SCIPPER

Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

argonics GmbH

in innovative navigation

argonav

Alberding GmbH

weather dock

BAW Bundesanstalt für Wasserbau

DLR Deutsches Zentrum für Luft- und Raumfahrt

WSV.de Wasserstraßen- und Schifffahrtsverwaltung des Bundes

NOVIMAR and SciPPPer – Results of two Projects regarding the Automation of Inland Navigation

Lock passage today

Features of lock passage

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- Confined space: 11.45m ship width vs. 12m lock width

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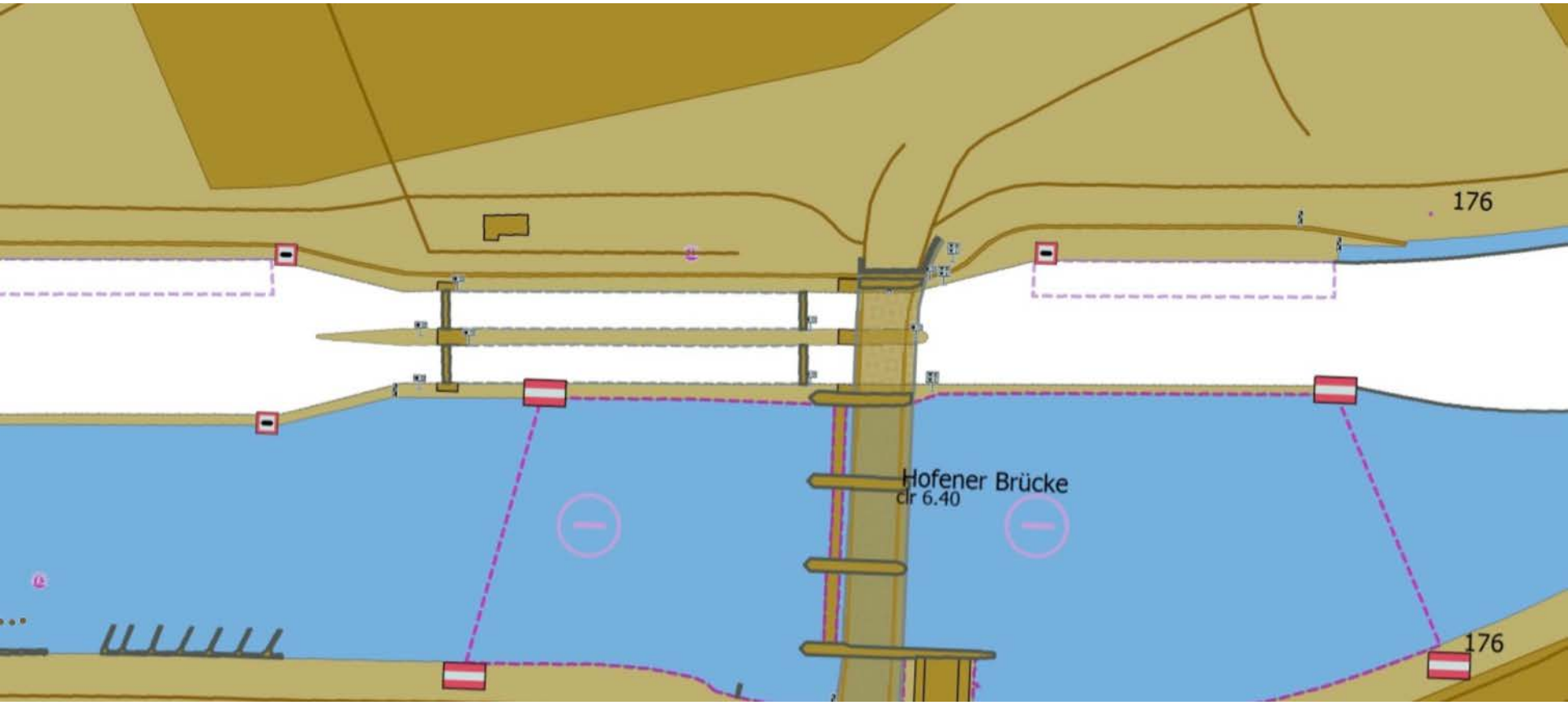
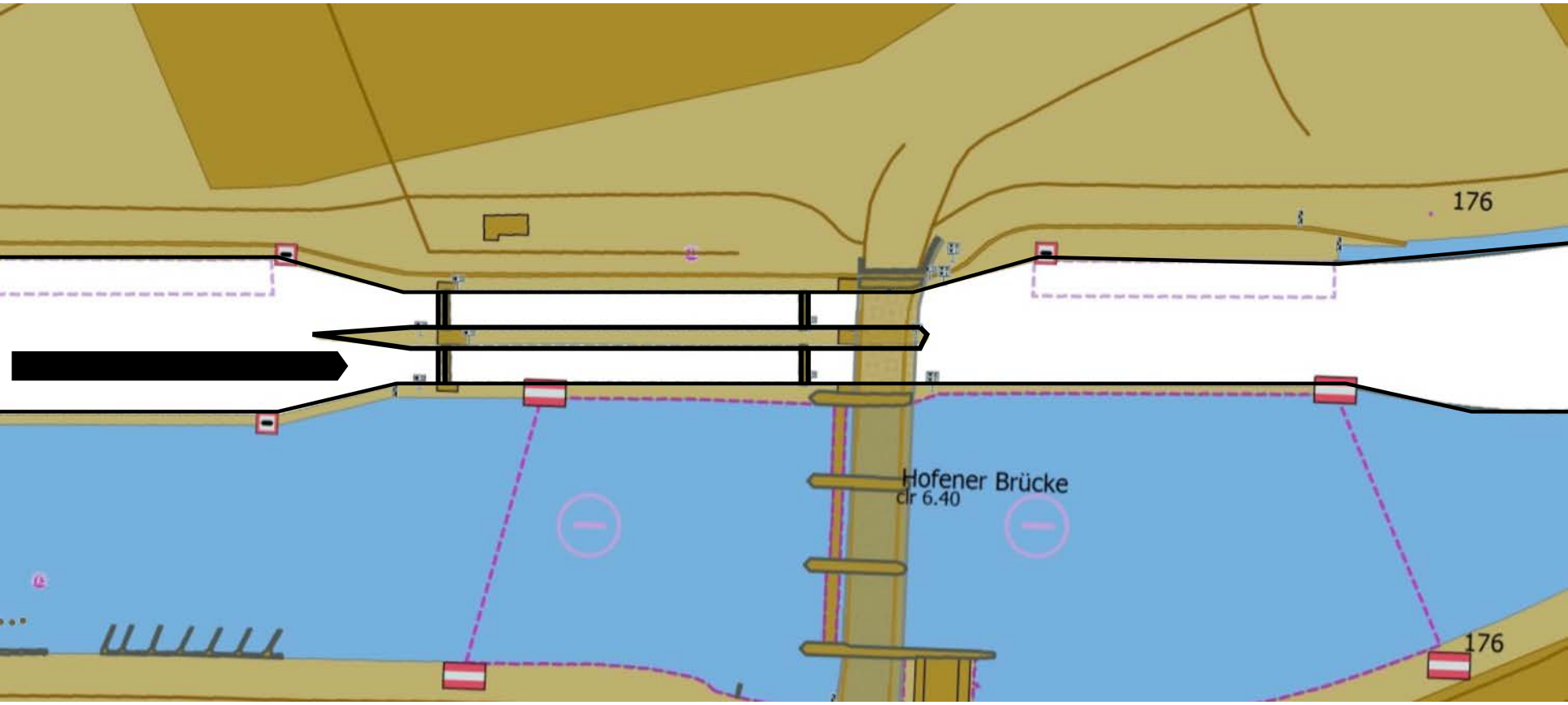
Schleusenassistenzsystem basierend auf
PPP und VDES für die Binnenschifffahrt
SCIPPPER – Automation of Lock Passage

