

# MARITIME WORLD MODEL FOR DATA-BASED THREAT ASSESSMENT

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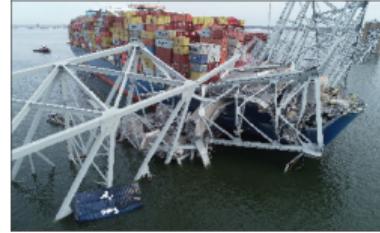
# Motivation



- Potential physical threats for critical infrastructures from ships or humans
  - Detecting of threats are necessary
  - Problem of only a few threats occurred
  - Situation awareness essential for the early detection of threats

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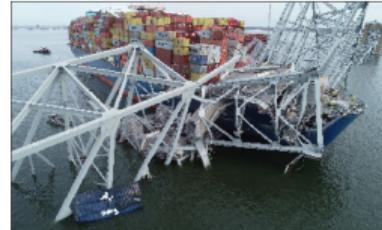
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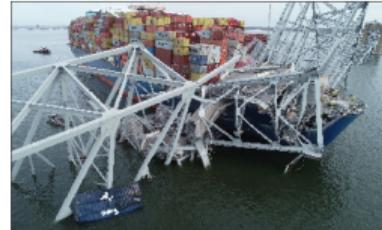
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# Motivation

- Potential physical threats for critical infrastructures from ships or humans
  - Detecting of threats are necessary
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  - Situation awareness essential for the early detection of threats
- Requirements for a world model:
  - Providing data to assess of situations
  - Enabling the use of historical, current, and synthetic data

