Simulated procedure for Sea Watch Service as an e-Navigation application

Autonomous sea navigation between vision and reality

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Track upstairs

- unmanned ship ??
- autonomous ship ?
- networking ship
- electronically ship
- iron ship
- log boat

Common Community
- VTS, shore- based piloting
- eNavigation

Data Processing
- Situational Awareness
- Smart sensing
- Command and Control

Communication Infrastructure
- Voice mail
- AIS, LRIT
- SatCom, …

Navigation System
- Satellite based positioning
- Electronically chart

Technical revolution
- Chronometer
- Compass,
- Radar

Tasks of the unmanned ship

- Autonomous navigation
  - Situational awareness, collision avoidance
  - Route planning, avoidance of grounding
- Autonomous maneuvering
  - Self organized Decision making
  - Command and control of ship steering and gearing
- Autonomous Watch service
  - Maneuver space observation
  - Communication between ship and service stations
- Autonomous stress control
  - Self checking for safety, maintenance and wear
  - Decision and task strategy
- Energy consumption
  - Fuel optimized ship operating
  - Reducing of ship's pollutant emissions

eNavigation components

Autonomous navigation needs	eNavigation is defined as
Common data platform	Data harmonizing and presentation
Reliable communication links	Data exchange
Enlarged information	Data collection
Hierarchical data merging	Data integration
Situational awareness	Data analysis

Aboard automated applications (1)

- Ship engine control room
  - AUT N: the engine includes a component for an automated and safe operation – a human based invasion is not necessary for n hours
  - Internal application (no relation to eNavigation)

Aboard automated applications (1)

- Ship bridge
  - Currently automated operation not available
  - Need of permanent command and control
  - Existing standards
    - Bridge Alert Management
    - Integrated Navigation System
  - Recent R&D projects, e.g.
    - Emergency Bridge (national)
    - Unmanned Ship (European)

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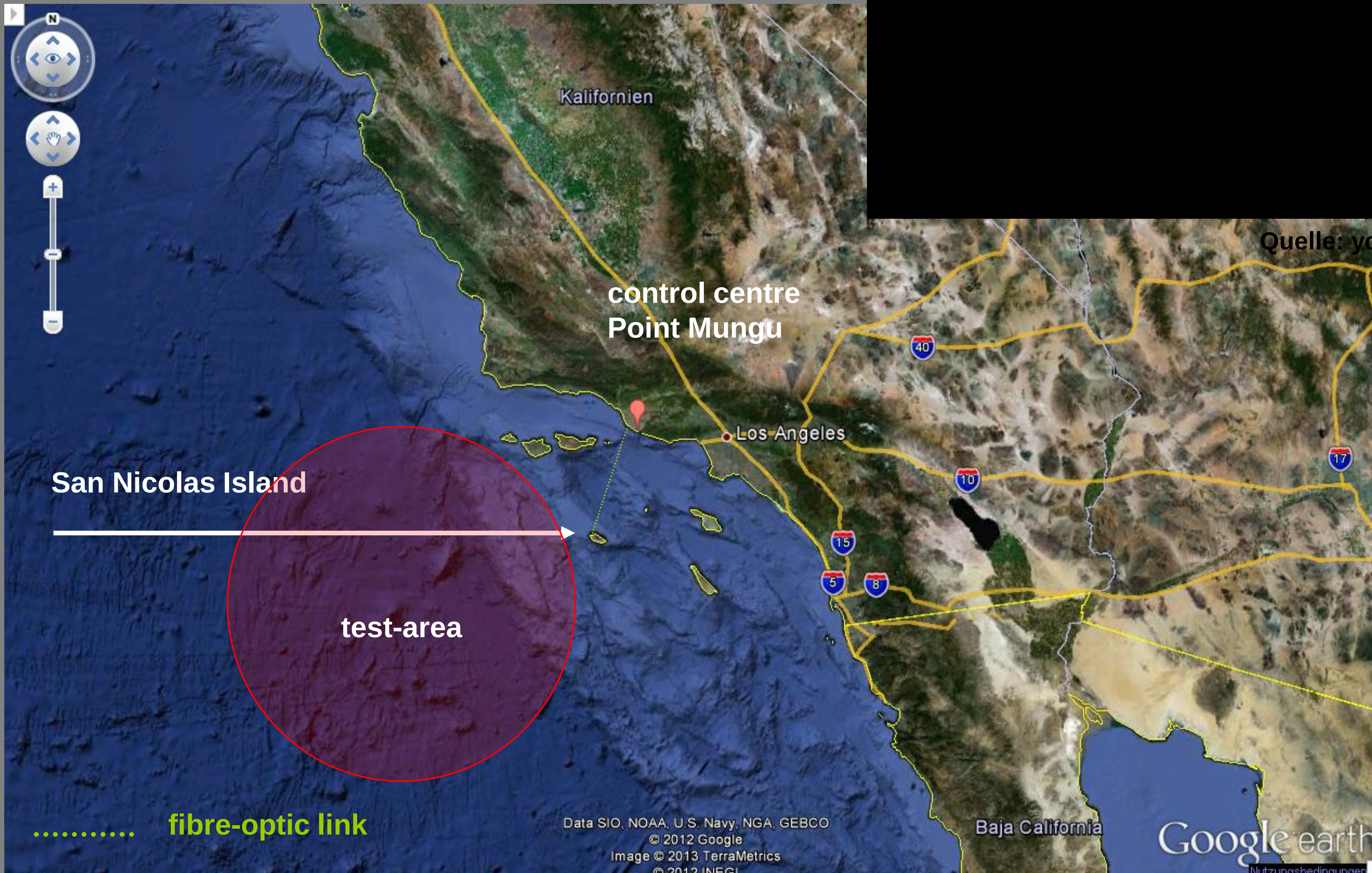
Aboard automated applications (2)

