Neural Networks for Satellite-Based Estimation of Precipitation

F. W. Chen
MIT Lincoln Laboratory, USA

This presentation provides an overview on the use of neural networks in precipitation estimation.

Neural networks provide a useful method for learning mathematical relationships using a representative sample of data. These are especially useful in situations where the relationships between variables are extremely complicated and simulations based on physical models are inadequate or computationally expensive.

Approaches to precipitation estimation can be classified into two groups: model-based and statistics-based. Model-based methods involve tuning parameters to match observations and then using the parameters to obtain precipitation rate. Statistics-based methods correlate brightness temperature observations with ground truth measurements. The physics of precipitation is extremely complicated and existing physical models do not adequately capture all of the variation of precipitation. Moreover, repeatedly running radiative transfer calculations can take a lot of time while neural net computations are much simpler.

Chen and Staelin (IEEE Trans. Geosci. Remote Sensing, 41(2), 2003) have developed a method for estimating precipitation using the passive microwave radiometer AMSU-A/B (Advanced Microwave Sounding Unit) aboard the NOAA-15, NOAA-16, and NOAA-17 satellites. The method applies spatial filtering and signal separation to extract information relevant to precipitation. The outputs of this signal processing component are then fed to a neural network. This method was trained using data from the NEXRAD ground-based radar network as ground truth and shows reasonably good agreement at 15-km resolution.

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