Maritime Use Case – Template

# Scenario

After being informed of the loss of the AIS contact with a particular fishing vessel one hour ago (at time 0), the Watch Officer (WO) now (at time t) needs to recover the track and locate the vessel. The locations of two unidentified tracks, called Vessel A and Vessel B, are provided as the only two possible locations for the missing vessel.

# Problem to solve / Question

The Watch Officer has to match the known features of the missing vessel, as reported by its last AIS contact, with the ones of the two unidentified tracks, as reported by the on-site sources. Hence, its name, MMSI, IMO, type, length, width, etc are known with a very high confidence to the Watch Officer.

The question is thus:

*Which one of Vessel A and Vessel B corresponds to the missing vessel?*

# ADP Breakdown

This section identifies the main components of the fusion system that influence the decision making process. The section systematically breaks down the overall problem by using the concept of Atomic Decision Procedure (ADP). In this way we make the evaluation context explicit: any evaluation subject is influenced by the inputs (types, quality) and the overall decision making goals (What is needed for decision making (representations/type of information)? What quality of the results is required? ...).

## Sources of information

|  |  |  |
| --- | --- | --- |
| Source | Data | FOV (scenario) |
| Radar | Position | Vessel A, Vessel B |
| Radar | Heading | Vessel A, Vessel B |
| Radar | Speed | Vessel A, Vessel B |
| Radar | Size | Vessel A, Vessel B |
| ATR | Position | Vessel A, Vessel B |
| ATR | Heading | Vessel A, Vessel B |
| ATR | Speed | Vessel A, Vessel B |
| ATR | Size | Vessel A, Vessel B |
| Operator A | Size | Vessel A, Vessel B |
| Operator B | Size | Vessel A, Vessel B |
| Operator C | Position | Vessel A |
| Operator C | Heading | Vessel A |
| Operator C | Speed | Vessel A |
| Operator C | Size | Vessel A |
| Operator C | Type | Vessel A |
| Cargo Captain | Position | Vessel B |
| Cargo Captain | Heading | Vessel B |
| Cargo Captain | Speed | Vessel B |
| Cargo Captain | Size | Vessel B |
| Cargo Captain | Type | Vessel B |
| SAR image | Heading | Vessel A, Vessel B |
| SAR image | Size | Vessel A, Vessel B |
| Camera | Position | Vessel A |
| Camera | Heading | Vessel A |
| Camera | Speed | Vessel A |
| Camera | Size | Vessel A |
| Camera | Type | Vessel A |

## Input Processes (Uncertainty Representation Processes)

This section describes the Input Processes that transform data to representations supported by the fusion processes. The outputs are encoded through suitable representations reflecting the uncertainty. The output is a function of the input data as well as various interpretation elements influencing the quality of the output, such as the source model, self confidence, objectivity, etc. We should explicitly describe the assumptions used in the implementation of the Input Processes.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Source | Input | Output (uncertainty representation) | Processing method  (a function considering the source types, objectivity, self confidence, etc.) | Assumptions/  risks |
| Radar | Position | Mean P, variance |  |  |
| Radar | Heading | Mean H, variance |  |  |
| Radar | Speed | Mean S, variance |  |  |
| Radar | Size | Mean Si, variance |  |  |
| ATR | Position | Mean P, variance |  |  |
| ATR | Heading | Mean H, variance |  |  |
| ATR | Speed | Mean S, variance |  |  |
| ATR | Size | Mean Si, variance |  |  |
| Operator A | Size | Mean Si, variance |  |  |
| Operator B | Size | Mean Si, variance |  |  |
| Operator C | Position | Mean P, variance |  |  |
| Operator C | Heading | Mean H, variance |  |  |
| Operator C | Speed | Mean S, variance |  |  |
| Operator C | Size | Mean Si, variance |  |  |
| Operator C | Type | Probability of correct classification |  |  |
| Cargo Captain | Position | Mean P, variance |  |  |
| Cargo Captain | Heading | Mean H, variance |  |  |
| Cargo Captain | Speed | Mean S, variance |  |  |
| Cargo Captain | Size | Mean Si, variance |  |  |
| Cargo Captain | Type | Probability of correct classification |  |  |
| SAR image | Heading | Mean H, variance |  |  |
| SAR image | Size | Mean Si, variance |  |  |
| Camera | Position | Mean P, variance |  |  |
| Camera | Heading | Mean H, variance |  |  |
| Camera | Speed | Mean S, variance |  |  |
| Camera | Size | Mean Si, variance |  |  |
| Camera | Type | Probability of correct classification |  |  |

## Information Combination (Fusion): Extracting new information

This section describes the used fusion methods. It might explicitly address (i) the modeling and (ii) the processing aspects (Algorithms).

### Basic modelisation

Observation variables: X = {A,B} X {Position, Heading, Speed, Size, Type} (10 variables)

Decision variable: H={A,B}

Fusion: Bel(H|X)

### Algorithms

Describe the used algorithms (e.g. Junction Tree, Approximate Inference). Discuss the impact of algorithms on the quality, performance, etc. in the context of the input types and the modeling elements.

### Assumptions and Simplifications

This section discusses the impact of the assumptions, simplifications and their impact on the decision making process.

## Decision Process

This section describes the usage of the fusion process outputs. Evaluate the impact of the preceding elements on the quality of the decision making process (e.g. the likelihood of making the right decisions). How is the decision making process sensitive to the source noise, the modeling parameters in the fusion processes?

Atomic Case Study - Template

## Use case

Maritime use case #1

## Type of ACS

Singular assessment

X Comparative assessment

## Solution #1

Basic modelisation + Bayes’ rule

## Question of interest

Which combination rule provides better results?

## Evaluation subjects

Bayes’ rule & Dempster’s rule

## Evaluation criteria (from the URREF ontology)

Data criteria

Reasoning criteria

Output criteria