- Military developments
  1. CUSV - Common Unmanned Surface Vessel

     (Source: AAI Corporation)



Quelle: youtube

Quelle: GoogleEarth

Autonomous civilian navigation (1)

- Existing aboard components
  - Complex bridge system applications are entering into modern ship bridges framed by standardized interfaces as IBS / INS
  - ECDIS substitutes the paper sea charts
  - AIS target display on Radar and ECDIS
- External Services
  - Shore based routing assessment and decision support
  - Remote controlled track guiding
  - Satellite based maintenance and updating

Autonomous civilian navigation (2)

- INS performance standards by IMO
  - **CCRS:** A sub-system or function of an INS for acquisition, processing, storage, surveillance an distribution of data and information providing identical and obligatory reference to sub-systems and subsequent functions within an INS and to other connected equipment, if available.
  - **Integrity monitoring:** Ability of the INS to provide the user with information within the specified accuracy in a timely, complete and unambiguous manner, and alerts within a specified time when the system should be used with caution or not at all.

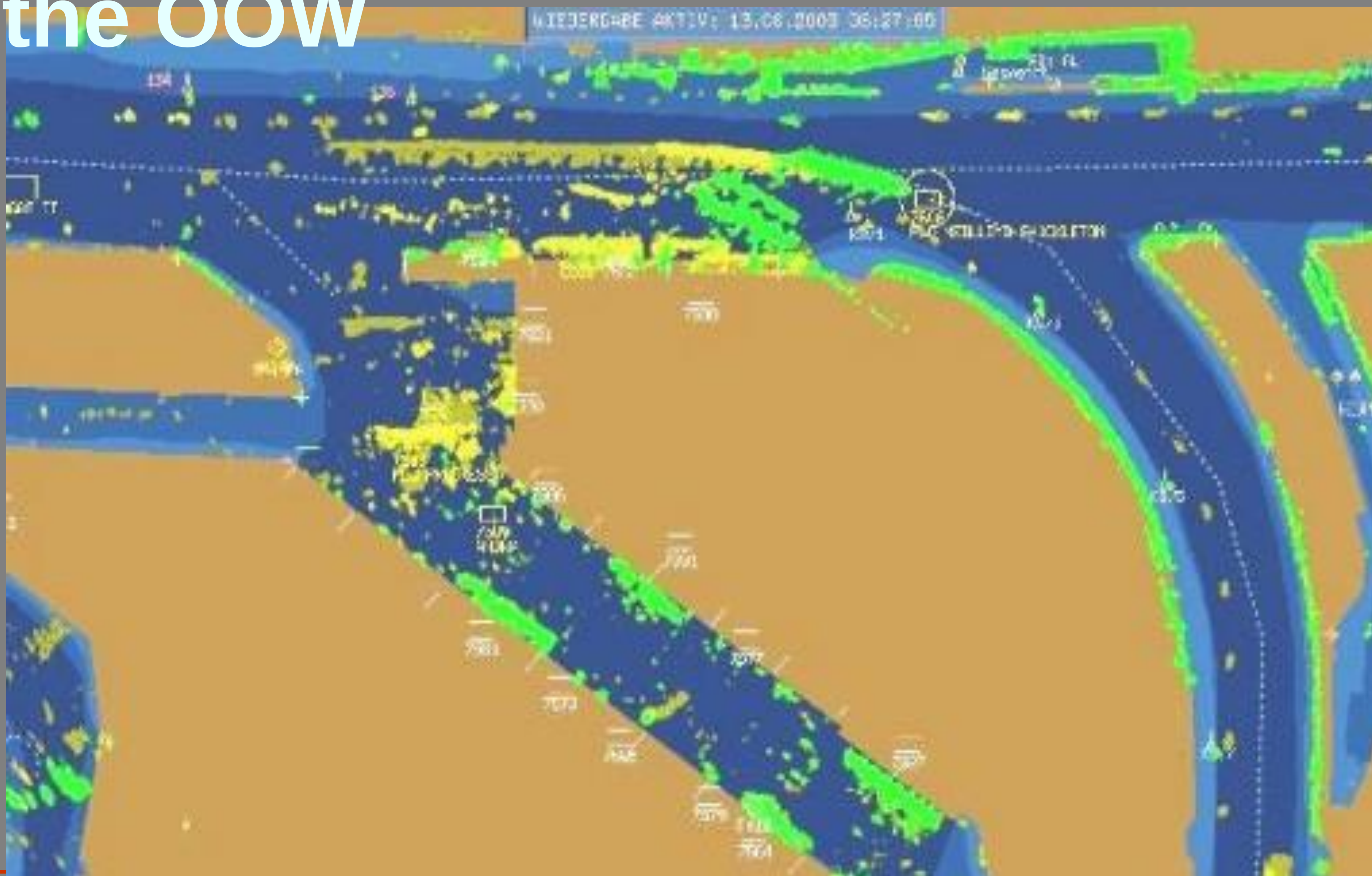
To do list for an autonomous navigation

- Navigation is more than a geometrical task:
  - Situation sensed navigation supported by time series information of position, surrounding und ship conditions
  - Shore based remote control support
- Safe data transfer between ship and shore
  - Safe navigational sensor data transfer
  - Safe remote control data transfer
- Bridge equipment reorganization
  - Wireless remote control interfaces, head-up display technology, hardwire linked navigational units installed on emergency ship bridge

Feasibilities of autonomous navigation

- Coming up feasibilities
  - Redundancy of satellite based positioning
  - 3D ECDIS
  - Hybrid navigation: semi-autonomous operating systems
    - time based
    - task based
- Future feasibilities
  - AUT 12 / AUT 24 – manned → support on demand
  - AUT 24 – unmanned → permanently remote controlled
  - AUT 24 – unmanned → mission controlled, event controlled, temporary remote controlled

Static navigational lines as reference between remote control station and the OOW



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Enhancing Efficiency guidance on dynamical “green lines”

