MARAUTEC
迈润智能科技

面向MASS的智能船舶态势感知解决方案

Thoughts on Situation Awareness Requirements for MASS Code

张兵华
Binghua (Ben) Zhang

航运AI数据平台秘书长
Secretary-general , Shipping AI Data Center

迈润智能科技（上海）有限公司董事长
Chairman, Marautec CO,. LTD

Smart Shipping · Digital Ocean

智能航行是航运发展的现实需求和未来方向
MASS is the Solution for Industrial Challenges

安全隐患 Safety	船员短缺 Crew shortage	成本压力 Costs

Crew shortage pie chart:
- 50s 31%
- >60s 25%
- 40s 19.30%
- 30s 12.50%
- 20s 12.20%

- 62% 的事故是由人为因素造成
  62% of accidents are caused by human factors
- 96% 的人员伤亡事故是人为因素造成
  96% of casualties are caused by human factors
- 航运事故每年损失15亿美金
  Shipping accidents cost $1.5 billion a year
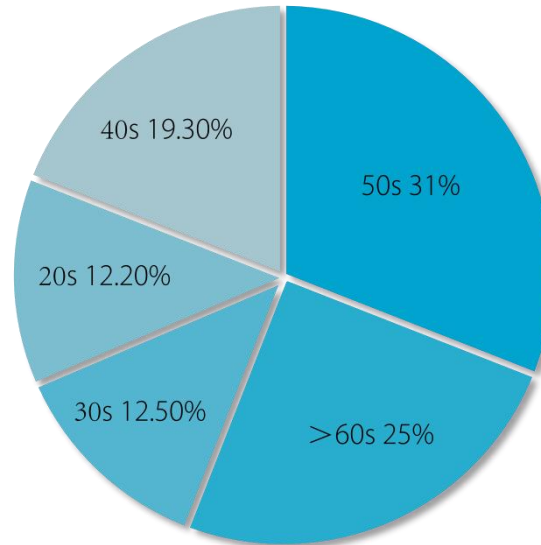
船员年龄结构（日本）：
Crew age profile (Japan):
50岁以上：56%
Over 50 years old: 56%
60岁以上：25%
Over 60: 25%

燃油成本：20~40%
Fuel cost: 20~40%
人员成本：10-40%
Personnel cost: 10-40%

现有技术的痛点及视觉感知技术的必要性

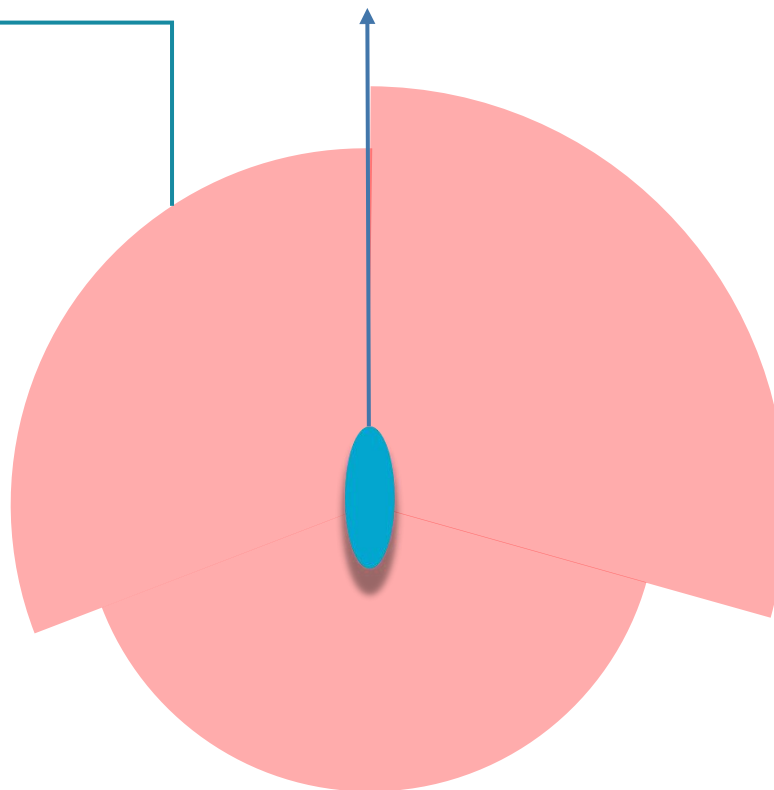**Shortcomings of Existing Technology & visual detection technology essential for MASS**

