CISE-DMS: A CISE-Gateway based Data Mining Service

Project co-financed by the European Commission

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Implementation of the Common Information Sharing Environment (CISE) for the EU maritime domain

1. Development of specific CISE information services
2. Development of CISE-enabled operational functionalities
3. Adaptation of the national IT systems

Build a capacity to analyze CISE data (data mining) + Generate added-value information for maritime surveillance
CISE Data Model

- Standardized description of maritime data
- Seven core data entities and eleven auxiliary ones

Various and large datasets
CISE-DMS Overview

General approach

Legacy systems → CISE’s amount of data → Machine Learning / Data Mining Algorithms → Maritime surveillance service → On-demand services

- Answering operational queries punctually
- Raising different levels alarms continuously

Background services
CISE-DMS Architecture

Complete infrastructure for data mining services

CISE GATEWAY

Common services

REST API / GET
Ships details, Real time positions, Cargo, Person, ...

REST API Alerts
Event Location History

Data Mining Service

UI datamining

DataMining API

Feeder

GIS Server

Processing Chain A

Processing Chain B

Message Bus (Rabbit MQ)

DataBase

Administration

Telespazio confidential information
Use cases definition from operational needs

- **Forecasting intrusions in unauthorized areas**: illegal fishing, immigration, protected areas...

- **Pollution**: identification of polluters

- **Suspicious behaviours**: trafficking

- **Search & Rescue**: failure event history, deviation from routes (delays in raising alarms)
Data types

- Ship registries
- Surveillance and intervention assets

Fusion of various data sources

- Position/movement of vessels (AIS, VMS...)
- Earth Observation Data

Src: U.S. Naval Institute

Src: MarineTraffic
Fusion results

Correlation of EO Data and AIS

Satellite imagery detection + AIS track for a given ship = Correlation

Ship detected in area of interest:
- Identification
- Ship History
- Further tracking
AIS clustering for motion prediction

Modelling patterns of life

Unsupervised clustering:
- 50,000 AIS points (~1 month)
- Longitude + Latitude + Heading
- Maritime routes with ways

Clustering

Misc. AIS Data in continental France ZEE

Maritime Routes
AIS : motion prediction applications & limits

Applications:
- Intrusion in restricted area (illegal fishing areas, protected areas...)
- Planning an interception

But AIS can be misleading = hacked
⇒ De-AIS (IreNav)

Modelling patterns of life

Probabilities of being on each route

Probabilities of presence in X minutes

Pallotta & al., 2013
Anomalies

- Distance to foreseen position (assuming the motion prediction models are reliable)

- Abnormal patterns

- Suspicious AIS information

- Look out for areas of interest (pollution, illegal fishing, immigration...)

- ...

Deviation from Patterns of life
Key concept: Confidence index

- Confidence index:
  - Ship registries
  - Assets for fisheries control
  - Immigration control
  - Departing locations and destinations
  - Number and location of stopovers
  - Number of law violations
  - Number of accidents
  - Analysis of state flag change
  ...

- Raising alarms based on:
  - Ship history
  - Ship current behavior
- Perspectives:
  - The technologies are available
  - Gathering samples in progress, using complete datasets when connection on CISE available
  - Tests will be conducted over the next few months
Any questions?