



Avikus
MARITIME AUTONOMOUS PIONEER

Commercialization status of autonomous navigation solution

September 2024

Dohyeong Lim Ph.D CEO

Driving force of autonomous ship

Autonomous navigation is not a choice but a necessity



150,000

- Shortage of around 150,000 seafarers within 5 yrs
- Over 50% of Japan's domestic vessels are aged 50 years or older.



80%

- Approximately 80% of maritime accidents are due to human error
- The Suez Canal incident in 2021 resulted in daily losses of approximately 1 trillion KRW

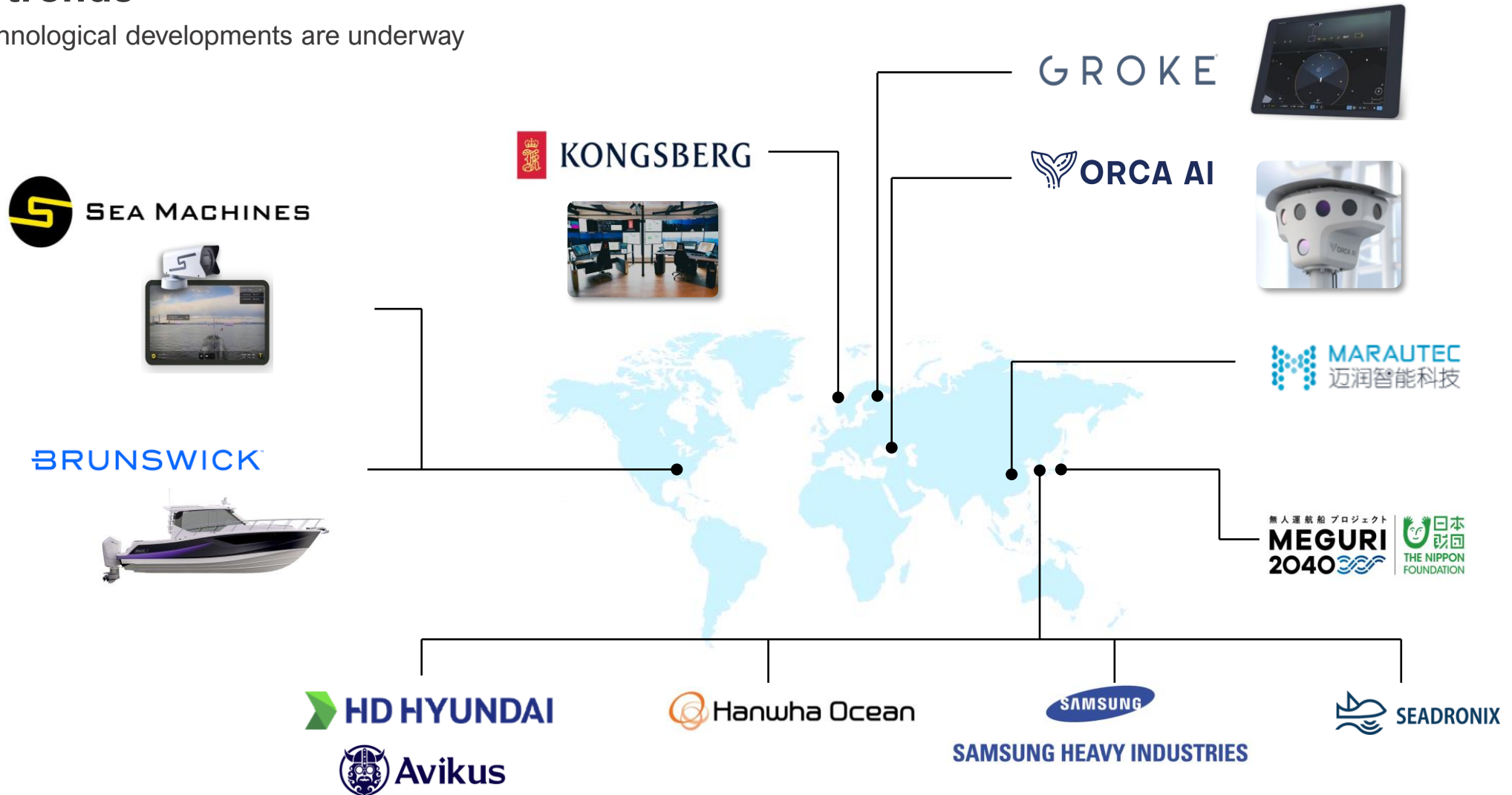


13%

- Maritime transportation accounts for 13% of GHG emissions
- 0% reduction in carbon emissions is necessary by 2030
- Vessels unable to meet IMO regulations face operational bans

Market trends

Diverse technological developments are underway



HD Hyundai's Voyage for MASS


From 'Smart Ship(IoT & Automation)' to 'Autonomous Ship(AI & Robotics)'

MASS


Maritime Autonomous Surface Ship




Navigation




Remote Operation




Comm.




