FORMAL SPECIFICATION OF SITUATIONS FOR SCENARIO-BASED TESTING OF MARITIME ASSISTANCE SYSTEMS

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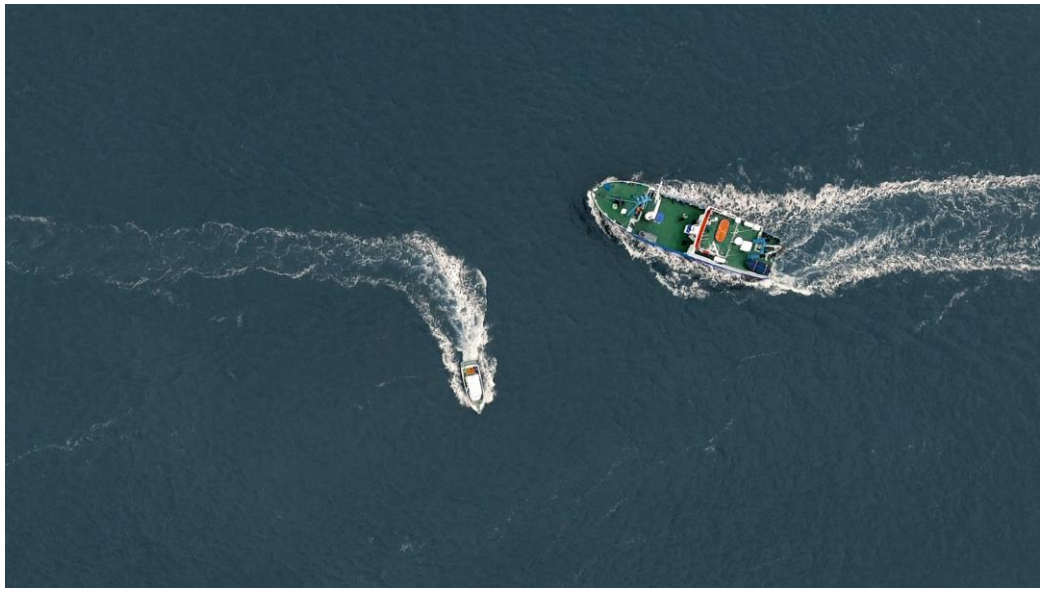
Challenge: Ensuring Safety of Maritime Assistance Systems

- Advanced maritime assistance systems rely on AI-based components in complex operating environments.
  - ➢Verification difficult, extensive testing necessary
- Distance based methods for ensuring safety of such systems easily miss rare but critical cases.
  - ➢Idea: Scenario-based testing

Possible Solution: Scenario-based testing

- Idea: Validate system behavior in scenarios.
- A scenario describes a range of operating conditions, like
  - behaviour of other traffic participants, infrastructure, weather.
- Test procedure: observe system under conditions described by scenario.
- Tests have to be conducted correctly (i.e. as described by the scenario) to be useful for system evaluation.



