SeaBEAT BEhavior Analysis Toolbox

Rule Based System

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Behavior Analysis Toolbox development

- Off-line processing
  - AIS tracks of reporting vessels
  - Many vessel tracks no ground truth on behavior/intention
  - GPS tracks of instructed vessels
  - Few vessel tracks with ground truth, mainly sailing ‘suspect’ patterns
  - VTS radar tracks
  - NLD Coast Guard trial with full optimised VTS radar processing chain
- Real-time processing live streams
  - Simulated vessel tracks
    - Dugs smuggle scenario
  - Live IVEF stream NLD Coast Guard
    - Fused AIS and VTS radar tracks
      - Screendump only presented

Behavior Analysis Drugs Smuggle Scenario

- In English Channel Drugs Smuggling Scenario:
  - The number of vessels both reporting and non-reporting is high in the large area of interest
  - Real time situation assessment is extremely demanding
- Automatic SeaBEAT BEhavior Analysis Toolbox for operator support has been developed

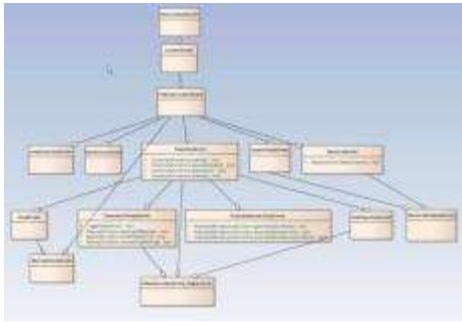
Drugs Smuggle Scenario
Simulated tracks

- Intelligence
  - Chemical tanker with drugs from Columbia
  - Drop off point in English Channel <buoys overboard>
  - Drugs picked up from sea by small non-reporting vessels

Rule Based System

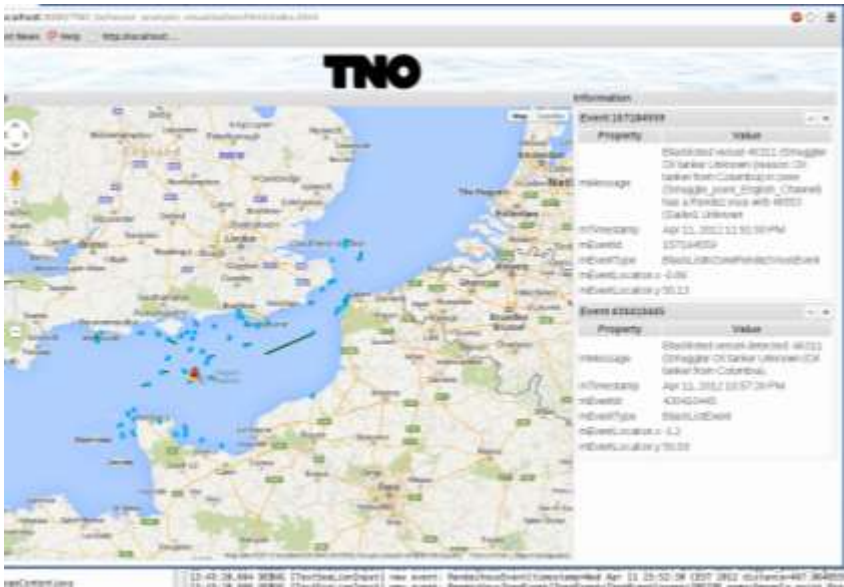
- SME (Subject matter Expert) expertise needs to be transferred in to the rule base system
  - SME can explain which portion of the behavior of the vessel (types) will be observable with the sensor suite.
  - Wide range of available Building Blocks facilitates knowledge formalisation

- Four types of building blocks
  - Kinematic of vessel
  - Interaction of vessels
  - Geographical and temporal context
  - Identity of vessel (and related open source data)



Introduction Behavior Analysis Tool Movie (1)

- Rule building blocks used in English Channel scenario:
  - Rendez vous of vessels
  - Vessels in (restricted) area
  - Blacklist
- Rules can be easily added
  - Complex rules are possible



Introduction Movie (2)