Ship Management & Reporting



Engine & Machinery



Cargo Handling



Maintenance & Repair



Emergency Response

HD Hyundai's Voyage for MASS

From 'Smart Ship(loT & Automation)' to 'Autonomous Ship(AI & Robotics)'



Steadfast Growth of Avikus

A Continuous and Upward Trajectory



Founded in January '21 by
HD HYUNDAI,
No.1 Shipbuilder in the world

10+ years of unprecedented
"smart ship" R&D legacy of
HD HYUNDAI



Industry-leading track records and data leadership with 400+ orders and 100+ installations

All **HD HYUNDAI** vessels are equipped with **Avikus** solutions(200+ every year)



90+ researchers & engineers joined from all over the world and the number will be 150~200

Attracting **top-tier talent** in AI, computer vision, software, and control from each industries



Technology is **scalable** for **all types of maritime surface vessel** from 20ft to 1,000ft +

References include commercial ships, leisure boats, coast guard ships and workboats

Stepwise Footprint of Avikus

From the World's First to the World's Best

'21



**Pohang Canal Cruise
Autonomous Navigation
Demonstration**

*World's 1st Canal Cruise
Autonomous Navigation
Demonstration*

'22



**Autonomous
LNG Carrier
Trans-Ocean Project**

*World's 1st Autonomous
Large Merchant Vessel
Trans-Ocean*

'23



**International Boat Show
Autonomous Boat
Demonstration**

*World's 1st Autonomous
Boat Live Demonstration
at the Boat Show*

**Autonomous Marine
Taxi in the city of
BUSAN**

*A new means of
transportation
for marine tourism*



Elevate the Autonomous Navigation Experience

With HiNAS for Ships and NeuBoat for Boats



“Revolutionizing maritime logistics”



“Democratizing the boating experience”

Unleash the infinite potential of the ocean by leading the paradigm shift of marine mobility

Safety

- Reduce accidents caused by human error
- Respond to the rack of experienced seafarers

Economy

- Improve fuel efficiency (Just-in-time)
- Reduce operation and new building costs

Sustainability

- Support emission regulations
- Provide relief to seafarers

Safety

- Reduce accidents caused by human error

Convenience

- Make boating easy and accessible to all

Pleasure

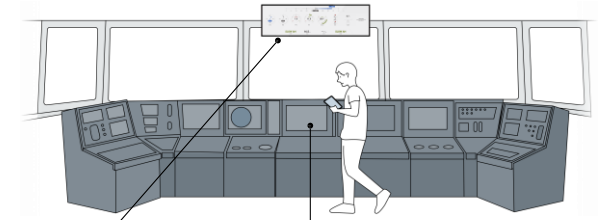
- Reduce driving-related anxiety and maximize carefree leisure time

For large commercial vessel

HiNAS solutions, total package for Autonomous Navigation

The concept of the HiNAS is to assist the navigation and maneuvering work of the seafarers of ships by autonomously performing the behaviors of humans.

Since this system is designed for assistance, it is a partially autonomous system, not a fully autonomous system which means all the responsibility of autonomous operation is belonging to the certified officers/captain on board.

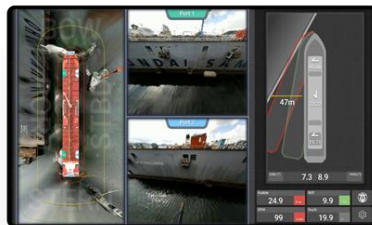


Modules of HiNAS



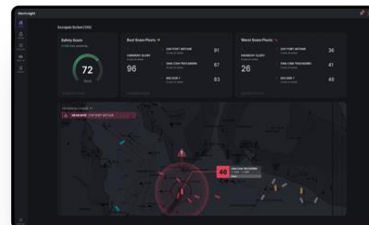
Navigation

- Vision Object Detection
- Sensor Fusion



SVM

- 360 Birds Eye View
- Collision/Allision warning



Cloud

- Fleet management (Safety, FOC, CII)
- Enhanced Situational Awareness



Control

- Voyage optimization
- Route following
- Collision avoidance

Autonomous Control

Avikus HiNAS

Situational Awareness

Key Feature of HiNAS Navigation

- Computer vision and deep learning-based **target detection**
- **IR camera-based** target detection at night or restricted visibility
- Using **sensor fusion** technology(RADAR, AIS, Cameras, LiDAR, etc.)