船舶周边态势感知是MASS的基础
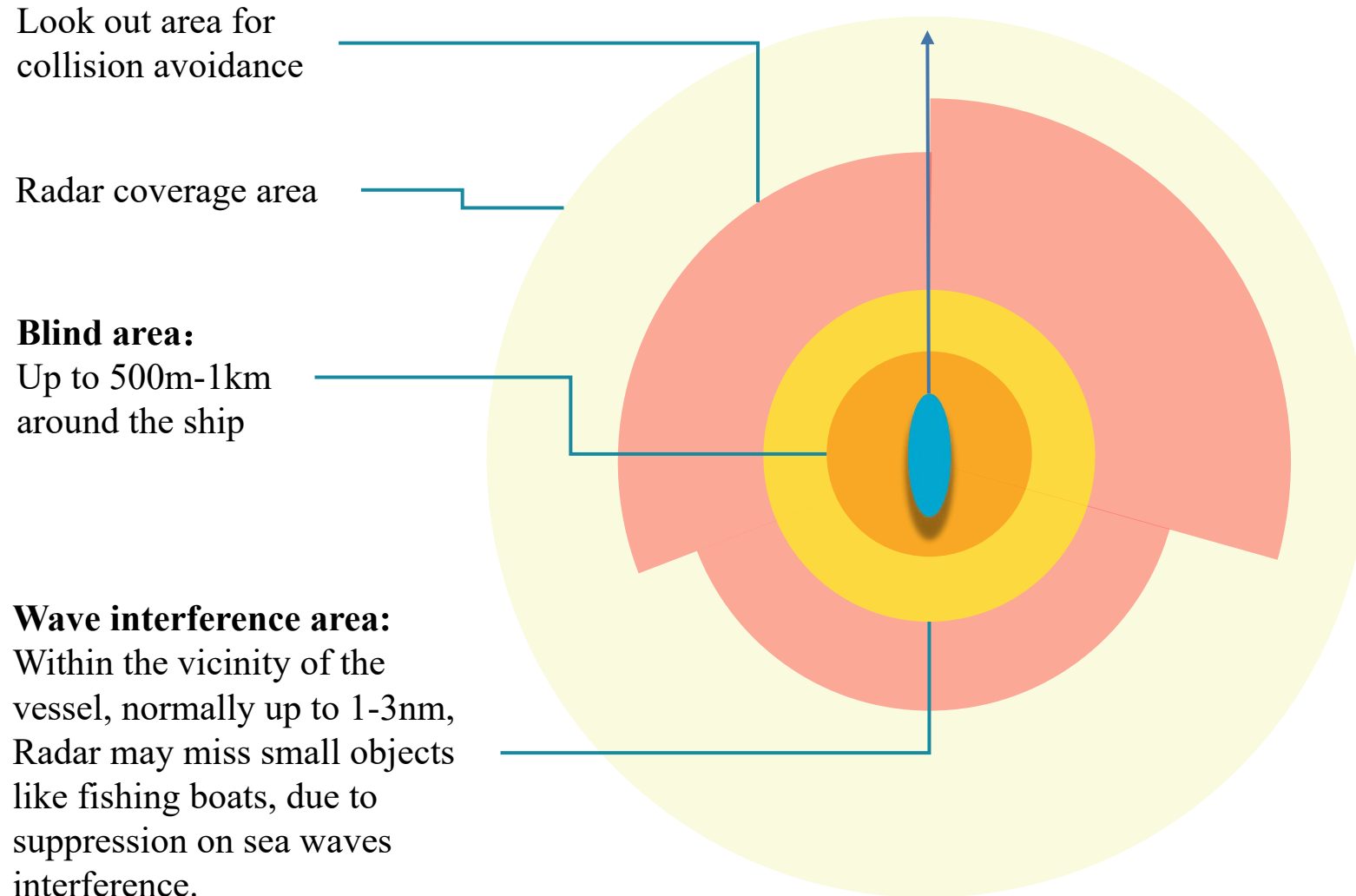## Surrounding Situation Awareness Foundation for MASS Navigation

Look out area for
collision avoidance

(GOODWIN E M.A statistical study of ship
domains[J].Journal of Navigation,1975)