- track keeping procedures → X - track error, distance to the next waypoint, …
- collision avoidance procedures → cpa / tcpa, solution appropriate to COLREG’s, …
- Using of pre-defined best manoeuvre task solution carried out as dynamical “green lines” by a computer based algorithm especially in harbour approaching situations or reaching manoeuvre destinations in narrow waters

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Introduction into dynamical "green lines“

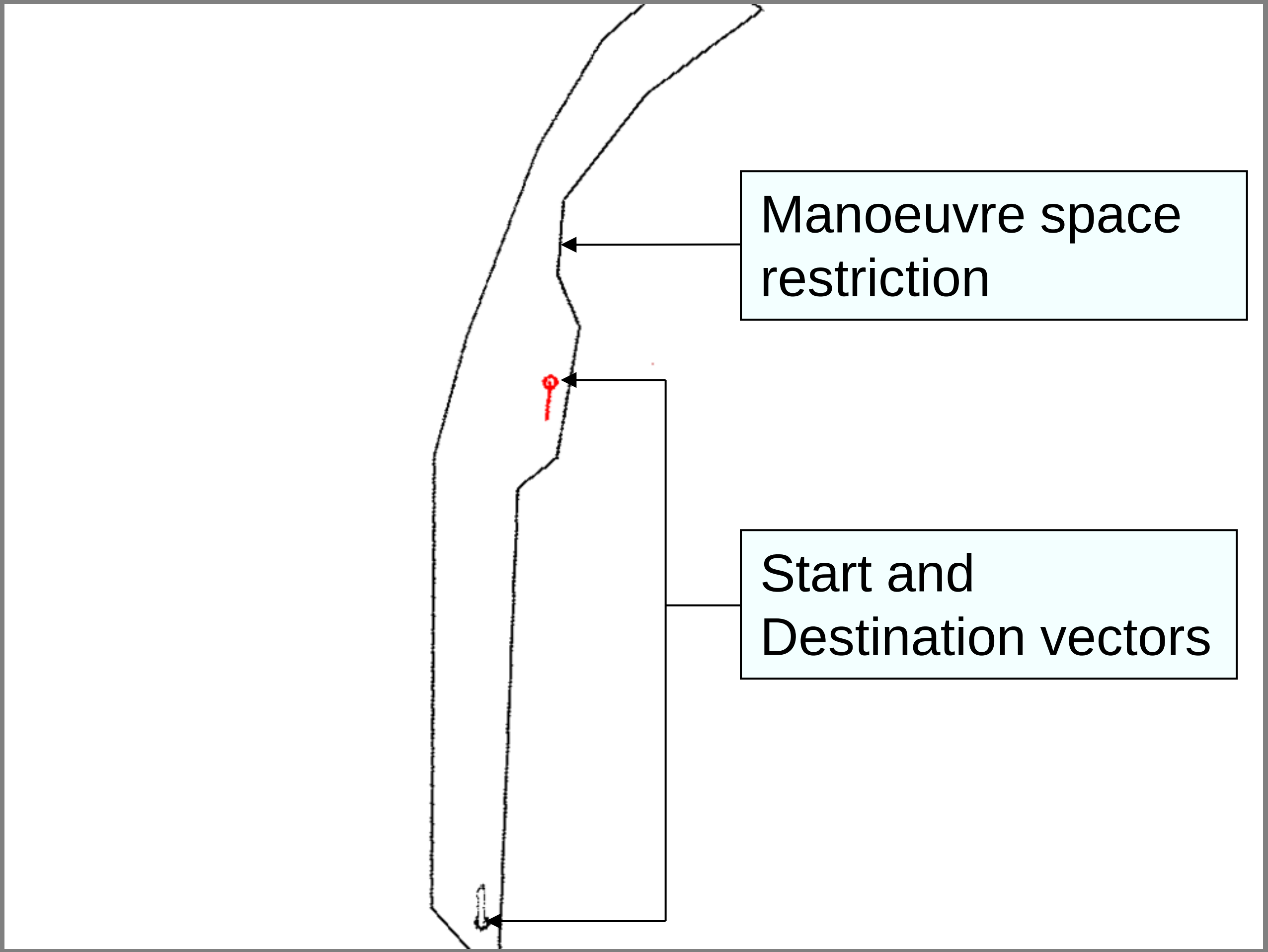
- Automatically generating of solution paths in respect to the following criteria in real time
  - physical static circumstances of the objects
  - physical dynamic circumstances of the objects
  - mariners habitualness (good seamanship)
- Best practice criteria for manoeuvring in restricted waters reaching the berthing place are:
  - minimum amount of course alternations
  - minimum path length
  - minimum sailing time