▶ IR(Infrared) Camera (120 deg. FOV)

▶ EO(Electro-Optical) Camera (180 deg. FOV)

Computer vision & deep learning-based objects detections
→ **Algorithm was developed based on more than 5M data points**

vessel(61%)

vessel(90%)

vessel(56%)

vessel(71%)

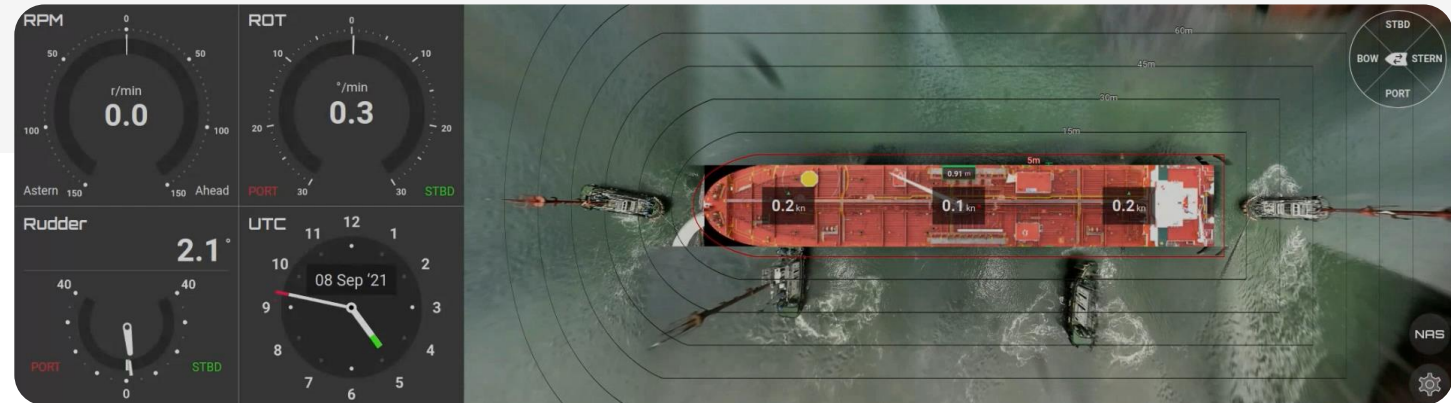
vessel(37%)

vessel(88%)

Real-Time 360° View

Key Feature of HiNAS SVM

- Useful when passing canal, narrow channel, berthing/unberthing
- Prevent the risk of armed robbery, stowaways, smugglers, etc.
- Actual Example from Korean Ship Owner
 - They caught an attempt of a stowaway in advance using HiNAS
- Monitoring from anywhere onboard using the portable device

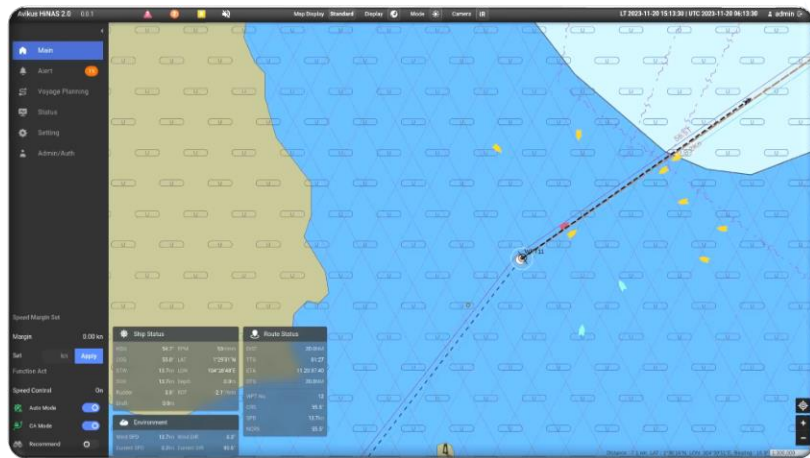
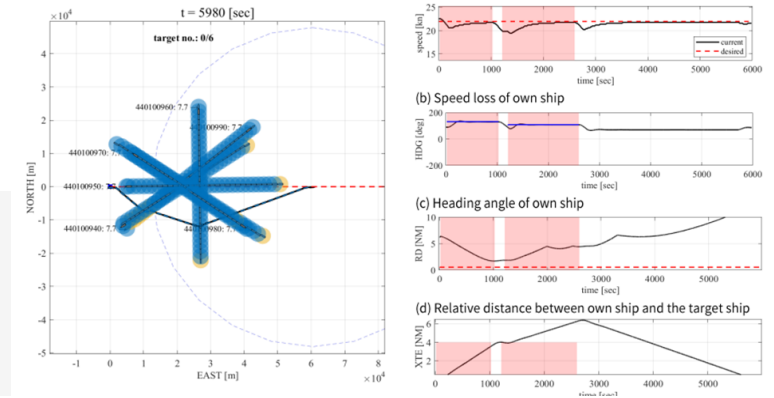