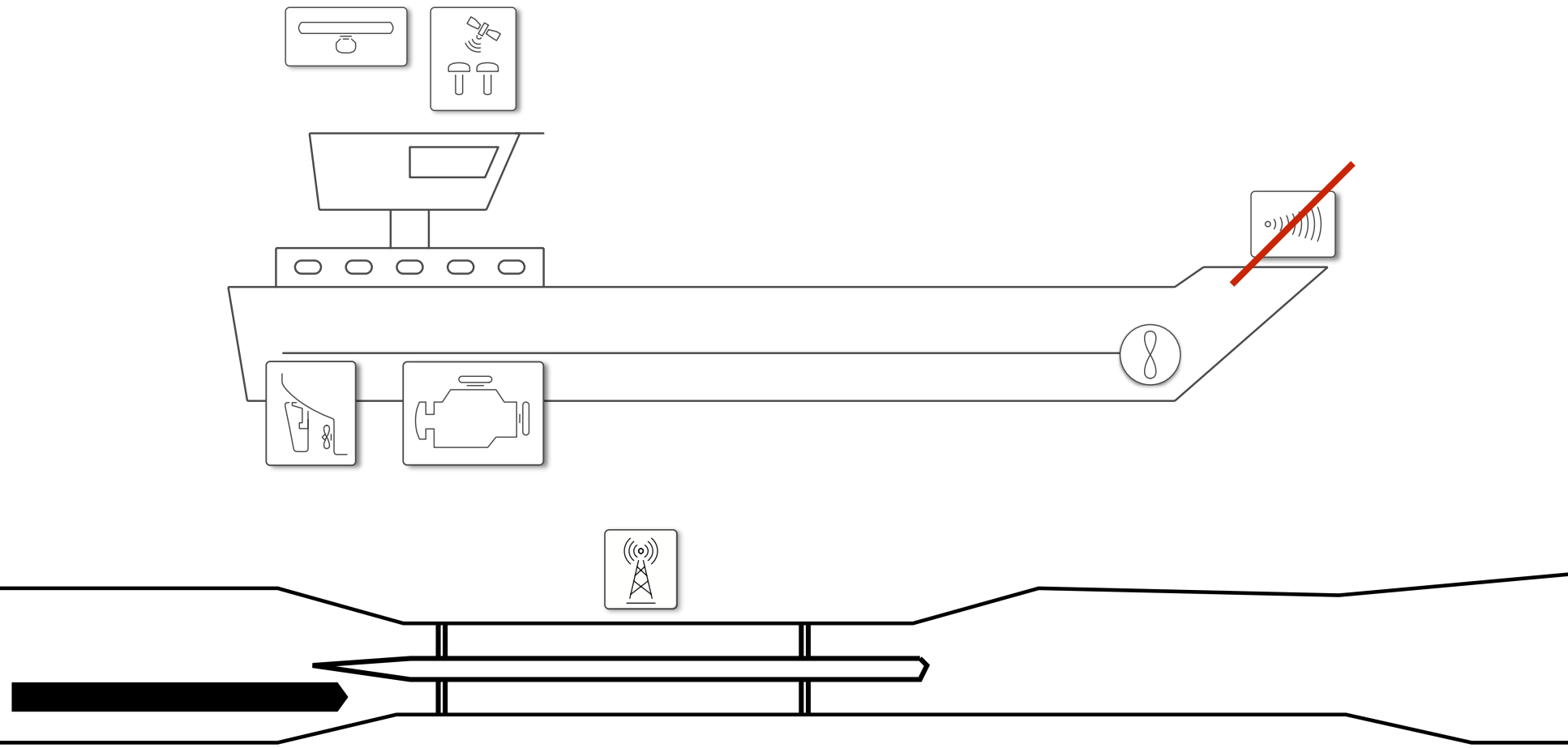
Lock in chart system



Lock in chart system



Sensors and actuators during lock passage



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