

# Autonomous Ship and COLREGS



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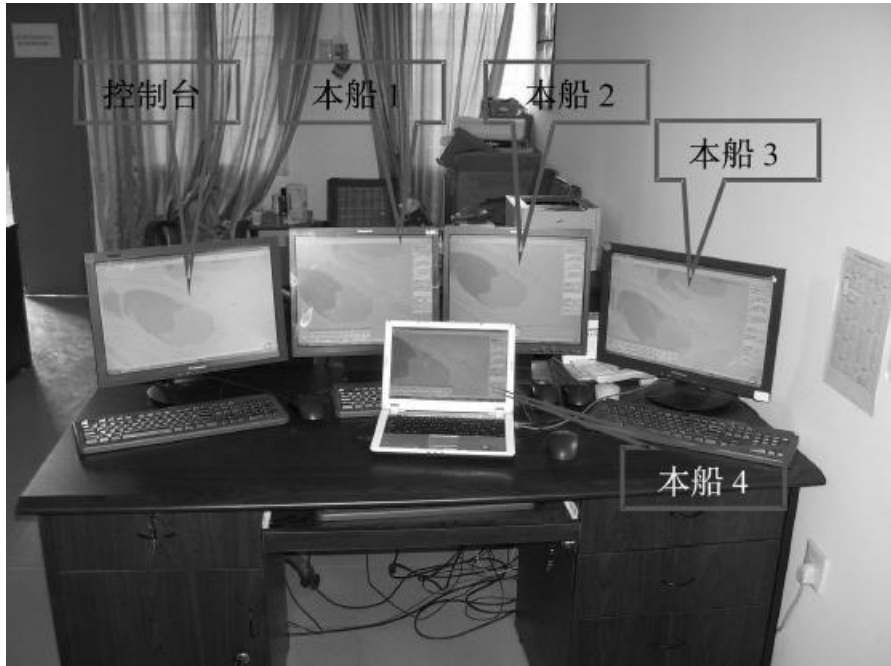
# Autonomous Ship and COLREGS

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- 1 Autonomous Ship Update in China
- 2 International Autonomous Ship
- 3 Autonomous Ship Features
- 4 Challenges and Impacts of Autonomous Ship
- 5 COLREGS
- 6 Ways Forward

# **1 Autonomous Ship Update in China**

# Research of Intelligence Collision Avoidance



Simulator of ship automatic collision avoidance

- Platform of ship automatic collision avoidance simulator developed
- Verification of multi ship collision avoidance decision making
- Study on ship-people collision avoidance decision making

# Rules for Autonomous Ship



中国船级社

智能船舶规范

2015

2016年3月1日生效

- Rules for Autonomous Ship have been published by China Classification Society (CCS) in Dec. 2015
- the Rules have entered into force since 1 March 2016
- the first standards for autonomous ship in China

# Rules for Autonomous Ship



## Smart Ship

- Intelligence in
  - ✓ ship hull
  - ✓ engine room
  - ✓ energy efficiency management
  - ✓ cargo management
  - ✓ integrated platform

# CAD for Autonomous Ship & Construction



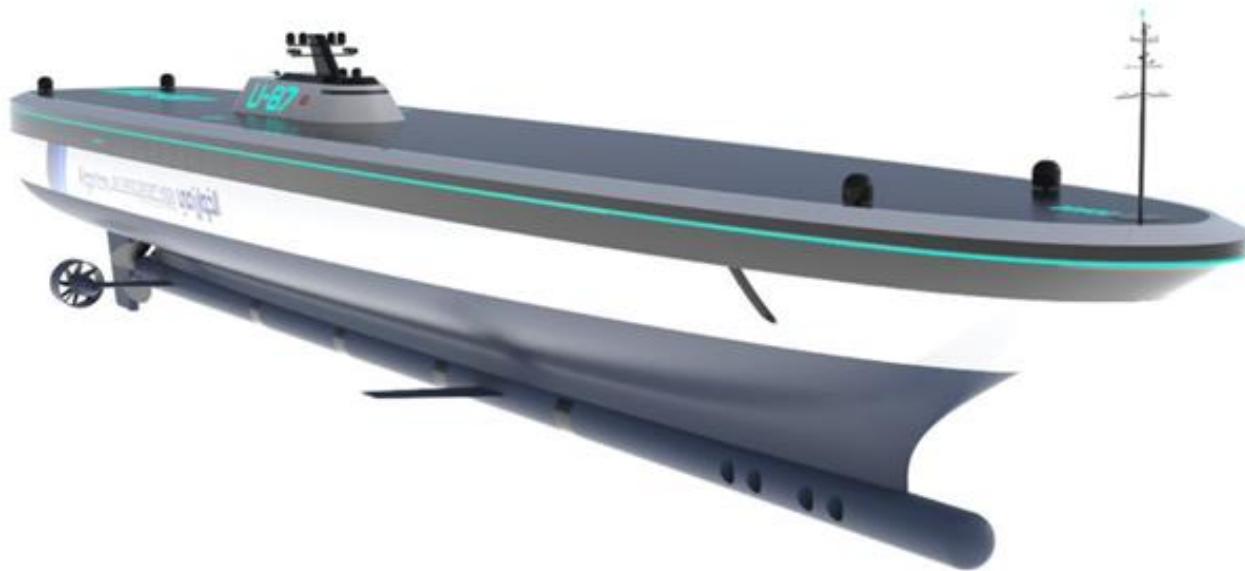
Siemens PLM Software

**SIEMENS**



COMPASS Software

# R&D for Autonomous Ship



Engine Room Remote Control



Energy efficiency

Remote control

Fault diagnosis on-line



# Construction of Autonomous Ship



Name: I-Dolphin

DWT : 38,800

Type: bulk carrier

Date:

construction

- Sept. 2016

delivery

- 2017



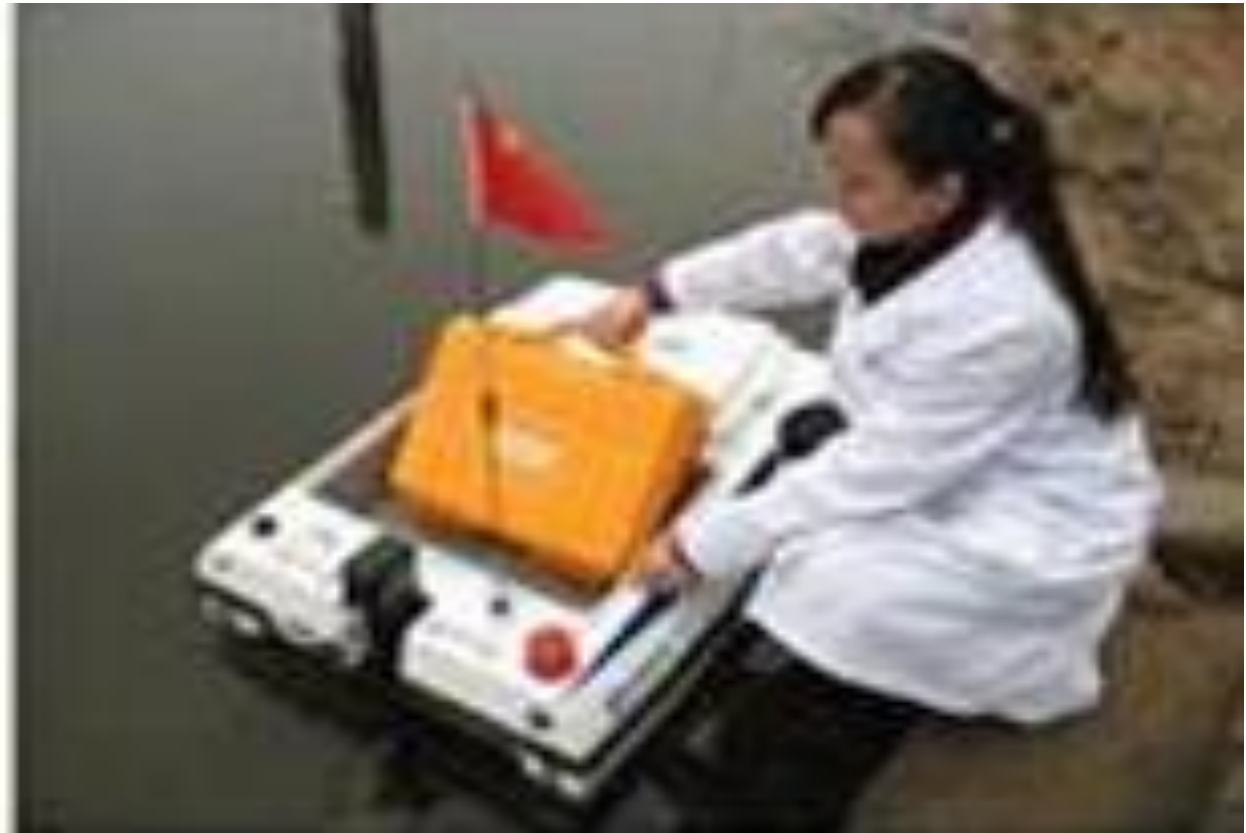
中国船舶工业集团公司

CHINA STATE SHIPBUILDING CORPORATION

# Wide Application of small Autonomous Ship



Meteorological Observation



Hydrography

# Wide Application of Small Autonomous Ship



Water Policing



Military Surveillance



Passage Clearance

## **2 International Autonomous Ship**

# International Autonomous Ship



Mayflower Autonomous Research Ship (MARS)  
to cross Atlantic Ocean in 2020 by UK



Autonomous Ship by the Netherlands

# International Autonomous Ship



Advanced Autonomous Waterborne Applications Initiative (AAWA) Project, By Rolls Royce



Autonomous Ship for Bridge Construction In the Netherlands

# International Autonomous Ship



Autonomy Levels for Ship Design and Operation  
by Lloyds Register



First Unmanned Maritime Products by 2025  
by Finland

# International Autonomous Ship



Research and development of autonomous ship is being conducted in

- Denmark
- Norway
- Finland
- Republic of Korea
- United Kingdom
- United States
- China