Collision Avoidance

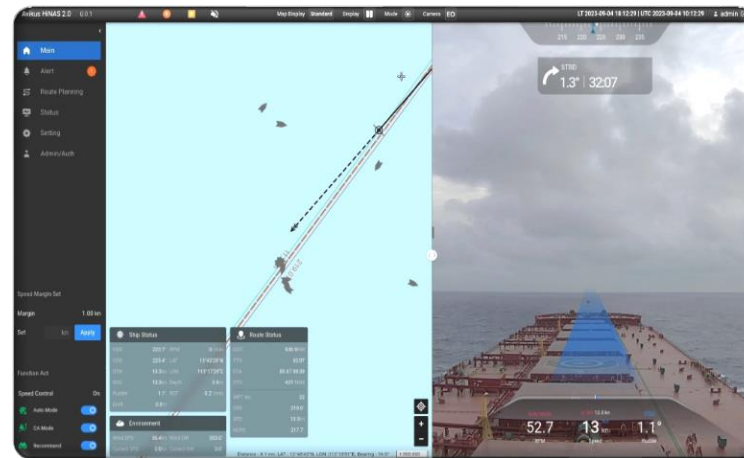
Key Feature of HiNAS Control

- Real-time collision detection and autonomous collision avoidance
- Incorporating experienced seafarers' know-how into algorithms, basically based on COLREG*

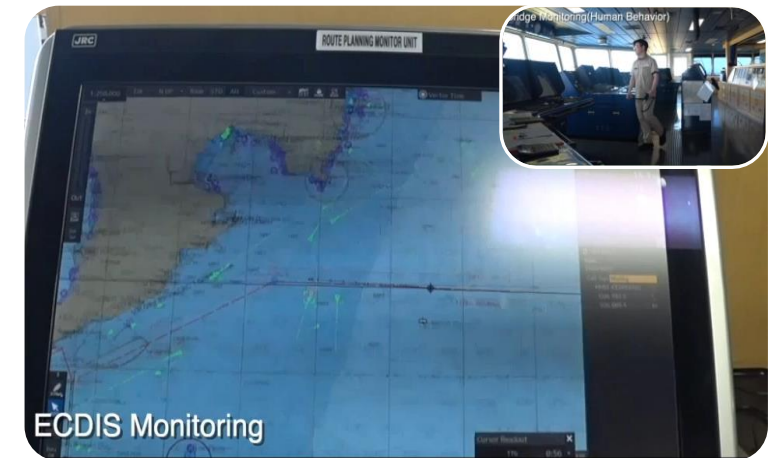
*International Regulations for Preventing Collisions at Sea



HILS(Hardware-in-the-Loop Simulations)



Autonomous transoceanic voyage (actual navigation using HiNAS)

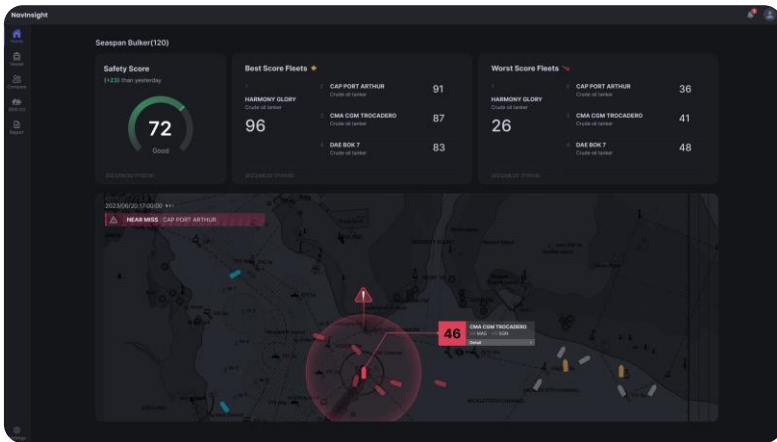


ECDIS Monitoring

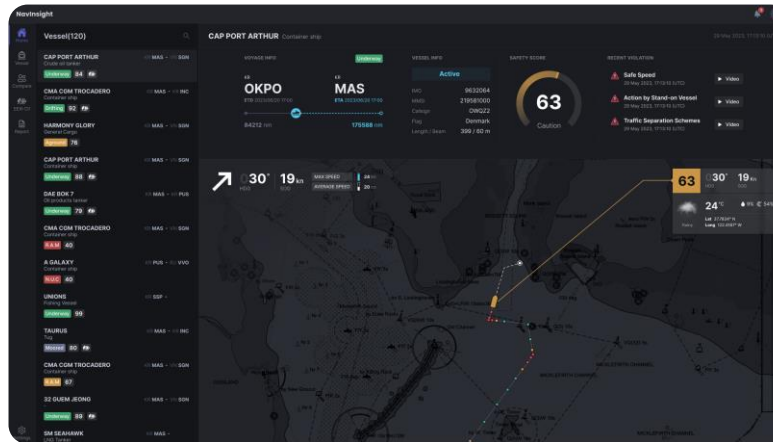
Cloud service

Key Feature of HiNAS

- Providing schedule monitoring, location tracking, OTA software update, black box function, etc.
- Real time fleet monitoring for safety, fuel consumption, and GHG emission.



