



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
 - › Screenshot 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

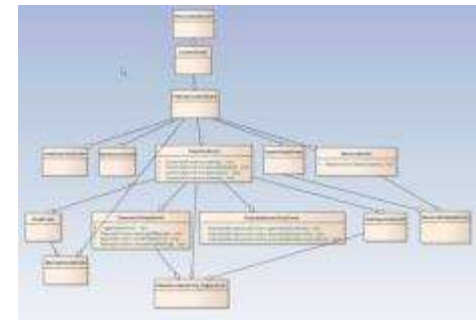




Rule Based System

- › 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





Movie SeaBEAT BEhavior Analysis Toolbox

The screenshot displays the SeaBEAT Behavior Analysis Toolbox interface. The main window shows a map of the English Channel and surrounding regions, with various features like sea maps, ship tracks, and ships visible. The TNO logo is prominently displayed at the top center of the interface.

On the right side, there are two "Information" panels showing details for specific events:

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 (Saler) Unknown
mTimestamp	Apr 11, 2012 11:51:00 PM
mEventId	157184559
mEventType	BlackListZoneRendezVousEvent
mEventLocation.x	0.88
mEventLocation.y	50.13

Property	Value
mMessage	Blacklisted vessel detected: 46311 (Smuggler Oil tanker Unknown (Oil tanker from Columbia).
mTimestamp	Apr 11, 2012 10:57:30 PM
mEventId	430410445
mEventType	BlackListEvent
mEventLocation.x	1.2
mEventLocation.y	50.09

At the bottom, a log window shows the following entries:

```

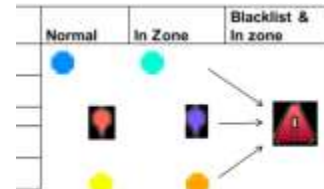
13:43:20,664 DEBUG [TestSeaLionInput] new event: RendezVousEvent[timestamp=Wed Apr 11 23:52:38 CEST 2012 distance=467.864859969846 locationVassell=Filter
13:43:20,666 DEBUG [TestSeaLionInput] new event: RendezVousZoneEvent[ZoneEvent=ZoneEvent[event=INSIDE name=Smuggle point English Channel type=smuggle area t
13:43:20,666 DEBUG [TestSeaLionInput] new event: MovingInZoneEvent[zoneEvent=ZoneEvent[event=INSIDE name=Smuggle point English Channel type=smuggle area t
13:43:20,666 DEBUG [TestSeaLionInput] new event: RendezVousZoneEvent[ZoneEvent=ZoneEvent[event=ENTER name=Smuggle point English Channel type=smuggle area t
13:43:20,666 DEBUG [TestSeaLionInput] new event: MovingInZoneEvent[zoneEvent=ZoneEvent[event=ENTER name=Smuggle point English Channel type=smuggle area t
  
```

The interface also includes a "Features" panel on the left with options for "Sea Map", "Ship tracks", "Ships", and "Events", each with a "2s" refresh button. A "Map" panel provides navigation controls. A "Log" window at the bottom shows the Java code being executed, including classes like SSensorType.java and SSensorStatusUpdateMessage.java.



Alarm messages

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

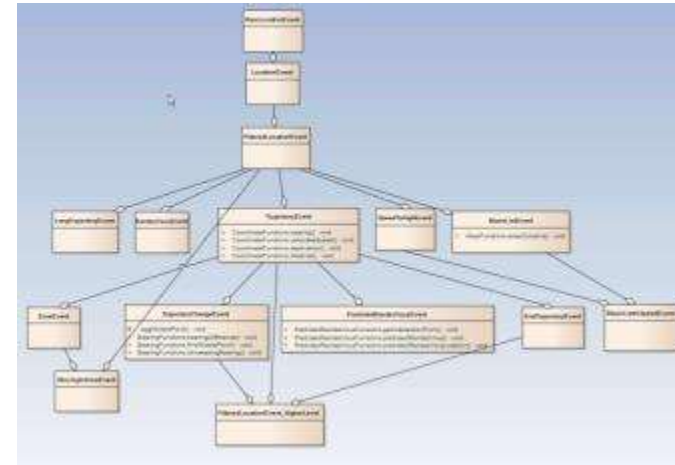


Event 157184559	
Property	Value
mMessage	Blacklisted vessel 46311 (Smuggler Oil tanker Unknown (reason: Oil tanker from Columbia) in zone (Smuggle_point_English_Channel) has a Rendez vous with 46553 (Sailer1 Unknown
mTimestamp	Apr 11, 2012 11:51:00 PM
mEventId	157184559
mEventType	BlackListInZoneRendezVousEvent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

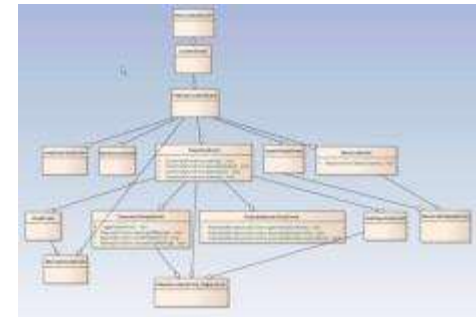




Summary SeaBEAT

- › 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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