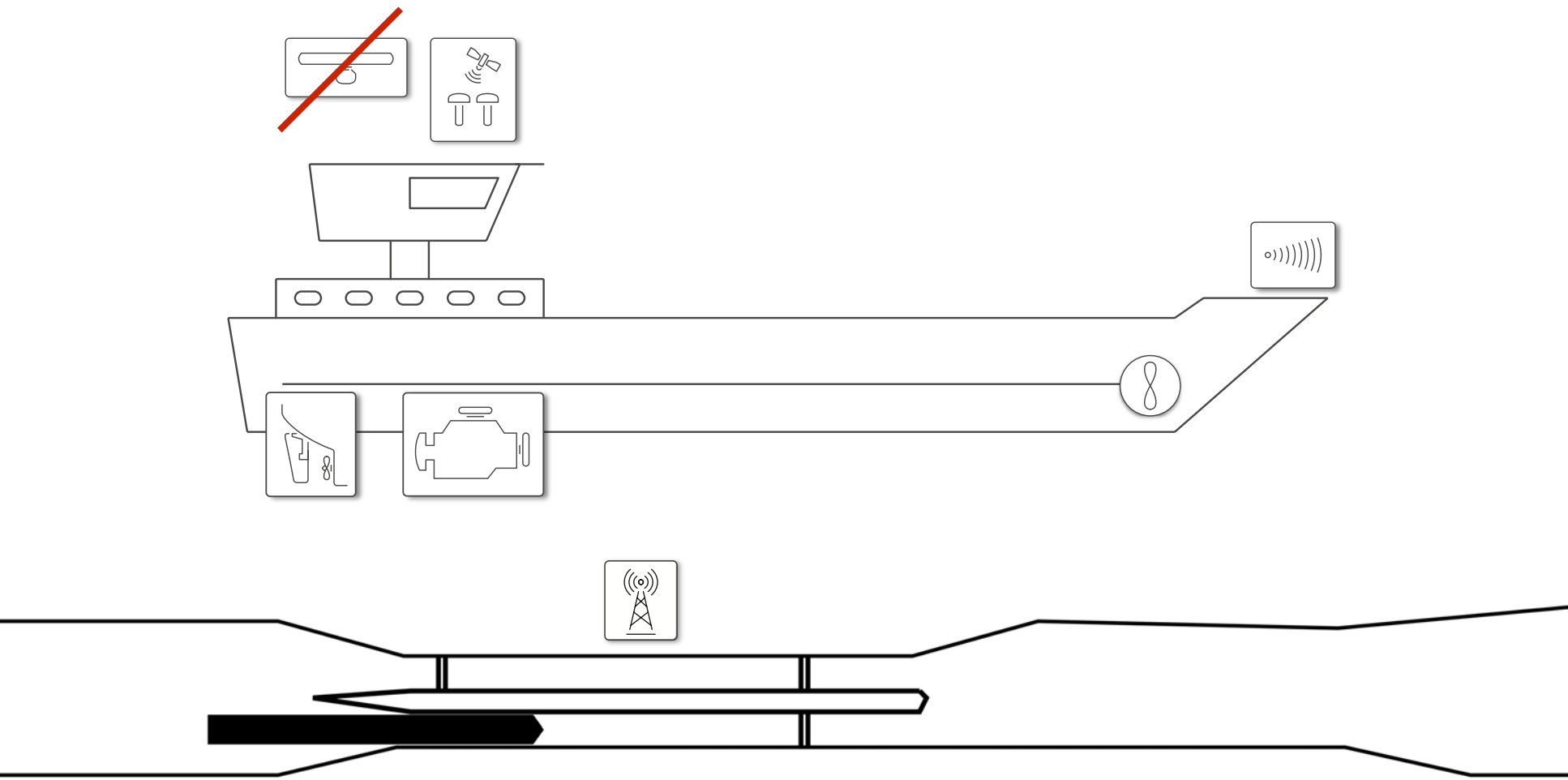

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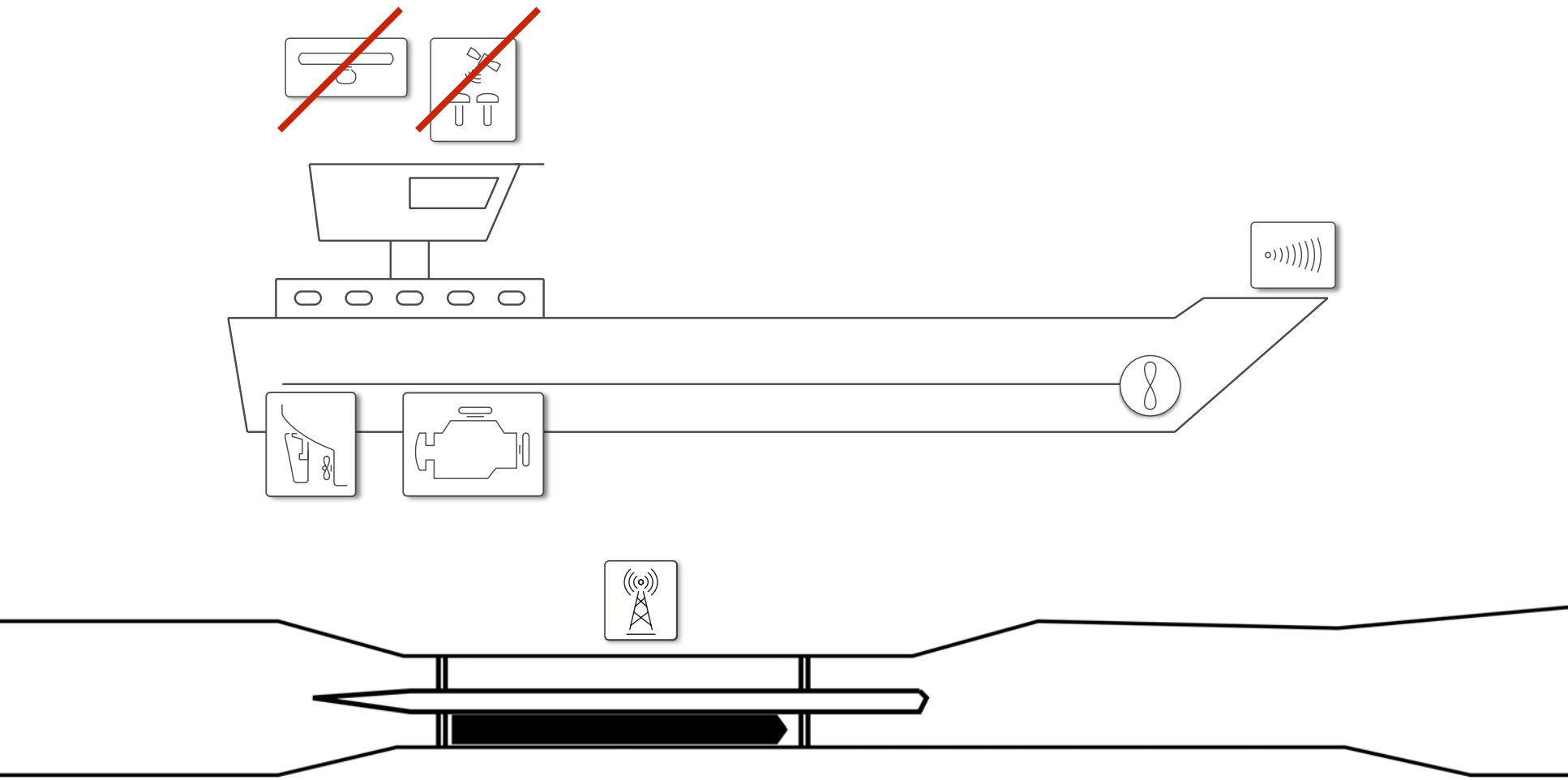

