Multivariate temporal data analysis for vessels behavior anomaly detection
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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 but also for supporting civil and military operations. Anomaly detection is a crucial specific field of data analysis 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. Generic Anomaly Detection Framework: Figure 3

Univariate vs Multivariate

Multivariate anomaly detection problem raise complex challenges due to the hidden data structure and semantics between time-series. Observation, Sequence, Context and Collective anomalies are still open and complex research challenges. Figure 1 illustrates a multivariate time-series.

Figure 1: Air and weather conditions represented in a multivariate time-series measured by a network of time-synchronized sensors.

Research Challenges & Goals

Research Challenges
• Categorical and real valued data parameters might have been manipulated by emitting entities.
• Complex relations of multiple dimensions affecting sensors data (Figure 4).
• 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.

Research Goals
New methods for - Observation, Sequence, Context and Collective - multivariate temporal data anomaly detection.

Marisa EU Project (*)

This research work is developed in the scope of Maritime Integrated Surveillance Awareness (Marisa) H2020 European Project. We aim at the development of new behavior analysis and anomaly detection methods and anticipate possible irregular activities, to support Search And Rescue operations and other civil and military operations.

Data sources: weather and sea conditions, vessels characteristics, geographic positions, undersea informations or radar and satellite information.

Figure 2: Maritime vessel tracks classification (Australia)

Figure 3: Multivariate temporal data generic anomaly detection framework.

Figure 4: Observations representation using two dimensions. Multiple contributing dimensions vectors are also represented in the biplot.

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