

DISCRETE MATHEMATICAL ANALYSIS FOR DATA MINING

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When dealing with discrete data we cannot directly use the powerful apparatus of classical mathematical analysis such as a limit, continuity, a derivative and so on because there are no such natural concepts in the discrete case. The discrete mathematical analysis (DMA) is an approach to data analysis that models these concepts for discrete data. The idea is to model human ability to analyze data based on the ability to deal with discrete objects that is superior of those of formal mathematics. For example, a cardiologist does not need spectral-temporal analysis to interpret a cardiogram.

The DMA consists of a series of algorithms aimed at addressing the major tasks of data analysis: clustering, anomaly detection on time series, finding of trends and extremes, time series smoothing and some others. These algorithms have been successfully applied to a number of problems in different domains including anomaly detection on seismic, tsunami, geoelectric, geomagnetic and gravity time series, global magnetic activity recognition, volcanoes monitoring, recognition of earthquake-prone areas and others.

This talk is focused on applications and recent advances of the DMA to the analysis of time series. Topics of anomaly detection on time series, time series smoothing, a derivative in the discrete case, and monitoring of dynamic processes are covered.