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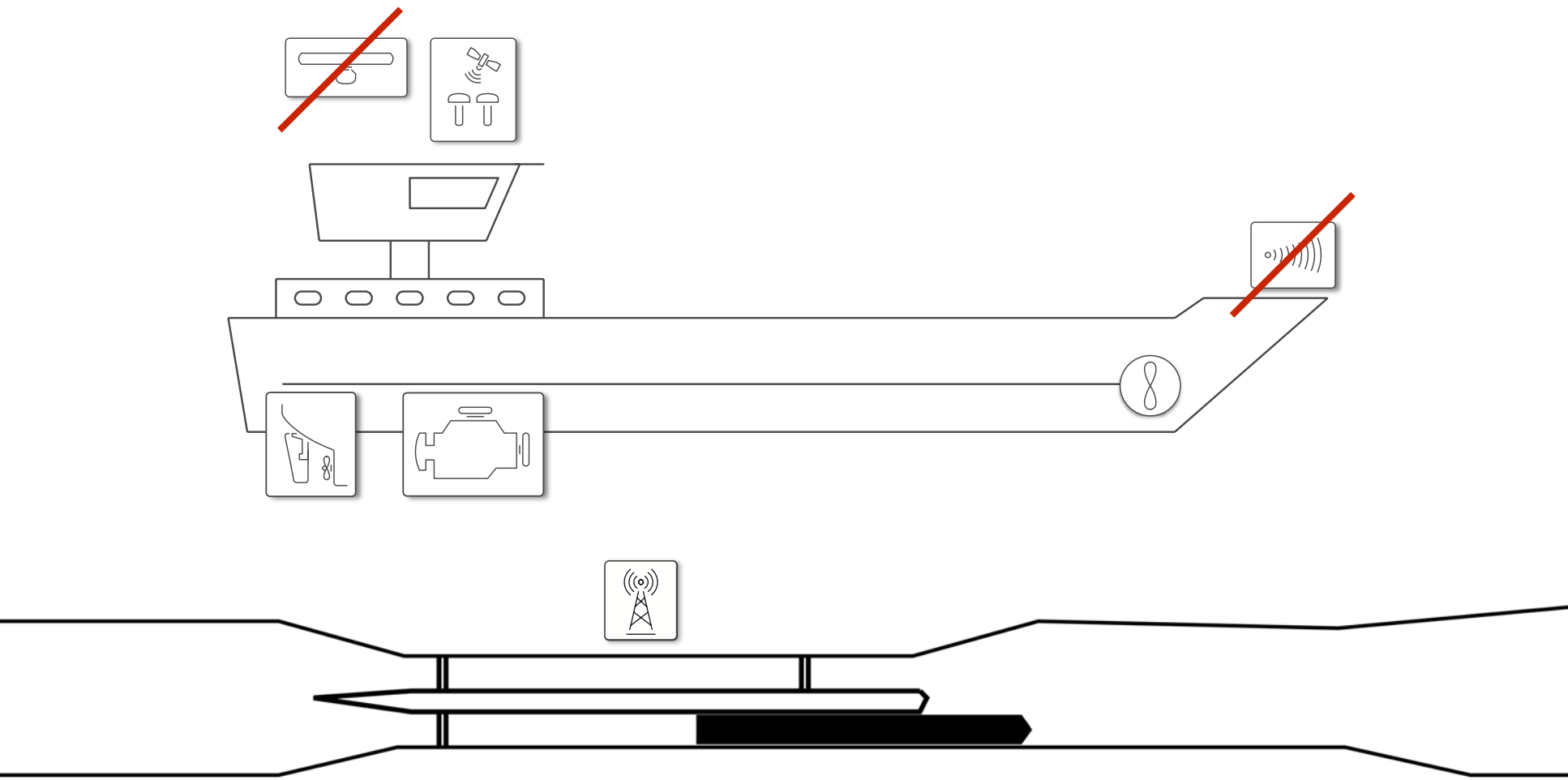
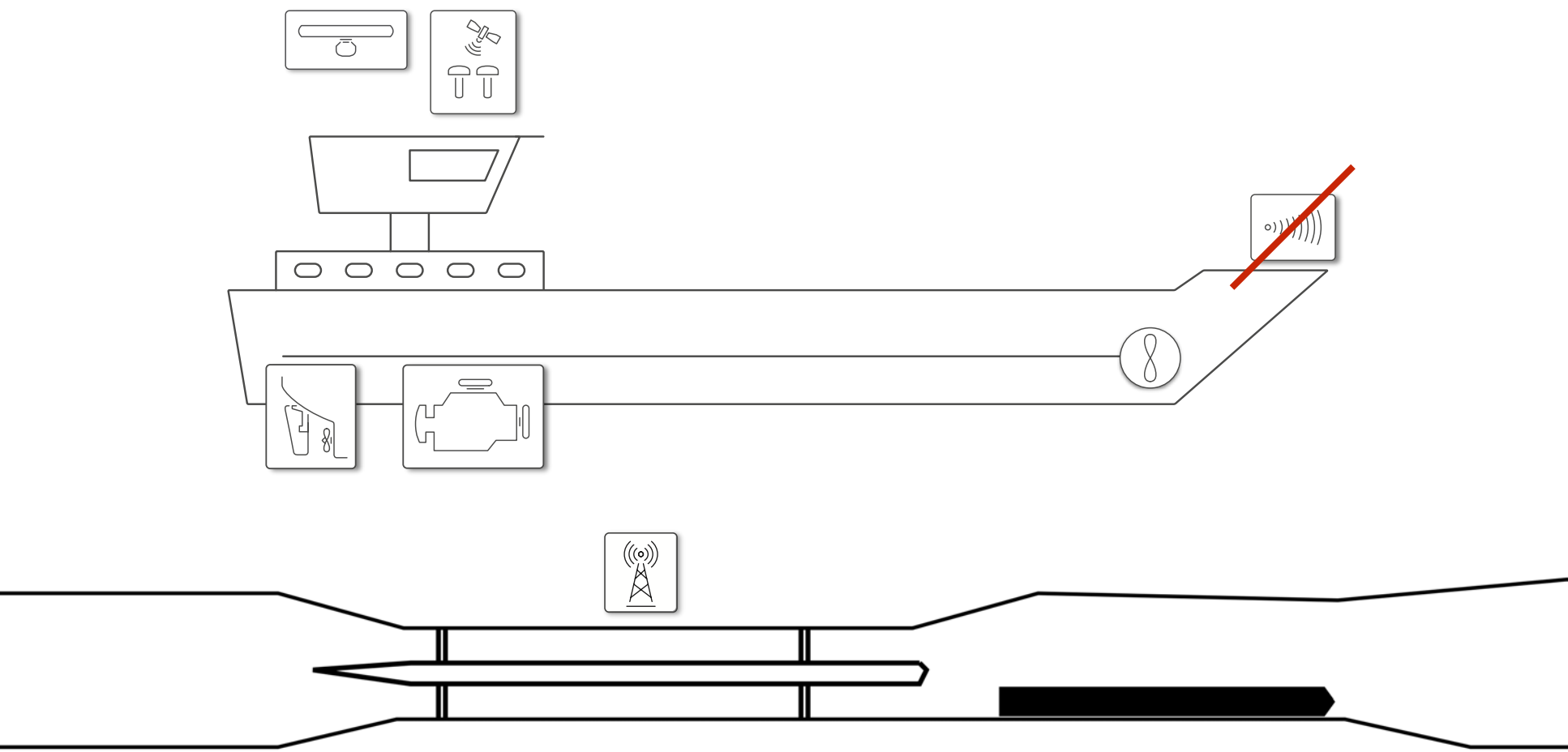
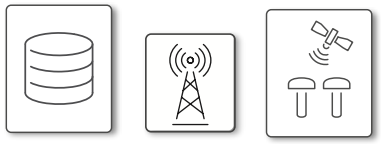