雷达覆盖范围和盲区
Radar coverage and blind area

Look out area for collision avoidance

Radar coverage area

Blind area：
Up to 500m-1km around the ship

Wave interference area:
Within the vicinity of the vessel, normally up to 1-3nm, Radar may miss small objects like fishing boats, due to suppression on sea waves interference.
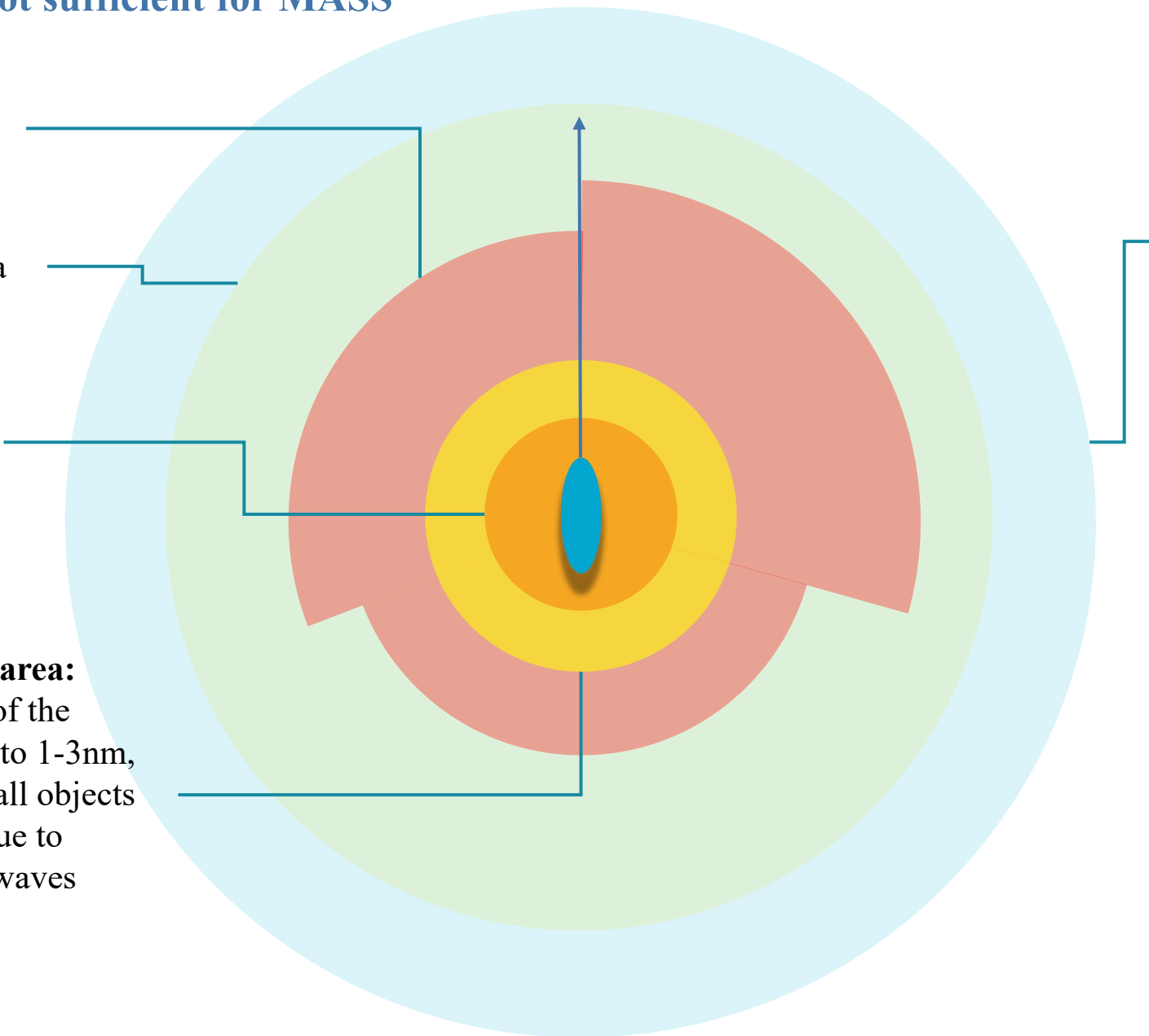
雷达和AIS不足以满足MASS的需求
Radar and AIS not sufficient for MASS

Look out area for collision avoidance

Radar coverage area

Blind area：
Up to 500m-1km around the ship

Wave interference area:
Within the vicinity of the vessel, normally up to 1-3nm, Radar may miss small objects like fishing boats, due to suppression on sea waves interference.