Kollisionsvermeidung von hochautomatisierten Schiffen
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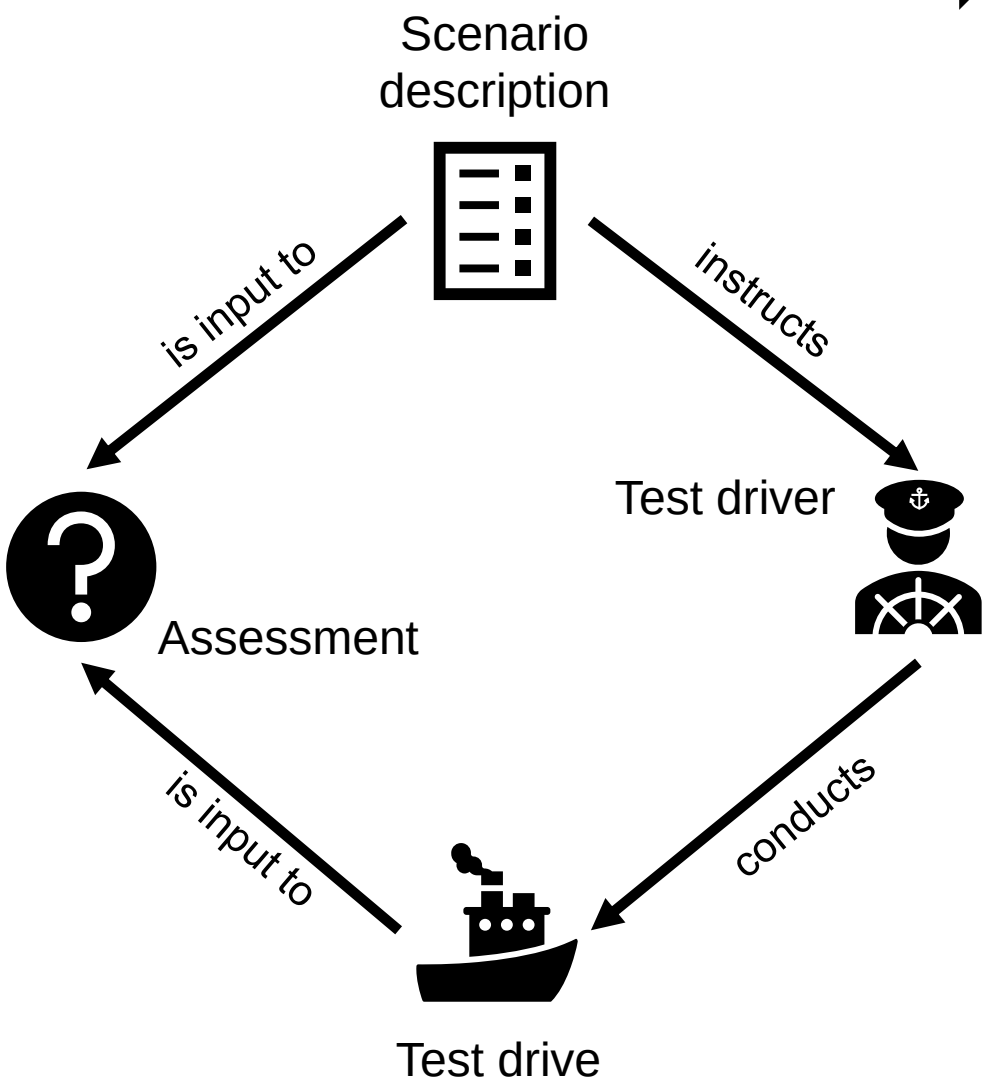
Problem: Scenario Specification and Assessment

- Research Questions:
  - How can the scenario description be communicated clearly to the test driver?
  - How can proper test conduction be checked objectively?
- Appropriate scenario descriptions should be
  - precise to avoid ambiguity,
  - human readable and domain specific to serve as test instructions,
  - intuitive to reduce specification errors,
  - formal to support automated monitoring of test conduction.