Fleet Dashboard



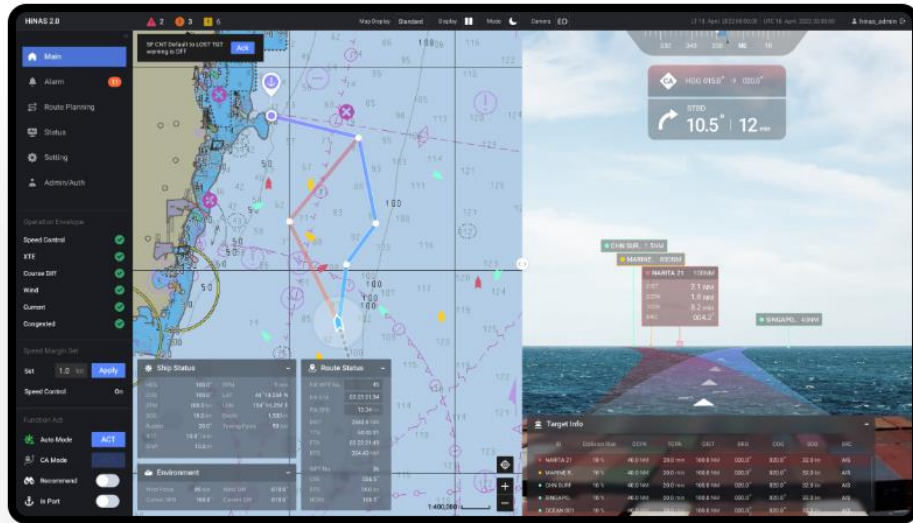
Vessel Monitoring



Blackbox Replay

Value Proposition of Autonomous navigation

Autonomous navigation brings safe and economic voyage



Safe Voyage

- Enhanced situational awareness and decision-making
- Collision avoidance route guidance and steering the vessel

Economic Voyage

- Voyage optimization based on ship dynamics, weather and ETA
- Automatic speed control and steering following the optimal economic voyage conditions

Safer voyage with Autonomous navigation

World's First Transoceanic Voyage with HiNAS Control



PRISM COURAGE(180K LNGC) Freeport,
USA('22. May 2nd)→Boryeong, KOR('22. Jun 2nd)

Autonomous route control

10,000km, 350hour navigation
without any human intervention

Autonomous collision avoidance

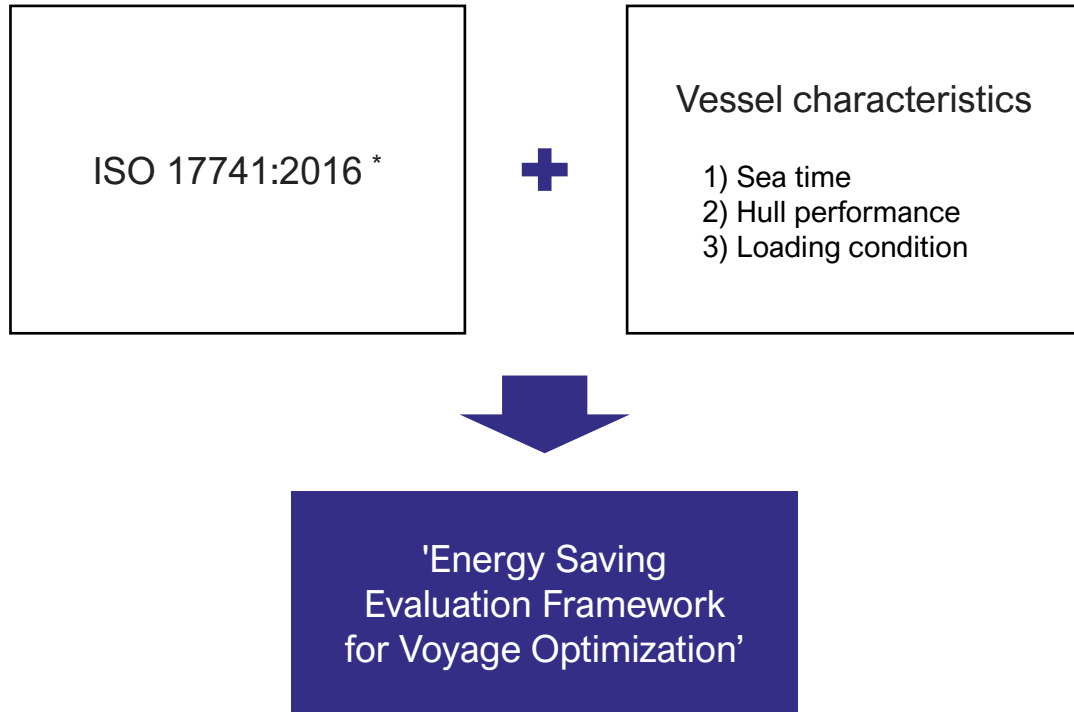
100 encounters, after collision risk assessment
70 course keeping, 30 avoidance