under the environmental conditions of drift and navigational space (depend from ship’s draught and water depths).

“green lines” Application

- The real time “green lines” generation using for remote control assistance from ashore
- The real time “green lines” generation using on the operating vessel

Demonstration of “green lines”



The algorithm carried out in advance a line between the starting point and the final destination.

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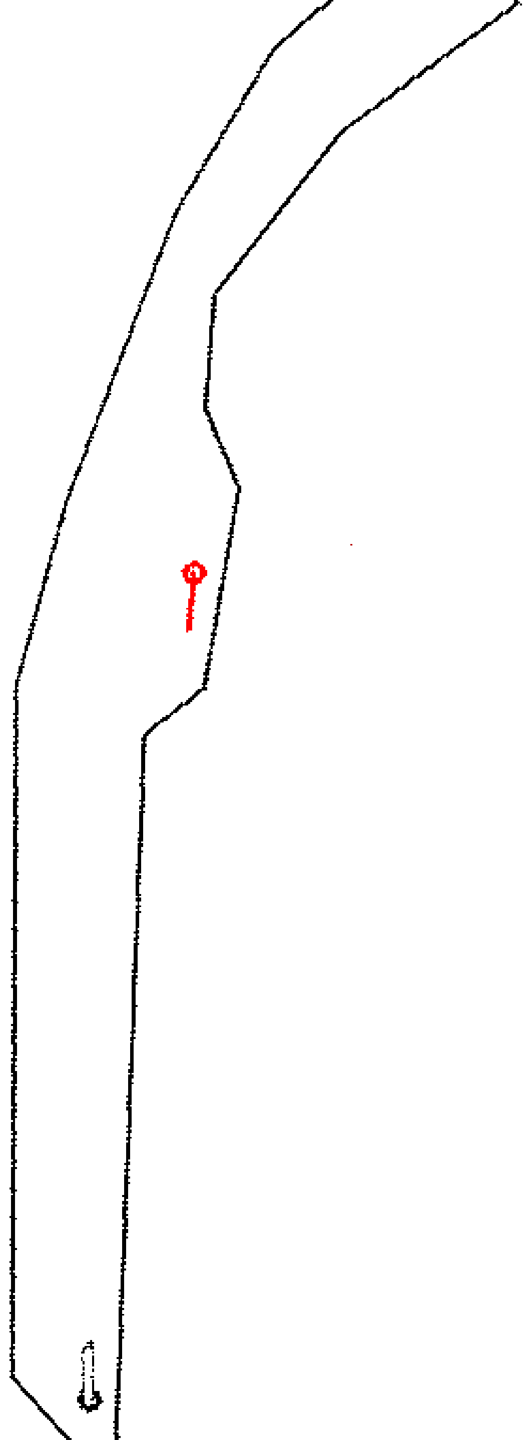