AIS coverage area
- Some ships may turn off AIS and cannot be monitored;
- Timing conflicts are likely to occur in busy waters, some times about 20-25% of the signals may be received;
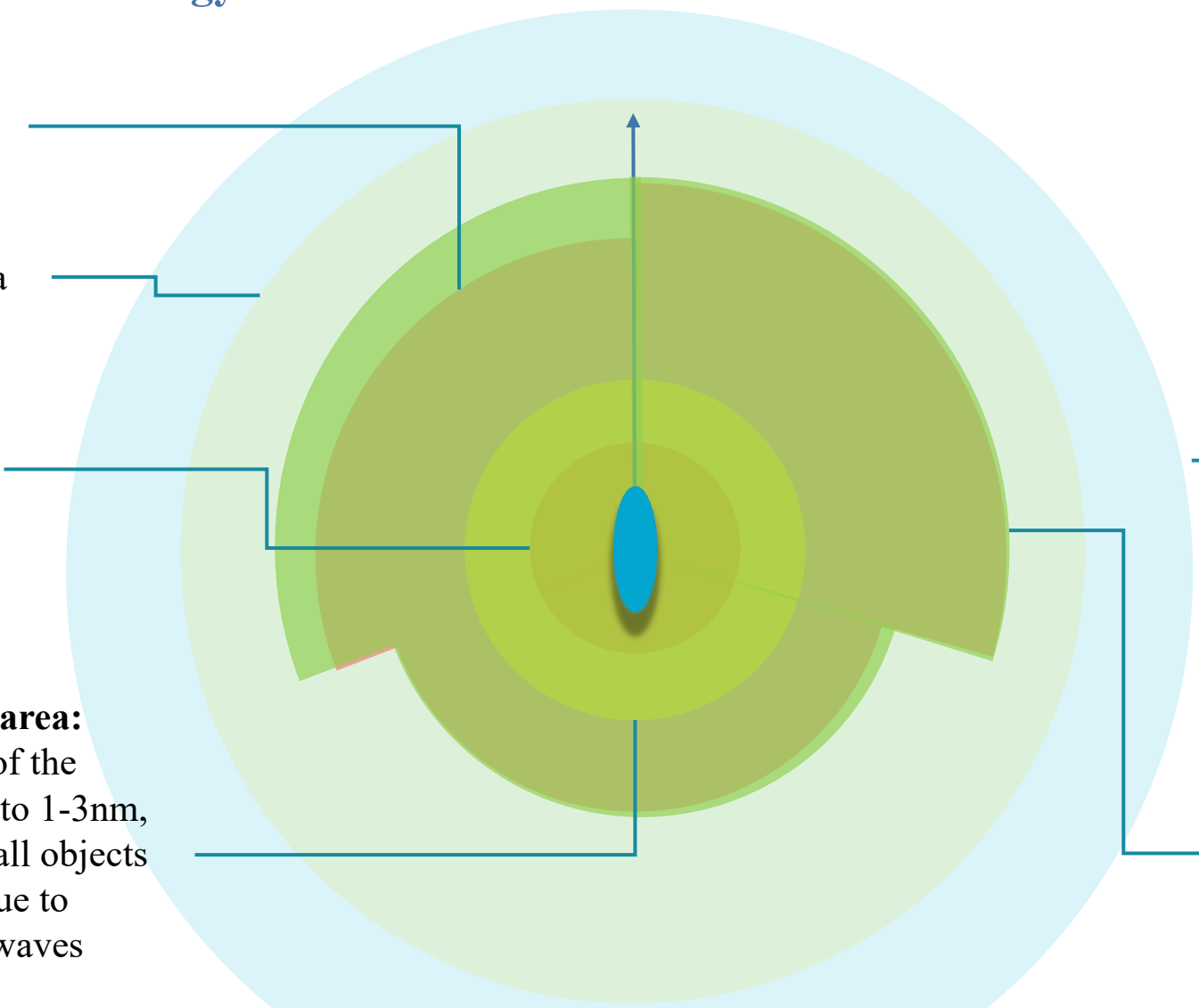- Time-delay