👉 Proving **Safe voyage**
with Autonomous Navigation Technology

Certified Evaluation Framework for Economic voyage

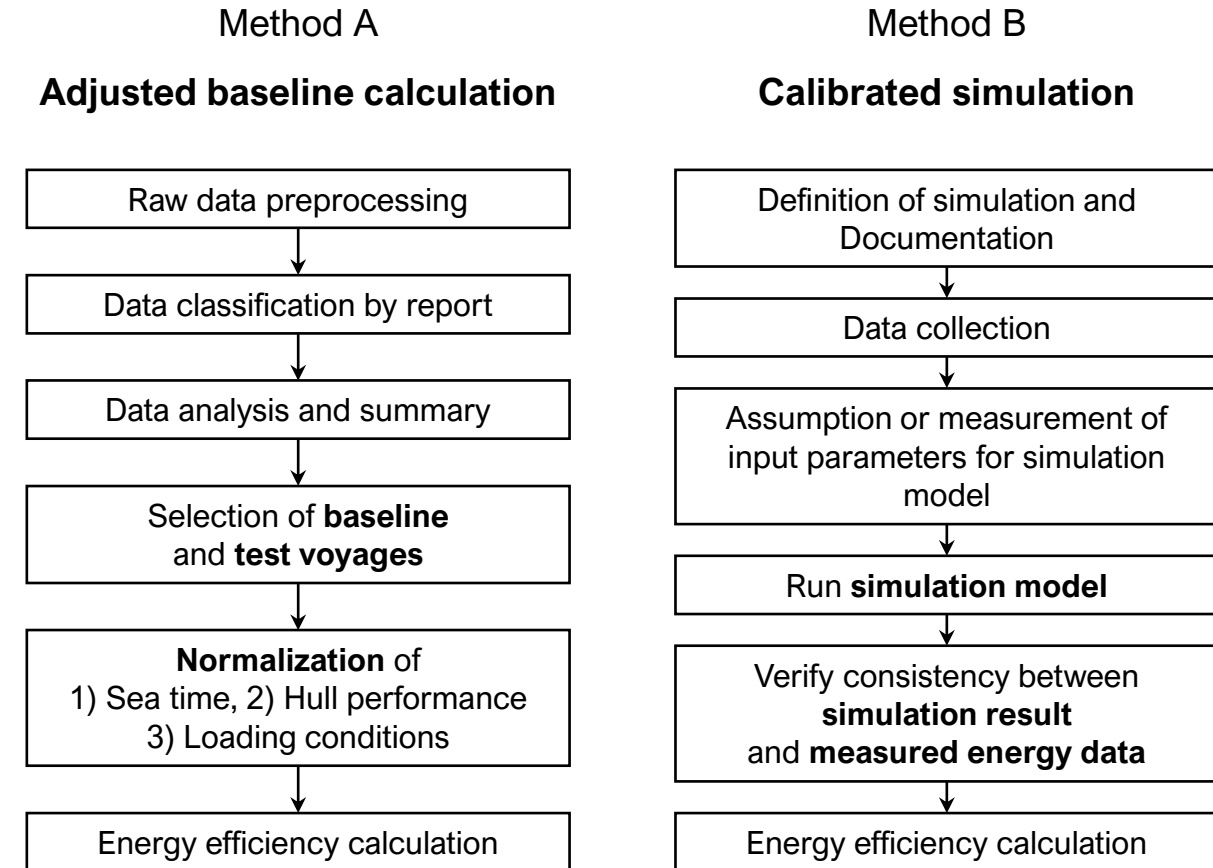
KR AIP for “Energy Saving Evaluation Framework for Voyage Optimization” in March 2024

[Summary of AIP]



* The methodology for measuring, calculating, and verifying project energy savings as stipulated by ISO