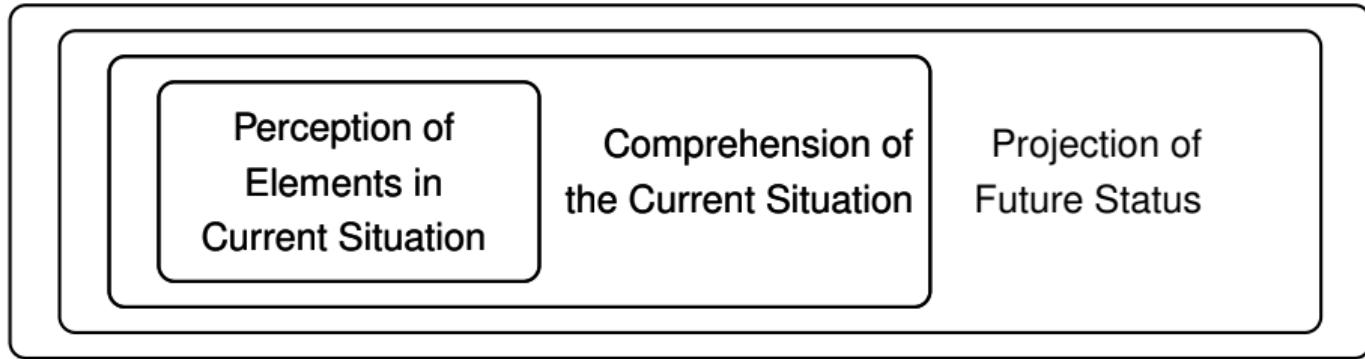


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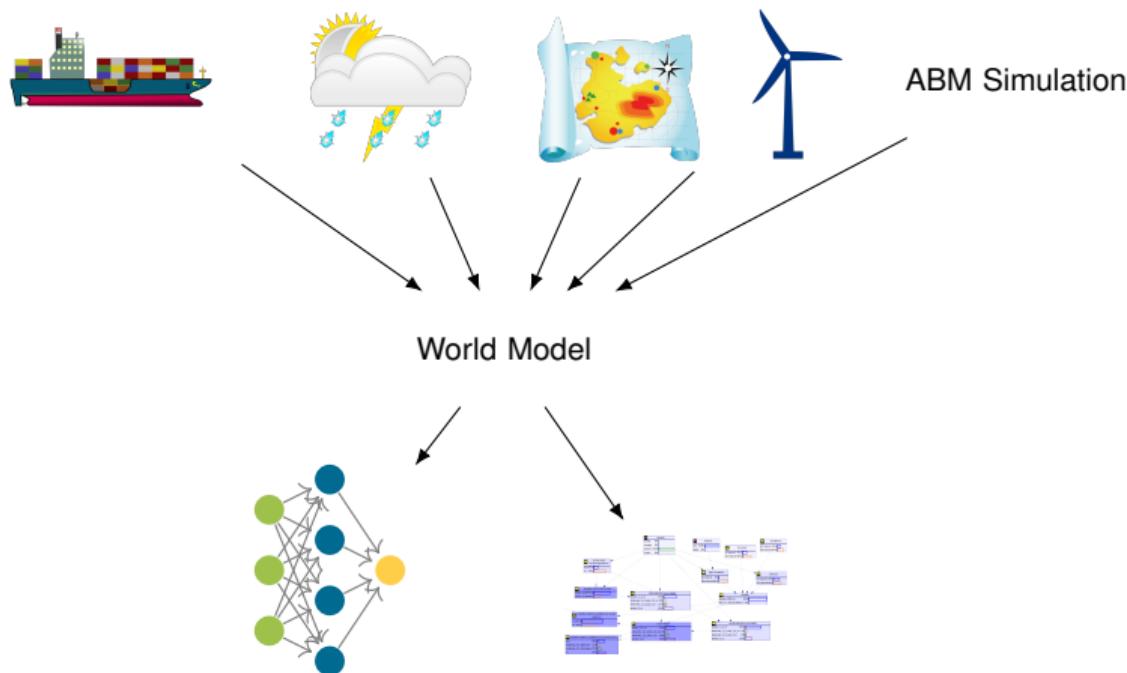
## Situation Awareness (adapted from Endsley 1995)



- Object orientated world model for analyzing maritime situations in Fischer 2016:
  - Receiving interface for observations
  - Data association for new observations
  - Access interface for situation analysis
- Ontology-Based Data Access (OBDA) system to detect abnormal behaviors in Brüggemann et al. 2016:
  - Combining data from various data sources in Relational Database Management System (RDBMS)
  - Accessing data via search queries

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  - Combining data from various data sources in Relational Database Management System (RDBMS)
  - Accessing data via search queries
- Comparison to our approach:
  - Existing world models consider maritime safety and not security
  - Synthetic data are not included

# Concept of World Model



- ship data based on Automatic Identification System (AIS) datasets:
  - positional data: location, speed over ground, draught, etc.
  - static data: ship dimensions, ship type, flag state, etc.
- environmental data:
  - weather data: wind, waves, current, etc.
  - bathymetry data
- infrastructure data based on Electronic Navigational Charts (ENCs):
  - location or geometries (lines, polygons)
  - type of infrastructures: cables, pipelines, offshore wind farms, etc.

# Request Interface for Weather Data



```
{  
  "weather_data_features": [str, ...],  
  "location": [{"latitude": float, "longitude": float},  
    ...],  
  "timestamp": [datetime, ...],  
  "interpolation": bool  
}
```

# Request Interface for Weather Data



```
{  
  "weather_data_features": [str, ...],  
  "location": [{"latitude": float, "longitude": float},  
    ...],  
  "timestamp": [datetime, ...],  
  "interpolation": bool  
}
```

- Interface to provide access to weather data by interpolating for time and location
- Assessing threats based on these weather condition:
  - Checking feasibility if a platform can be entered

# Request Interface for Ship Data



```
{  
  "location_bounds": {  
    "north": float, "south": float,  
    "west": float, "east": float  
  },  
  "time_range": [datetime, datetime],  
  "ais_data_features": [str, ...],  
  "weather_data_features": [str, ...]  
}
```

# Request Interface for Ship Data



```
{  
  "location_bounds": {  
    "north": float, "south": float,  
    "west": float, "east": float  
  },  
  "time_range": [datetime, datetime],  
  "ais_data_features": [str, ...],  
  "weather_data_features": [str, ...]  
}
```

- Interface to combine ship and weather data
- Assessing threats based on ship (and weather) data:
  - Checking if a ship is moving towards a wind farm

# Conclusion and Outlook



- World model concept offers interfaces to provide historical and current data from different databases (access for synthetic data missing)
- Several data sources are combined: ship, weather, and infrastructure data (in progress)
- Perception of situations using data from the world model
- Threat assessment coming in future work

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