# **3 Autonomous Ship Features**

# Intelligent Navigation and Collision Avoidance



- AIS
- ECDIS
- Sensing
- Satellite communication
- E-navigation
- GPS/GLONAS/BDS
- Intelligent navigation and collision avoidance

# Simplified Structure, Equipment and System



- Simplified structure, equipment & system
- Reduction in self weight
- Optimisation in internal space arrangement

# Safer, Greener and more Efficient

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- Human element
- Marine environment protection
- Operational cost

# Shore-based Management for Autonomous Ship



- Port captain to monitor and manage autonomous ships
- Smart operation pattern
- Less manning to Zero manning

## **4 Challenges and Impacts of Autonomous Ship**

# Maritime Safety Administration V Autonomous Ship

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Challenges Maritime Safety Administration may face:

- Legal regime and standards to regulate autonomous ship
- Traffic environment for safe operation of autonomous ship
- Monitoring of autonomous ship

# Challenges of Collision Avoidance Autonomous Ship Faces at Sea

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Challenges the shipping industry may face:

- Rules of collision prevention between manned ship and unmanned ship
- Unified standard performance of autonomous ship system developed by different country and company
- Liability in case of collision accident



# Unified Standard for Industry

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- Unification of rules of construction
- Unification of standard of survey
- Unification of rules and standard for certification and renewal

# Other Challenges

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## Other challenges

- Human elements in remote control
- Navigation
- Pilotage
- Berthing and unberthing
- Traffic separation scheme

**5 International Regulations  
for Preventing Collisions at Sea  
(COLREGS), 1972**

# COLREGS, 1972

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- International Regulations for Preventing Collisions at Sea (COLREGS), 1972 are broken down into six Parts and four Annexes.
- The essential Part is Part B, the Steering and Sailing Rules, which is further divided into three Sections.

# COLREGS, 1972

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- The rules in Section I, applying in all conditions of visibility, are of a general nature relating to lookout, safe speed, risk of collision and actions to avoid collision etc.
- The rules in Section II apply only to vessels that are in sight of one another.
- Section III, i.e. Rule 19, applies only to vessels navigating in or near an area of restricted visibility which are not in sight of one another.

# COLREGS, 1972

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## Difference between Sections II and III

- Under the set of rules applicable to vessels in sight of one another (Section II), distinctions are made between collision encounters (head-on, crossing and overtaking), give-way vessel and stand-on vessel, and various categories of vessels.

# COLREGS, 1972

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## Difference between Sections II and III

- Under the set of rules applicable to vessels **NOT** in sight of one another (Section III), no such distinctions are made.
- For the application of the COLREGS, “whether or not in sight of one another” matters very much!

# COLREGS, 1972

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in sight of one another

- Rule 3(k) states that: Vessels shall be deemed to be in sight of one another only when one can be observed visually from the other.
- It means that two vessels see each other with human eye, not by radar or AIS.
- However, unmanned ships do not have a human eye.



# COLREGS, 1972

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## Unmanned ships, how?

- Unmanned ships cannot see visually another vessel
- Current COLREGS are basically for observance by human mariners only, with the application of the conduct of vessels in sight of one another being human visual sight-based

# COLREGS, 1972

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## Unmanned ships, how?

- Current COLREGS do not apply to unmanned ships
- We need a set of new collision regulations that apply to unmanned ships

# COLREGS, 1972

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## Collision avoidance regime

- Interaction between an unmanned ship and a manned ship, how ?
- Interaction between two unmanned ships, how ?
- Involvement in a multi-ship encounter, how ?

# COLREGS, 1972

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## Lights and shapes

- How an unmanned ship exhibits lights and shapes?
- How to sound the sound signals required by COLREGS?
- Will unmanned ships be exempted from the requirements?

# COLREGS, 1972

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## Function and status of a shore-based navigator

- What is the legal status of a shore-based navigator who controls an unmanned ship in terms of collision avoidance?
- What is the qualification and certification required?
- What is the legal responsibility in the event of a collision?

# 6 Ways Forward

# Considerations for COLREGS to be reviewed

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## COLREGS

Rule 1 - Application

Rule 2 - Responsibility

Rule 3 – General definitions

# Considerations for COLREGS to be reviewed

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## Part B – Steering and sailing rules

Rule 4 – Application

Rule 5 – Look-out

Rule 6 – Safe speed

Rule 7 – Risk of collision

Rule 8 – Action to avoid collision



# Considerations for COLREGS to be reviewed

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## Communication Coordination between Ships

Part C Lights and shapes

Part D Sound and light signals

# Considerations for COLREGS to be reviewed

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## Definition of Navigational Watch

navigational watch

look-out

# Considerations for COLREGS to be reviewed

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Measures for transition period from

manned ship

to unmanned ship

# Considerations of COLREGS to be reviewed

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## Ways forward

marine industry

shipping companies

shipbuilding and marine equipment manufacturer

maritime administration and member government

Proposals to International Maritime Organization

# Thank You

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