Sensors and actuators during lock passage



Work packages

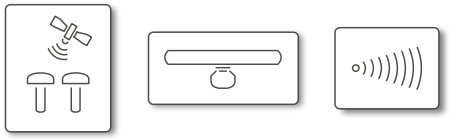


Land-based Technologies

- Lock information
- GNSS corrections
- AIS/VDES infrastructure
- Server infrastructure

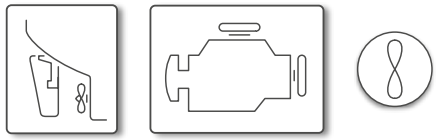
Communication

- VDE
- Transmission of PPP and lock data



Onboard Technologies

- High-precision GNSS position/heading from PPP data
- Close range sensors
  - Lidar
  - Radar



Maneuvering control/ Simulation

- Simulation model lock Koblenz
- Thrust allocation
- Path planning
- Maneuvering control

Alberding

WSV.de
Wasserstraßen- und Schifffahrtsverwaltung des Bundes

DLR

weather dock AG

argonav

DLR

BAW
Bundesanstalt für Wasserbau

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Solutions by SciPPPer

Features of Lock Navigation

- Confined space: 11.45m ship width vs. 12m lock width
- Low visibility: 110m ship length, blocked by ship hull
- Shadowing by lock chamber: height difference
- Complex maneuver: rudder angle, rpm, bow thruster
- Full concentration required, accidents with high costs
- Lock passage times: up to 30 minutes, up to 15x per day

Solutions by SciPPPer

Features of Lock Navigation

- Confined space: 11.45m ship width vs. 12m lock width → GNSS with PPP via AIS/VDES
- Low visibility: 110m ship length, blocked by ship hull
- Shadowing by lock chamber: height difference
- Complex maneuver: rudder angle, rpm, bow thruster
- Full concentration required, accidents with high costs
- Lock passage times: up to 30 minutes, up to 15x per day

Solutions by SciPPPer

Features of Lock Navigation

- Confined space: 11.45m ship width vs. 12m lock width ✗
- Low visibility: 110m ship length, blocked by ship hull
- Shadowing by lock chamber: height difference
- Complex maneuver: rudder angle, rpm, bow thruster
- Full concentration required, accidents with high costs
- Lock passage times: up to 30 minutes, up to 15x per day

Solutions by SciPPPer

Features of Lock Navigation

- Confined space: 11.45m ship width vs. 12m lock width ✗
- Low visibility: 110m ship length, blocked by ship hull → GUI
- Shadowing by lock chamber: height difference
- Complex maneuver: rudder angle, rpm, bow thruster
- Full concentration required, accidents with high costs
- Lock passage times: up to 30 minutes, up to 15x per day

Solutions by SciPPPer

Features of Lock Navigation

- Confined space: 11.45m ship width vs. 12m lock width ✗
- Low visibility: 110m ship length, blocked by ship hull ✗
- Shadowing by lock chamber: height difference
- Complex maneuver: rudder angle, rpm, bow thruster
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- Lock passage times: up to 30 minutes, up to 15x per day

Solutions by SciPPPer

Features of Lock Navigation

- Confined space: 11.45m ship width vs. 12m lock width ✗
- Low visibility: 110m ship length, blocked by ship hull ✗
- Shadowing by lock chamber: height difference → Integration of LiDAR/Radar sensors
- Complex maneuver: rudder angle, rpm, bow thruster
- Full concentration required, accidents with high costs
- Lock passage times: up to 30 minutes, up to 15x per day

Solutions by SciPPPer

Features of Lock Navigation

- Confined space: 11.45m ship width vs. 12m lock width ✗
- Low visibility: 110m ship length, blocked by ship hull ✗
- Shadowing by lock chamber: height difference ✗
- Complex maneuver: rudder angle, rpm, bow thruster
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Solutions by SciPPPer

Features of Lock Navigation

- Confined space: 11.45m ship width vs. 12m lock width ✗
- Low visibility: 110m ship length, blocked by ship hull ✗
- Shadowing by lock chamber: height difference ✗
- Complex maneuver: rudder angle, rpm, bow thruster → Multi-variable control
- Full concentration required, accidents with high costs
- Lock passage times: up to 30 minutes, up to 15x per day