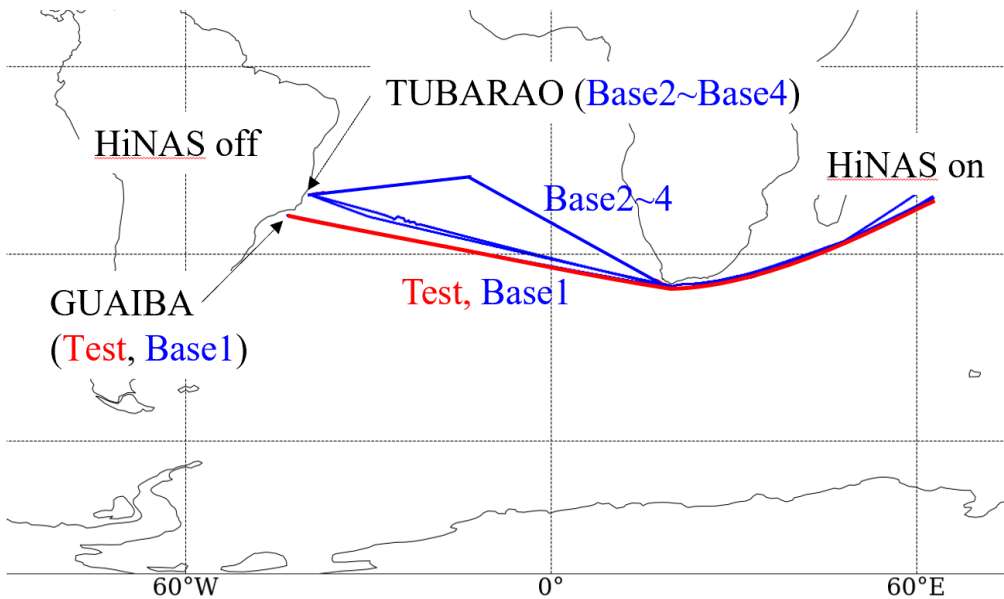
[Analyzing method]



Fuel saving proven by Case Study

Average fuel saving of over 10% by the certified methods

- Target vessel type: 325K VLOC
- Shipowner: Pan Ocean(KOR)
- Test route: Singapore – Brazil



- **Approximately the same route**
- **Collecting voyage data from same vessel**
 - With HiNAS Control
 - Without HiNAS Control(Historical data for same route)
- **Analyzing Fuel Oil Consumption** for each historical/test case and simulated case
 - ☞ Confirmed achieving a **fuel savings effect of 5-15% through HiNAS Control**

The Best Green Energy Solution

Autonomous navigation technology that also contributes to fuel savings

[Comparison of Fuel Saving Devices for Vessels]



HiNAS Control



Air Lubrication System



Rotor Sails

<p>Cost-saving benefits</p>	<p>Avg. 10%</p>	<p>5~8%</p>	<p>3~8%</p>
<p>Main function</p>	<ul style="list-style-type: none"> Automatically control steering and speed via Autopilot, BMS Suggesting Optimal route and voyage conditions 	<ul style="list-style-type: none"> Emitting small air bubbles onto the hull surface Reducing friction resistance 	<ul style="list-style-type: none"> Install the rotating cylindrical columns Utilizing the pressure difference to assist propulsion

Real Experiences, Real Satisfaction

Unveiling User Testimonials

—
Received orders of more than **400 sets**

—
Equipped in all of HD Hyundai's **new building ships**



“**FUTURE IS HERE**

“The new display is **simple yet effectively** present the necessary navigation information, making it very nice!

Especially, it is **intuitive to perceive the risk of collision** using the congested mode and extremely convenient with the addition of wide/full-screen mode.”

Captain of the container ship of Seaspan



Expansion into small-scale vessels

Autonomous navigation getting closer to everyday life



DOCK

- 3D Cluster
- **360 Birds Eye View**



NAVI

- 3D Cluster
- **Object Detection**



AutoDOCK

- 3D Cluster
- **Autonomous Navigation & Collision Avoidance**
- **Safe Path**



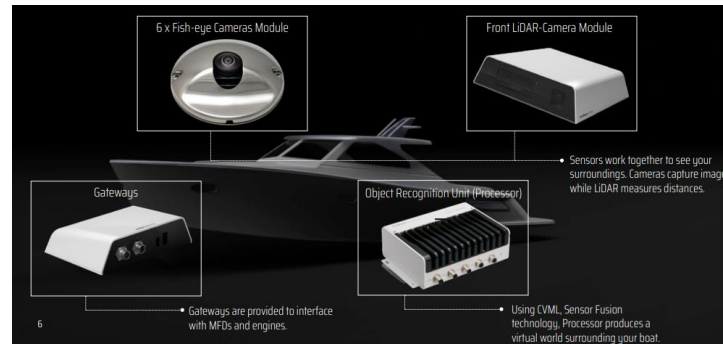
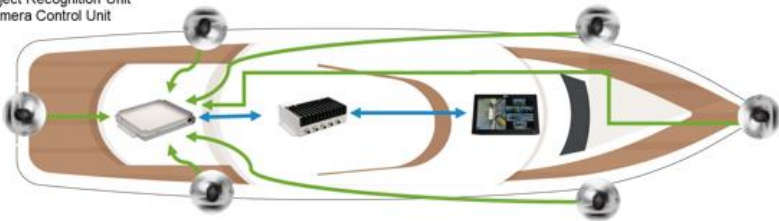
AutoNAVI