The real time experiment

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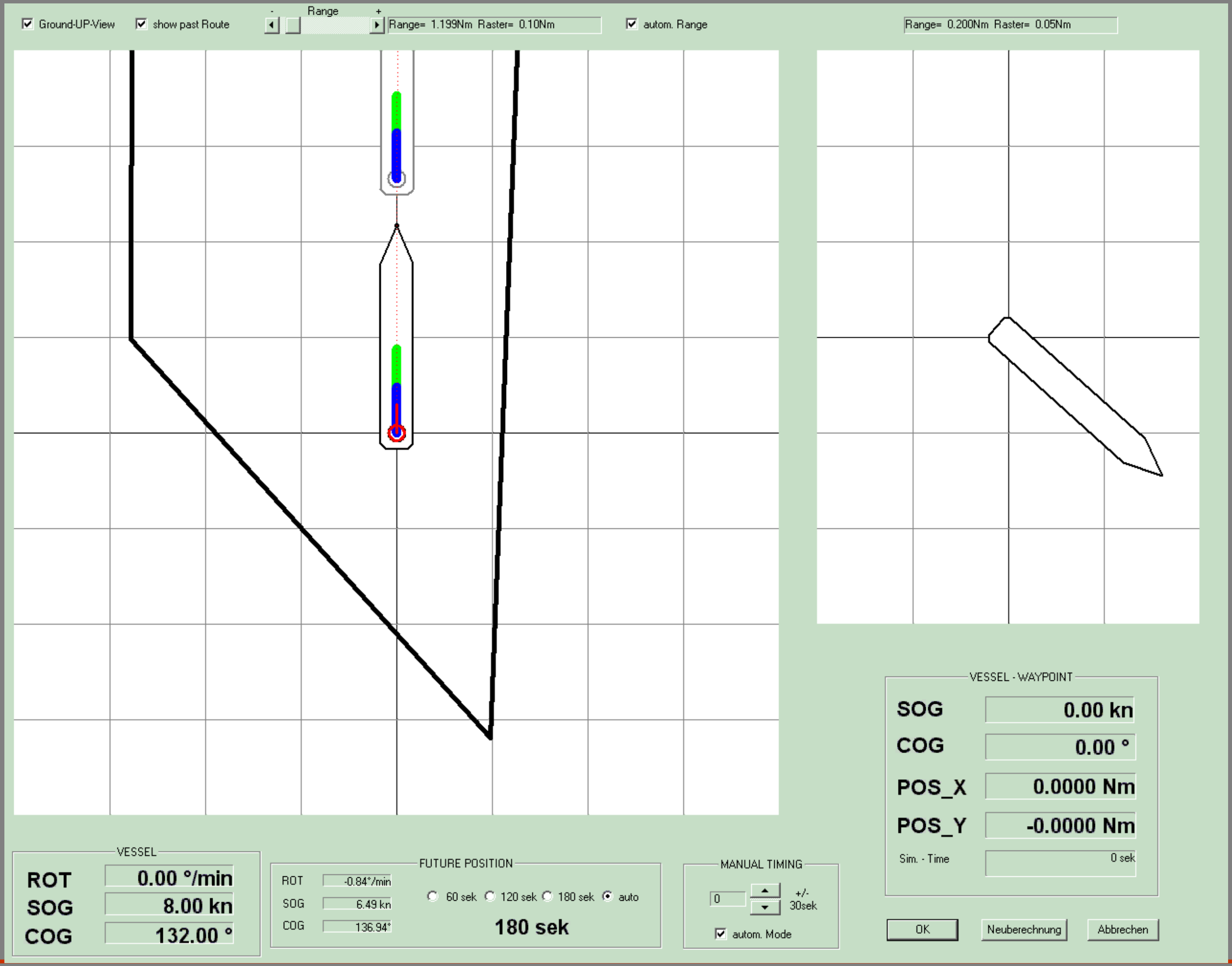
dynamical "green line" in a Task Example – start position