Solutions by SciPPPer

Features of Lock Navigation

- Confined space: 11.45m ship width vs. 12m lock width
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Features of Lock Navigation

- Confined space: 11.45m ship width vs. 12m lock width ✗
- Low visibility: 110m ship length, blocked by ship hull ✗
- Shadowing by lock chamber: height difference ✗
- Complex maneuver: rudder angle, rpm, bow thruster ✗
- Full concentration required, accidents with high costs → Automation
- Lock passage times: up to 30 minutes, up to 15x per day

Solutions by SciPPPer

Features of Lock Navigation

- Confined space: 11.45m ship width vs. 12m lock width
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Solutions by SciPPPer

Features of Lock Navigation

- Confined space: 11.45m ship width vs. 12m lock width ✗
- Low visibility: 110m ship length, blocked by ship hull ✗
- Shadowing by lock chamber: height difference ✗
- Complex maneuver: rudder angle, rpm, bow thruster ✗
- Full concentration required, accidents with high costs ✗
- Lock passage times: up to 30 minutes, up to 15x per day → Reduction

Solutions by SciPPPer

Features of Lock Navigation

- Confined space: 11.45m ship width vs. 12m lock width
- Low visibility: 110m ship length, blocked by ship hull
- Shadowing by lock chamber: height difference
- Complex maneuver: rudder angle, rpm, bow thruster
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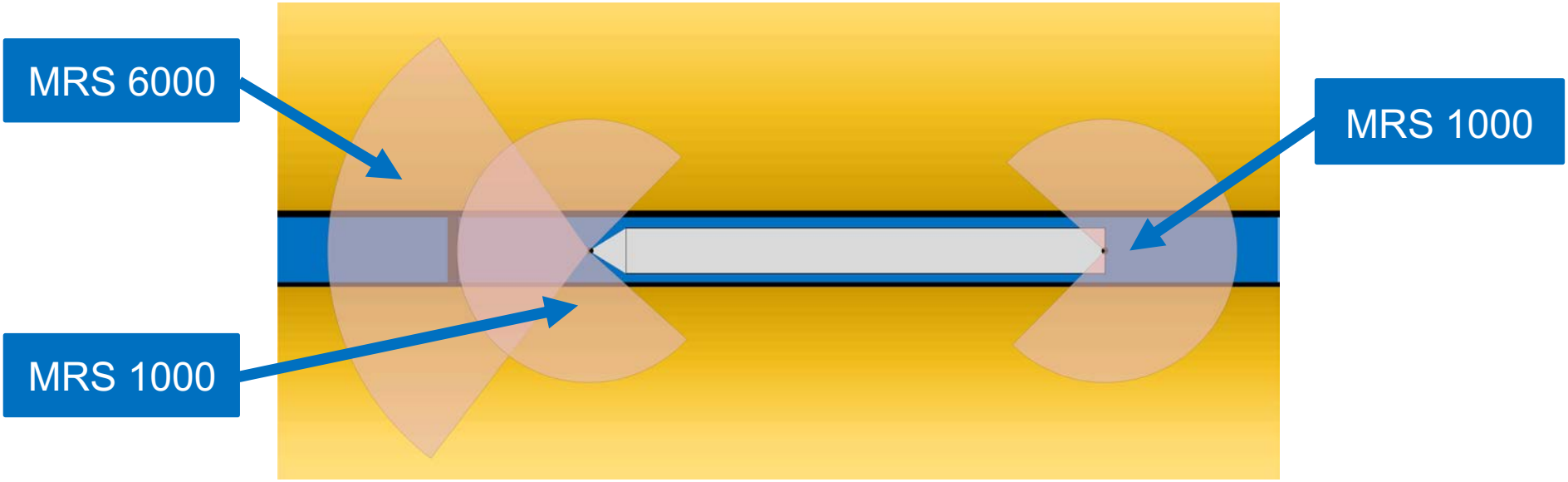
Close range sensors