视觉感知技术的必要性
Visual detection technology essential for MASS

Look out area for collision avoidance

Radar coverage area

Blind area：
Up to 500m-1km around the ship

Wave interference area:
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AIS coverage area
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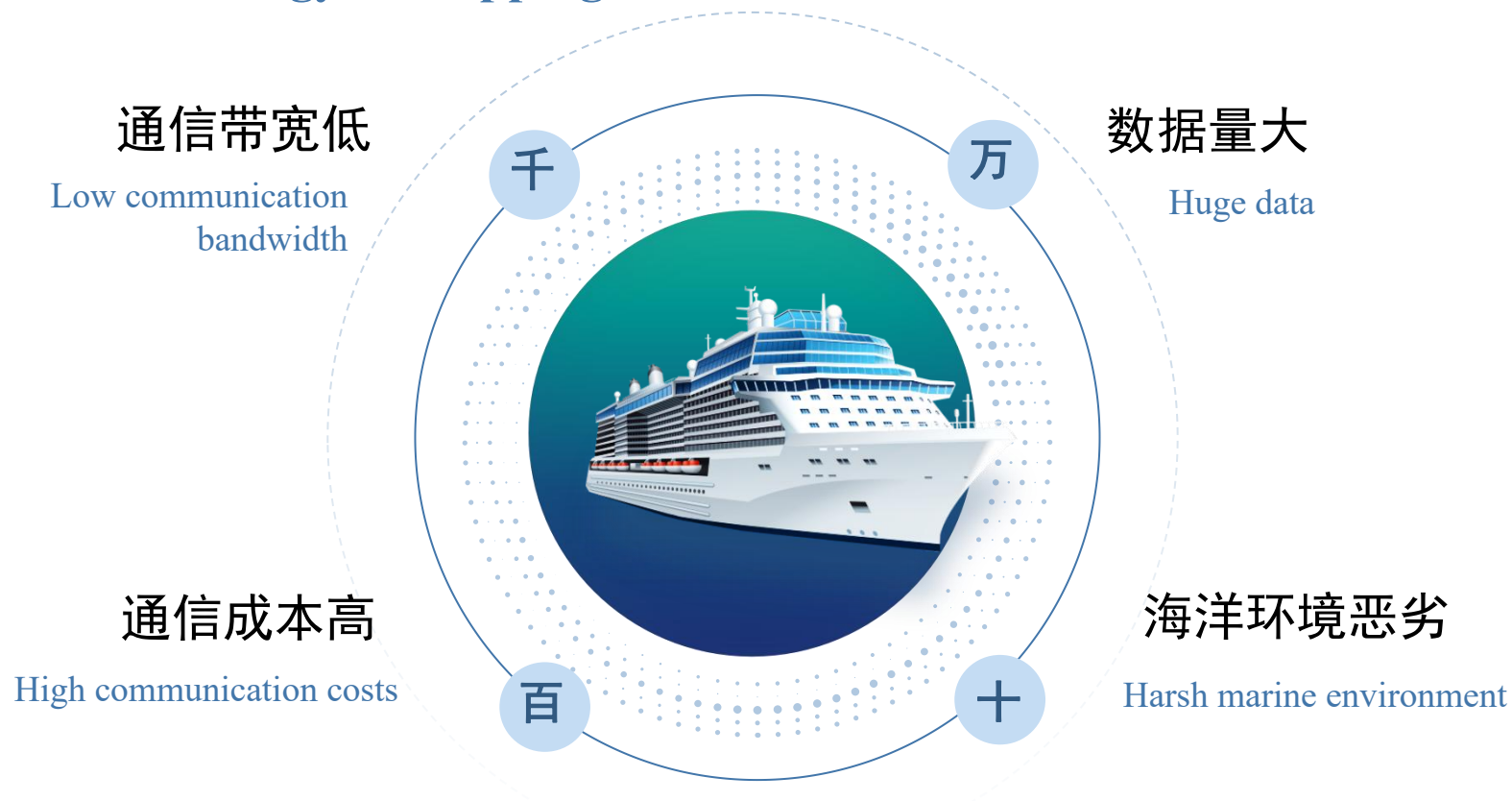- Timing conflicts are likely to occur in busy waters, some times about 20-25% of the signals may be received;
- Time-delay

Visual detection technology:
- Up to 99.99% detection rate;
- Can make up shortcomings of Radar and AIS;
- Can be used independently;
- Less affected by vibration and motion of vessel;
- Strong anti-interference ability；
- Easy to check/verify.

视觉感知在海事领域的挑战
Challenges for Visual Technology in Shipping Industries

通信带宽低
Low communication bandwidth

数据量大
Huge data

通信成本高
High communication costs

海洋环境恶劣
Harsh marine environment

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Huge amount of data, in conjunction with low bandwidth and high costs for communication on sea, makes the MASS with only two choices, either Remote Controlled vessel, which is only possible for near-shore (<20km), short-voyage shipping routes, or autonomous driving vessel with visual detection technology, which can be applied on all water.

