Anomaly detection in multivariate temporal data

PhD Program in Computer Science and Engineering

Rui Maia (rui.maia@tecnico.ulisboa.pt)

Temporal data and anomaly detection

Temporal and time-series data analysis is a broad research field with different relevant applications such as cyber-security, health care, biomedicine, automotive industry, financial analysis and supporting civil and military operations. Anomaly detection is a specific field of data analysis considered as crucial in multiple applications areas, since abnormal data behaviour typically represent critical situations that should be addressed.

E.g.: network traffic pattern change might indicate a cyber-attack, abnormal heart beating frequency can help anticipate and prevent heart-attacks, vessels behaviour might help detecting smuggling.

In the scope of our work, the following challenges were identified:

• Categorical and real valued data parameters might have been manipulated by emitting entities.
• Complex relations affecting sensors data (e.g.: weather, sea and undersea conditions).
• Hidden semantic relations between different time-series or temporal data.
• Presence of different noise patterns and origins due to the use of complex networks of sensors.

Identify: Observation, Sequence, Context and Collective anomalies

Datasets are made available by Australian Maritime Safety Authority (AMSA2), Office for Coastal Management of the National Oceanic and Atmospheric Administration (NOAA3), National Centres for Environmental Information (NOAA4) and Australian Ocean Data Network (AODN5):

• Automatic Identification System (AIS) vessel data
• Open access climate data, including atmosphere and ocean related information.

Air and weather conditions represented in a multivariate time-series measured by a synchronized sensor network.

Representation of multivariate AIS positions using multiple dimension vectors.

Multivariate temporal data generic anomaly detection framework.