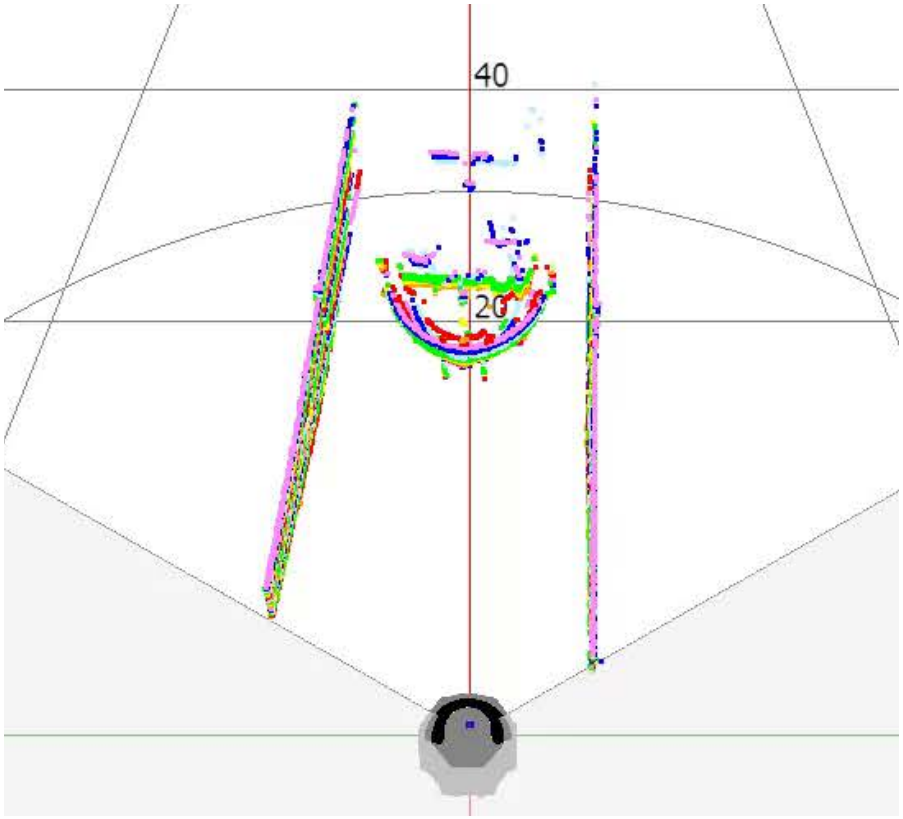


Close range sensors

MRS 6000

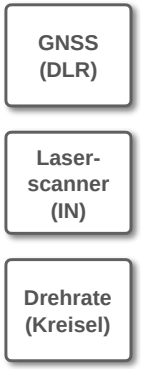
MRS 1000

Close range sensors



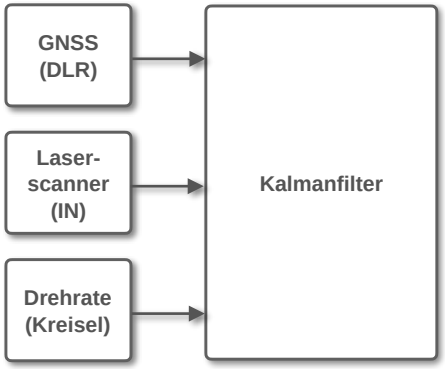
Control loop

- Interface to sensors



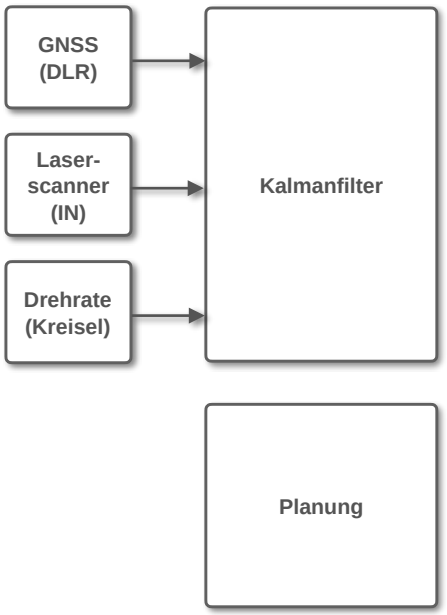
Control loop

- Interface to sensors
- Kalman filter to estimate position from GNSS and LiDAR measurements



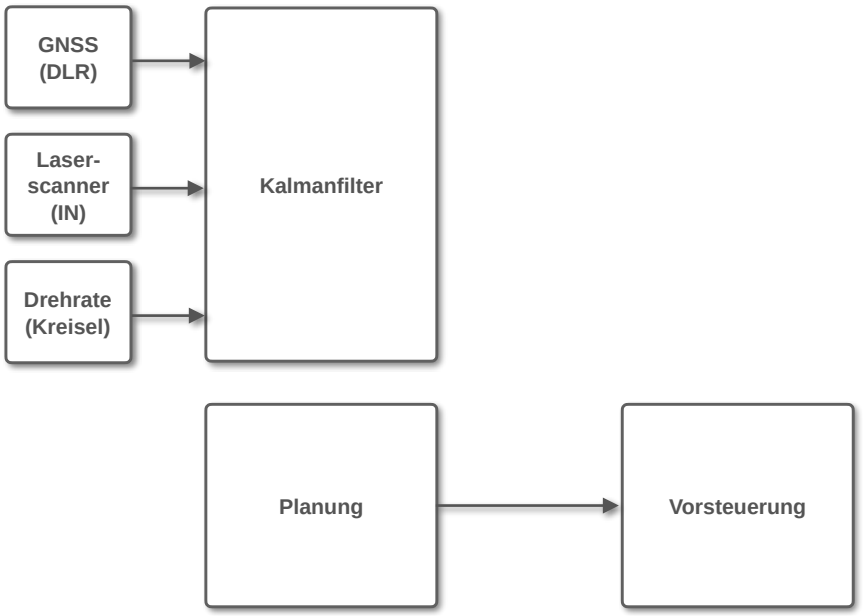
Control loop

- Interface to sensors
- Kalman filter to estimate position from GNSS and LiDAR measurements
- Planning of maneuver with cubic splines



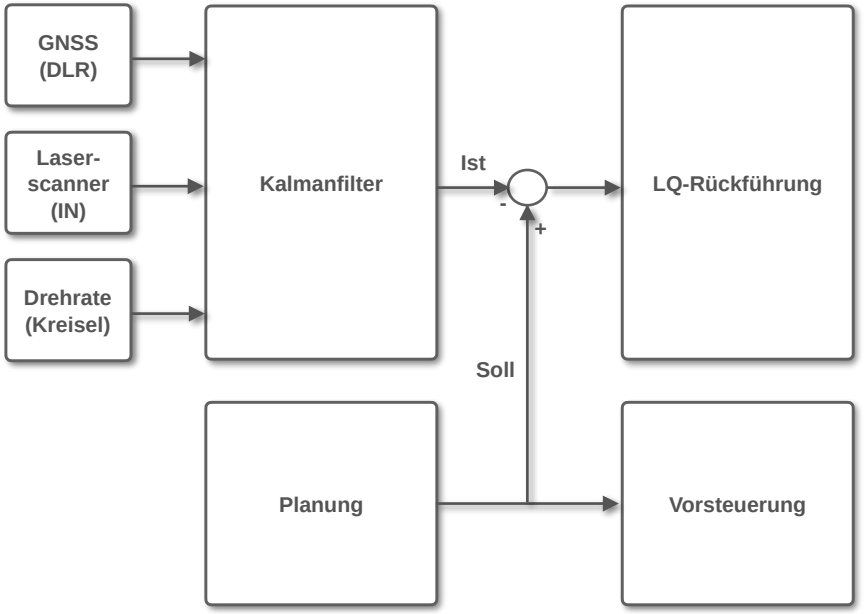
Control loop

- Interface to sensors
- Kalman filter to estimate position from GNSS and LiDAR measurements
- Planning of maneuver with cubic splines
- Feedforward calculates required forces and moments