➢ Maritime Traffic Sequence Charts

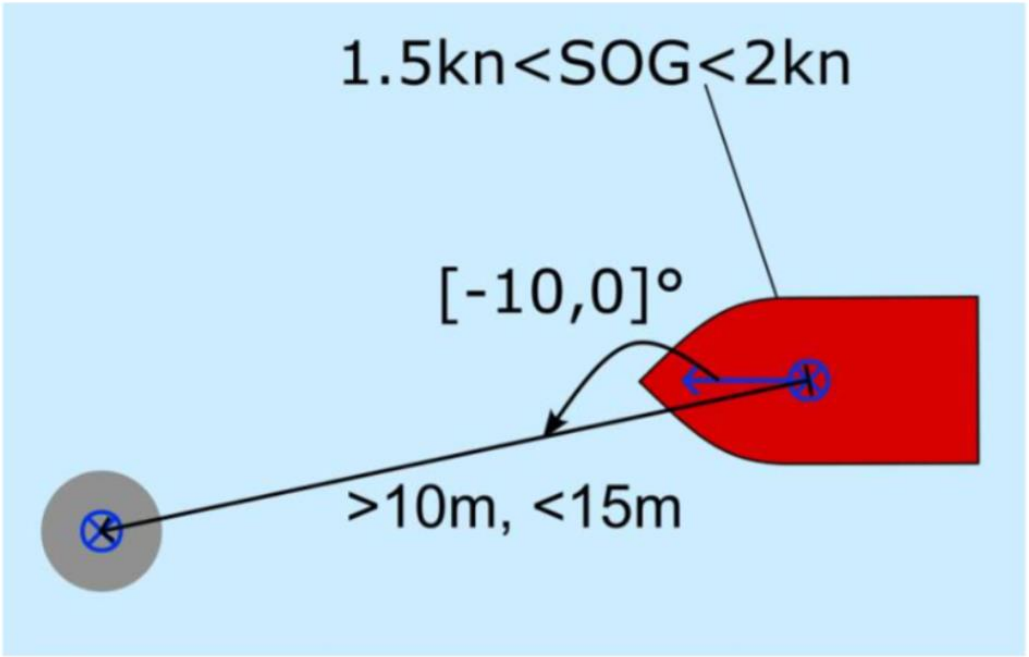


Case Study:
Test situations for an object detection system

- System under test: Object detection system on a ship
- Example test situation: Single reference object a short distance ahead of ship or slightly towards the port side, ship moving relatively slowly
- Task: Formalize the test situation
- Observables:
  - Ship : position, heading, speed over ground
  - Reference object: position
- Refinement:
  - Distance between ships and reference objects positions: 10 to 15 meters
  - Speed over ground: 1.5 to 2 knots
  - Relative bearing of reference object from ship: -10 to 0 degrees

Case Study - Formalisation

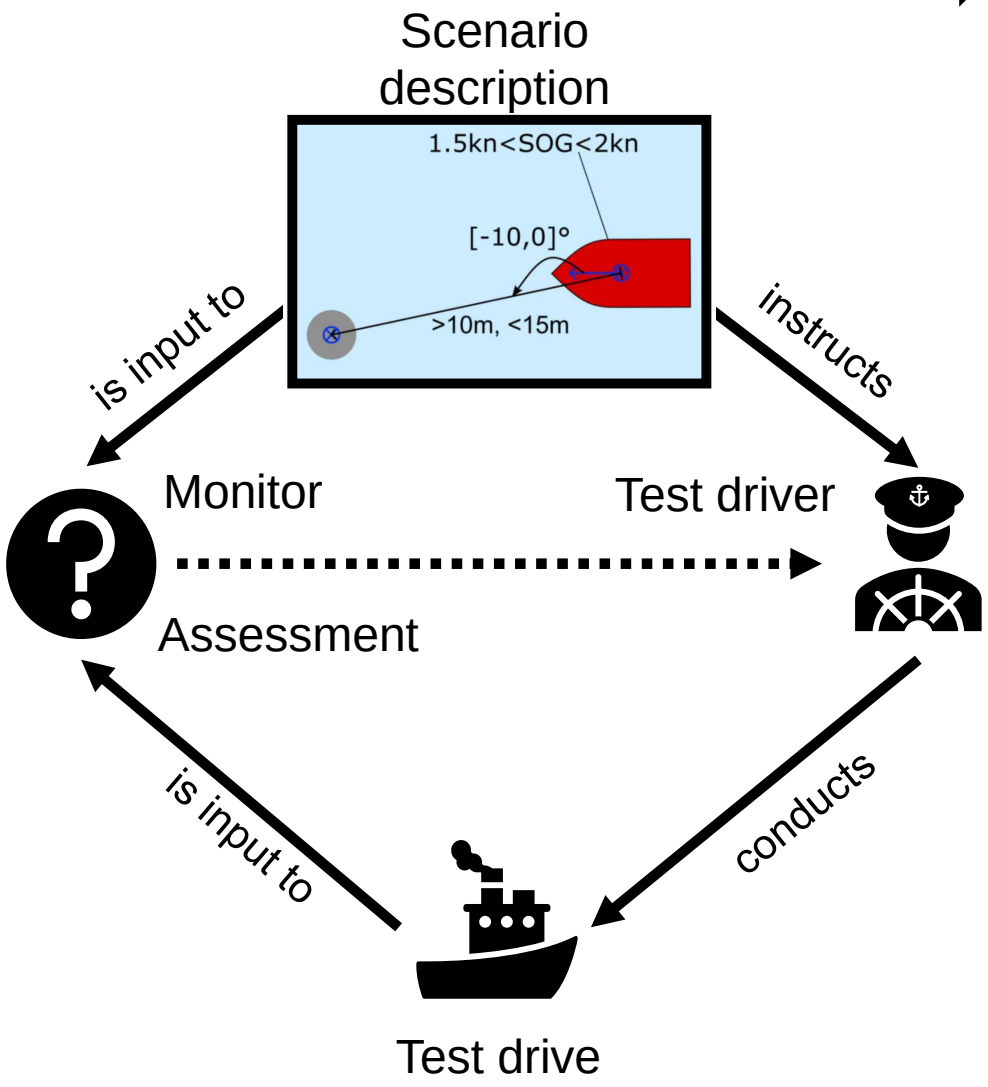
Test Situation: Single reference object a short distance ahead of ship or slightly towards the port side, ship moving relatively slowly