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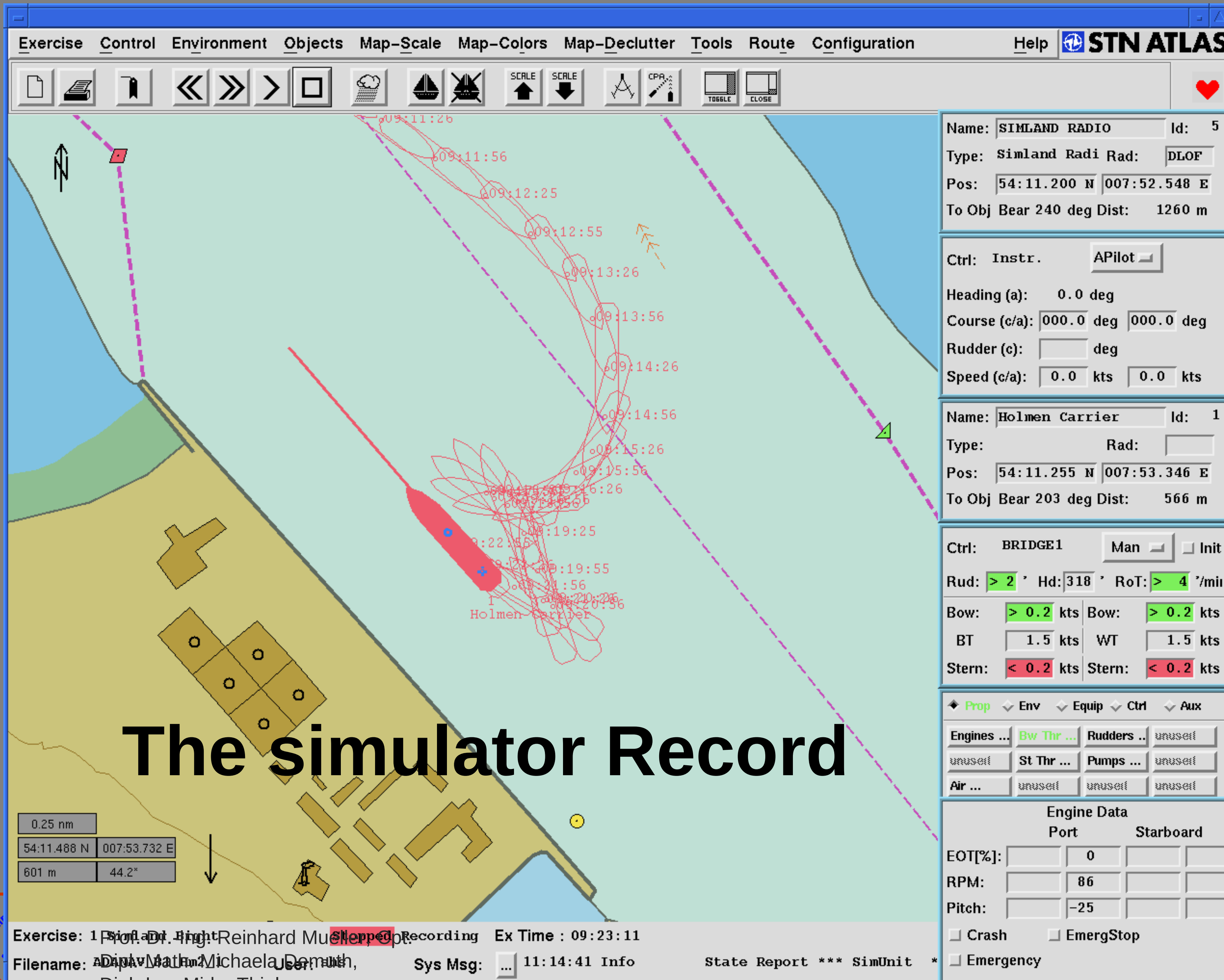
The simulator Record



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Summary

- Operation in connection with the SHS robust and in real time
- Add-on tool for attaining SHS training’s efficiency
- Applicable for conventional ships
- Further developments into applications for
  - On-board stand alone service tool
  - VTS service tool
  - Portable pilot units

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Conclusion

The challenge to be faced is the harmonization, the integrity and the reliability of the all-embracing system. Then the acceptance of e-Navigation will rise due to its benefits will be evidently. For example decision support tools for berth-to-berth navigation could be a key indication of e-Navigation. Then the visionary e-Navigation will turn into a practicable one.

In respect to a challenge of 100 per cent the vision affects 3 per cent reality - maybe.

Thank you for your attention