted to be 868 mm.

It is possible to further develop the methodology for prediction at other time and space scales. An organized hierarchy of such systems has the potential to provide a cost-effective supplementary forecasting system. *(P.Goswami and P.Bhoominathan)*

Local Representation of Numerical Functions in Multi-dimension

Local representation of numerical functions are needed in many applications, such as in the post-processing of computed or measured data. Taylor series expansion is usually employed for such representation. The errors associ-

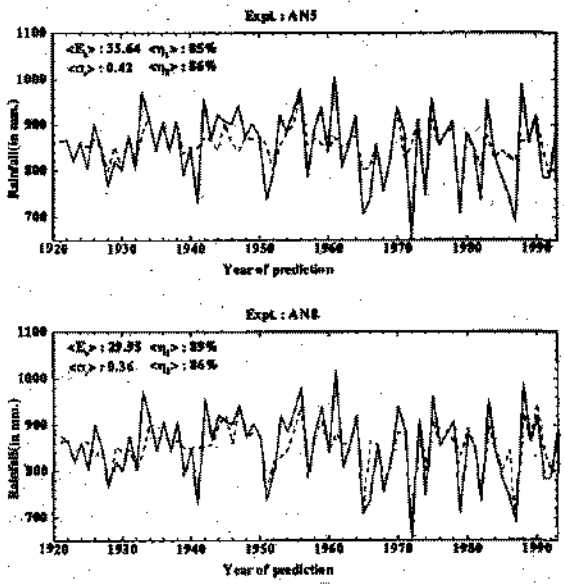

Fig. 22: Comparison of annual prediction of Indian summer monsoon rainfall (ISMR) using cognitive network, – – – –, with observed values, ——

ated with the representation are examined. Two new methods have been developed to construct representations in multi-dimension. These representations when used in numerical algorithms, were found to give a more robust scheme compared to when a usual representation is used. Use of these new representations in numerical algorithms is being further investigated. *(A. Kumar)*