视觉感知技术在船舶行业中的应用优势

Advantages of Applying Visual Detection Technology in Shipping Industry

识别率高，对于MASS CODE至关重要。

Essential for MASS Code due to its high detection rate

简单直观，易于检查/验证。

Simple and intuitive, easy to check/verify

不依赖于通信基础设施投资，适用于所有路线和场景，可降低总体成本。

Not depending on telecom. Infrastructure investment, suitable for all routes and scenarios, less overall costs

在汽车领域被广泛接受和应用，且已在船舶行业开展了测试。

Widely accepted & used in car industry and have been tested in marine sector

迈润智能在船舶周边态势感知方向的实践

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HD transmission at 2M/s bandwidth
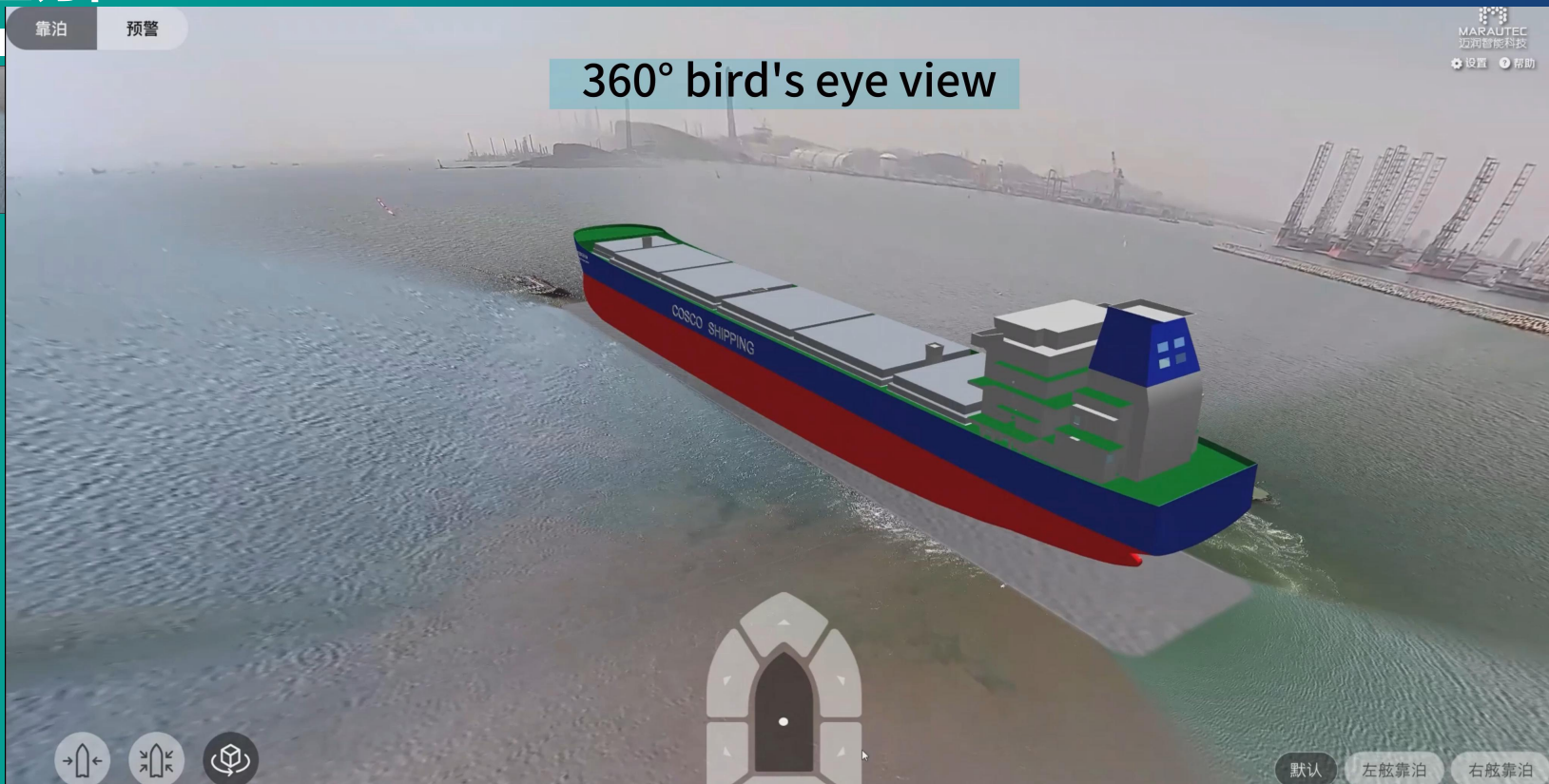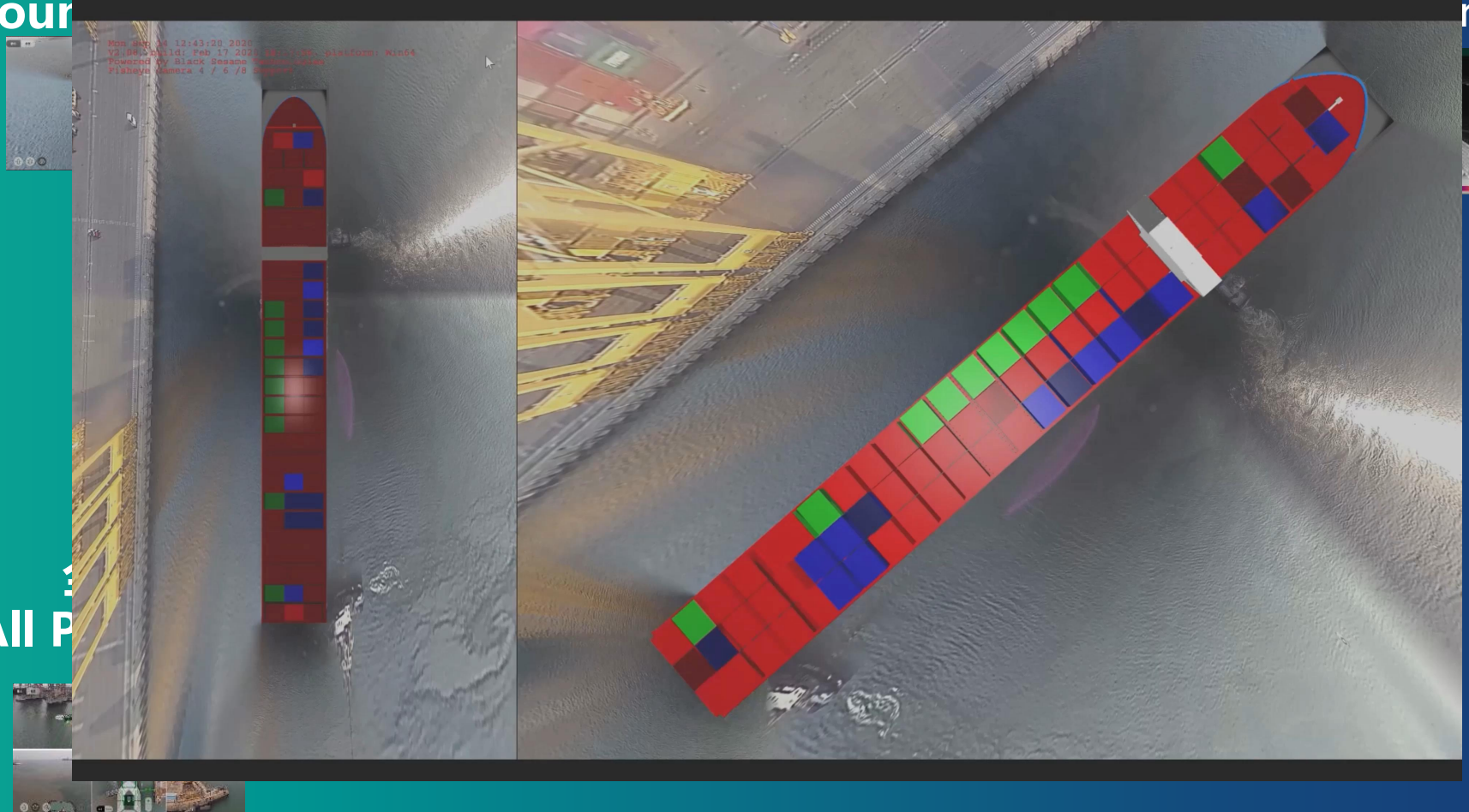
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AI 视觉感知技术vs. 其他技术
AI Visual Detection vs. Other Technologies