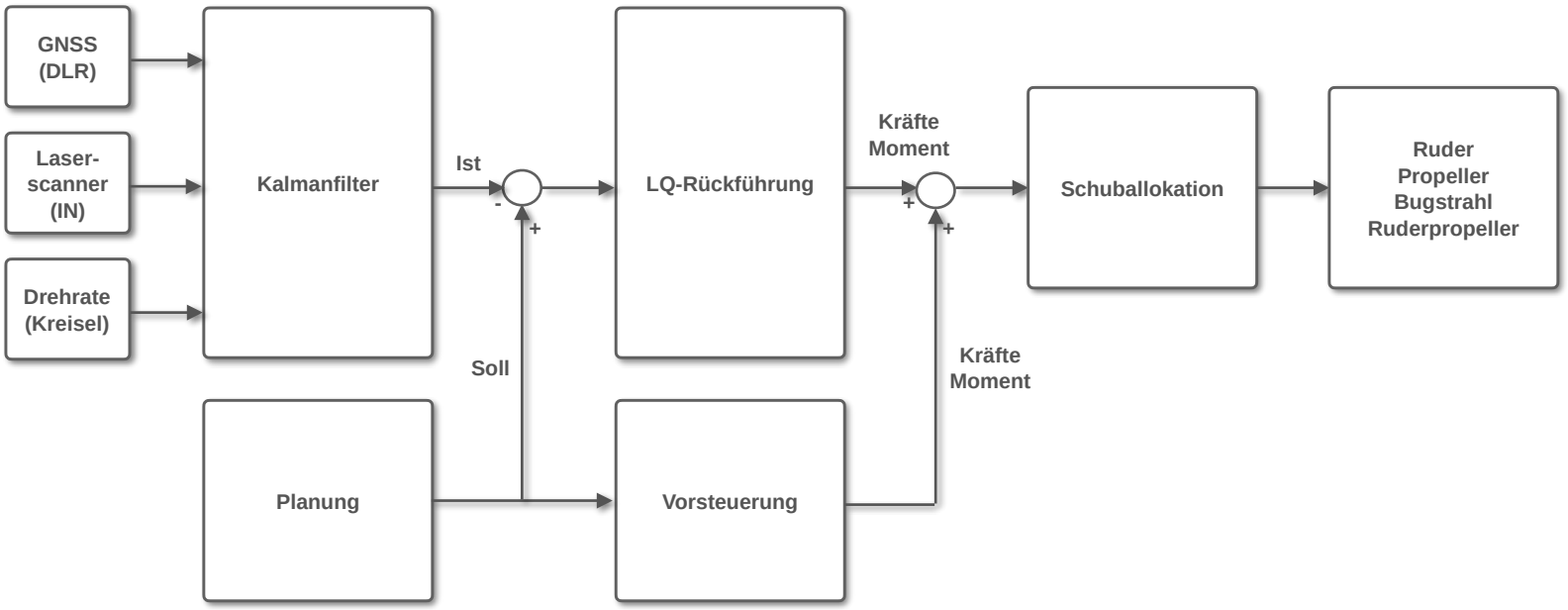
Control loop

- Interface to sensors
- Kalman filter to estimate position from GNSS and LiDAR measurements
- Planning of maneuver with cubic splines
- Feedforward calculates required forces and moments
- LQ feedback calculates forces and moments from deviations



Control loop

- Interface to sensors
- Kalman filter to estimate position from GNSS and LiDAR measurements
- Planning of maneuver with cubic splines
- Feedforward calculates required forces and moments
- LQ feedback calculates forces and moments from deviations
- Thrust allocation calculates required rudder angle and engine rpms from forces and moments



Validation on simulator

Validation on simulator

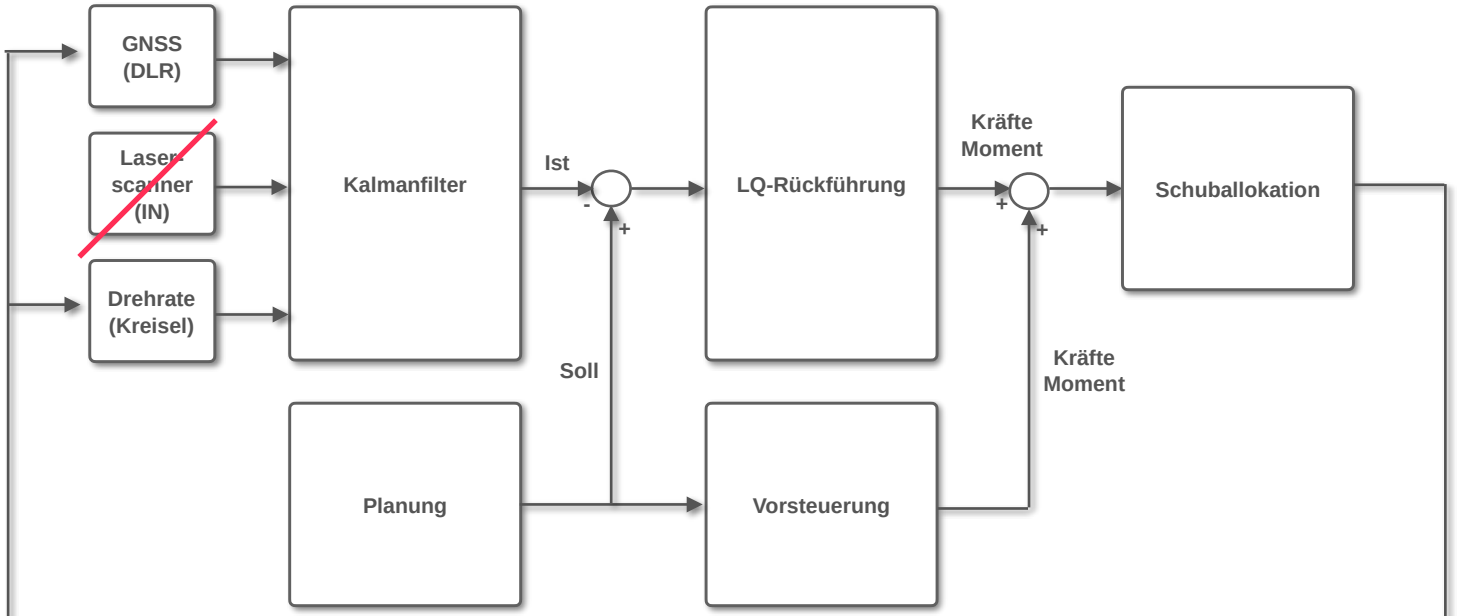
Simulation of all levers

Validation on simulator

Simulation of all levers

Switching via relays

Validation on simulator



Validation on simulator

SCIPPER

Schleusenassistenzsystem basierend auf PPP und VDES für die Binnenschifffahrt

Demonstration am Simulator der BAW

Videomaterial: BAW, Karlsruhe, CC BY 4.0

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Final demonstration

Final demonstration

Thank you for your attention!

alexander.lutz@argonics.de