- Color schema Rule Based Behavior Analysis

	Normal	In Zone	Blacklist & In zone
Vessel			
Rendez Vous			
Blacklist			

- Alarm message

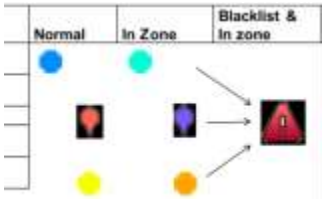
Event 1985941520

Property	Value
mMessage	Blacklisted vessel detected: 46311 (Smuggler Oil tanker Unknown (Oil tanker from Columbia).
mTimestamp	Apr 11, 2012 11:12:30 PM
mEventId	1985941520
mEventType	BlackListEvent
mEventLocation.x	-1.11
mEventLocation.y	50.1

TNO innovation for life

Movie SeaBEAT
BEhavior Analysis Toolbox

Alarm messages

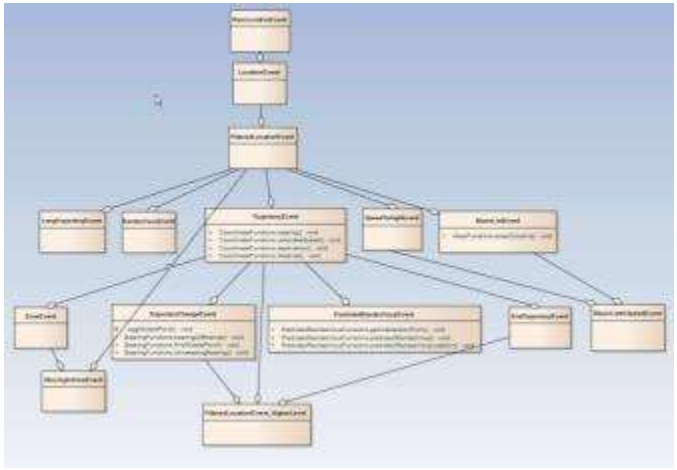


- Behavior Analysis Alarm Messages
  - Self explaining
    - Type alarm
    - Vessel involved
    - Reason alarm raised
    - Zone involved

Event 157184559

Property	Value
mMessage	Blacklisted vessel 46311 (Smuggler Oil tanker Unknown (reason: Oil tanker from Columbia) in zone (Smuggle_point_English_Channel) has a Rendez vous with 46553 (Sailer1 Unknown
mTimestamp	Apr 11, 2012 11:51:00 PM
mEventId	157184559
mEventType	BlackListInZoneRendezVousEvent
mEventLocation.x	-0.88
mEventLocation.y	50.13

Current set rule based building blocks SeaBEAT BEhavior Analysis Toolbox

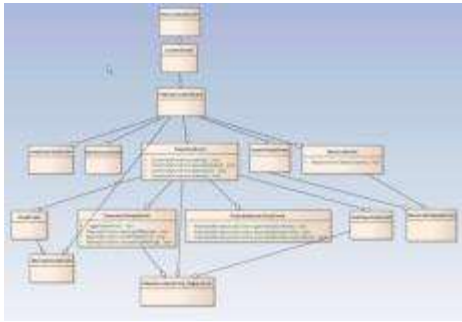


- Bearing (Change) to high
- Speed (Change) to high
- Perpendicular to Coast line
- In (restricted) region
- Rendez vous
- Blacklisted vessel

- When historical analysis of vessel traffic is available
  - Typical for high traffic density areas (per vessel type / time of day)
  - The following additional buildings blocks are available;
    - Vessel sails similar as “normal traffic”
    - Vessel deviates from “normal traffic”
    - Vessel location too far from area with high traffic density

Summary SeaBEAT

- Rule based Behavior Analysis Toolbox developed on
  - GPS tracks
  - VTS radar tracks
  - Simulated drugs smuggling scenario
  - NLD coast guard live IVEF stream



- Four types of rule based building blocks implemented
  - Kinematic of vessel
  - Interaction of vessels
  - Geographical and temporal context
  - Identity of vessel (and related open source data)

QUESTIONS

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