Case Study - Evaluation

The chosen formalization:

- specifies the test situation as intended
- is human-readable
- is precise and formal
- supports automated monitoring



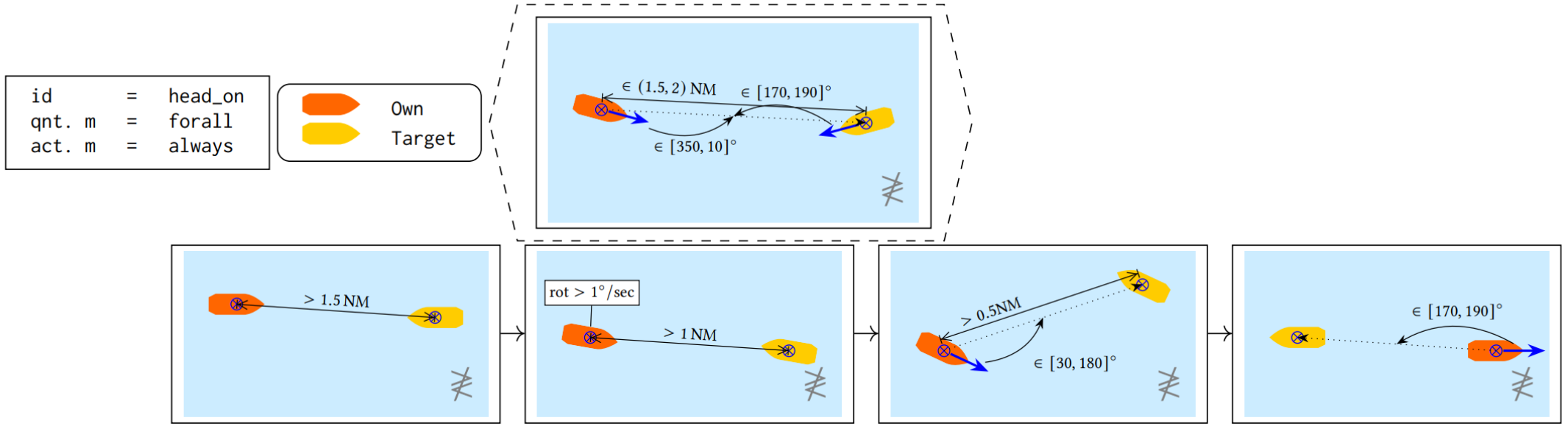
Conclusion and Outlook

- Scenario-based testing is a promising approach for ensuring safety of maritime assistance systems.
- Challenge: specification and assessment of proper test conduction.
- Maritime Traffic Sequence Charts provide an appropriate formalisation of a test situation in our case study.

- Currently working on a more extensive Case Study
  - Formalizing further and more complex test scenarios

Maritime Traffic Sequence Charts – Additional Example

Specification of COLREG Head-On:



Imprint

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