- 3D Cluster
- **Auto-Docking**
- **Visual Bumper**

Enhanced Situational Awareness

Autonomous Control

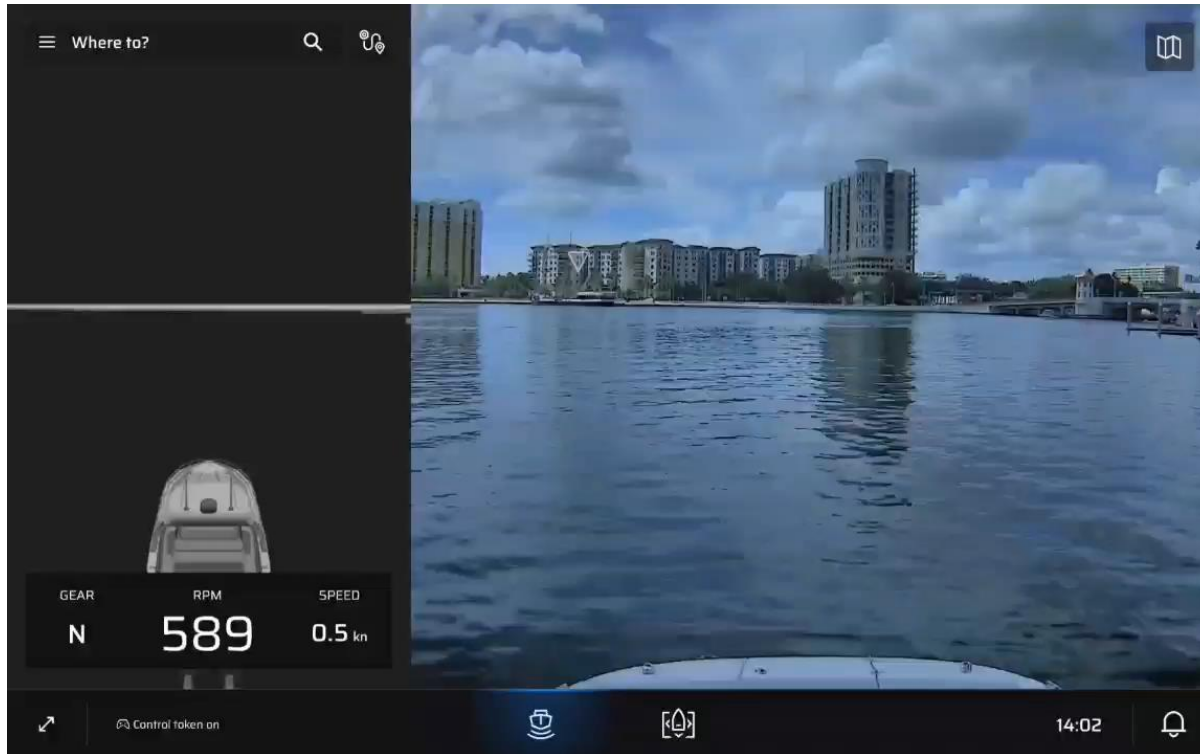
6 Surround View Monitor Cameras
Object Recognition Unit
Camera Control Unit



reddot winner 2024

Becoming closer to everyday life

users enjoy safe and comfortable boating



[Live Demo Show at IBEX 2023, Florida]

- **Route Planning & Following**
automatically generate an optimized route and follow the route
- **Collision Avoidance**
Automatically avoids collisions by sensing the surrounding conditions and identifying potential risks
- **Auto Docking**
Finds docking spots and automatically docks safely

Maritime Autonomous Pioneer

Stepwise approach to higher-level of autonomy

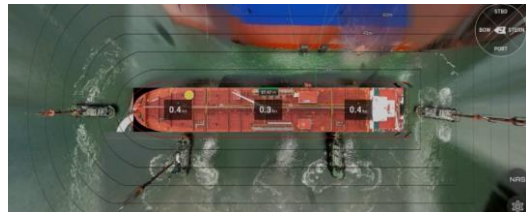
2021~

Autonomous Level 01

Navigation assistant system for ships



AI navigation assistance / Collision avoidance control



Surround view/Auto berthing

2023~

Autonomous Level 02

Autonomous solution for boats



Leisure boat autonomous solution

2025~

Autonomous Level 03

Autonomous platform as a service



Cloud service platform for ships



Apps for leisure boat autonomous solution

2027~

Autonomous Level 04

Maritime autonomous mobility business



Marine mobility business based on autonomous navigation

Beyond Navigation

Partner for Safer, Cleaner and Smarter voyage



Safer

**Recognition
Preventing**

- Reduce accidents caused by human error
- Respond to the rack of experienced seafarers



Cleaner

**Efficiency
De-carbonization**

- Improve fuel efficiency
- Switch to eco-friendly fuels



Smarter

**Digitalization
Artificial Intelligence**

- Monitor the operational status
- Propose optimal operating conditions

Your partner for safer and greener voyage

THANK YOU

Dohyeong Lim

Mobile : +82-10-3060-4295

Email : dohyeong.lim@avikus.ai, www.avikus.ai