类型 Type	内容 Contents	识别率的高低取决于 Detected by
CCTV	摄像头+ 视频 Camera+ video	人眼/大脑 Human eye/brain
增强现实 AR	摄像头+ 视频+ AIS + 雷达 Camera + video+ AIS + Radar	AIS + 雷达 AIS + Radar
AI视觉感知 AI Visual Detection	摄像头 + 视频+ AI算法 Camera + video + AI algorithm	AI视觉感知技术 AI Visual Detection
迈润航海慧眼 Marautec i-EYE	摄像头+ 视频+ AI + AIS + 雷达 + 电子海图 Camera+ video+ AI + AIS + Radar + E-chart	AI视觉感知+ AIS+ Radar AI Visual + AIS+ Radar
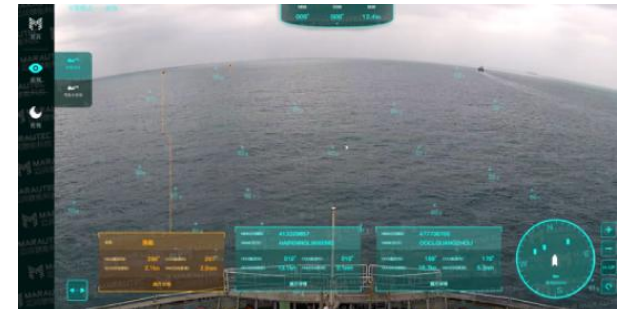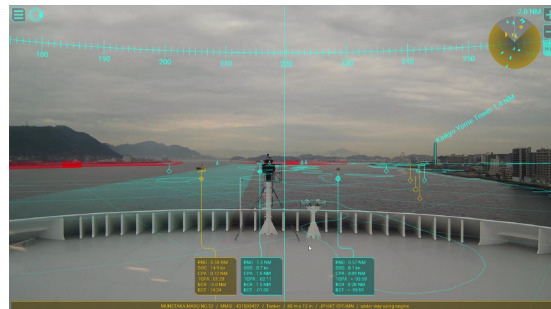
CCTV

AR

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应用船型及合作客户
Business Cases

集装箱船
Container Ship

散货船
Bulk carrier

液化石油气船
LPG

涉客船舶
Cruise Ship

多用途船
Multipurpose Ship

江船
River Boat

拖轮
Tug boat

挖泥船
Dredger

COSCO SHIPPING

SDSC

国家能源集团 CHN ENERGY

CSSC
上海外高桥造船有限公司

CCS CHINA CLASSIFICATION SOCIETY 中国船级社

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ZDIAI 震兑

基于MASS规则的
船舶周边态势感知的规则思考

Thoughts on Surrounding Situation Awareness Requirements for MASS Code

MARAUTEC
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自主驾驶和遥控驾驶路径对比
Remote Controlled Vs. Autonomous with AI Visual Detection Technology

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Autonomous (AI included)

Lookout Assistance	Risk Alert	Autonomous level 1	Autonomous level 2	Autonomous level 3	Autonomous level 4	Autonomous level 5
Visual Detection +Radar + AIS + E-Chart	+Collision risk identification	+Route planning for collision avoidance	+Recommending maneuvering strategy (engine speed/rudder)	+Automatic control & monitored & intervened by crew on board	Equipments maintenance by crew onboard & Monitored and intervened by onshore staff standby	Fully autonomous, unmanned onboard +Onshore staff standby +Contingency plan

Remote Controlled

Radar+AIS+E-chart	+Real-time HD video transmission	+Onshore Remote control

Remote Controlled + AI

Radar+AIS+E-chart + visual detection	+ Sea-Shore Core Data Transmission+Onshore video reconstruction	+Onshore Remote control

	Number of Crew	Qualification Required	Work Load	Visual Detection Technology	Data Volume	Bandwidth Required	Signal Stability Required	Telecommunication Infrastructure Investment	Suitable Route
Autonomous	Reduced gradually	Reduced gradually	Reduced gradually	Required	Small	Low	Low	Low, based on existing maritime communication infrastructure	All route
Remote Controlled + AI	Crew moved onshore	High	Reduced	Required	Small	Low	High		Short distance, near shore
Remote Controlled				None	Huge	High	High	High	

需要定义的参数
Parameters to be defined

识别范围：影响因素
Detection range: Affecting factors

速度
Speed

回转半径
Radius of turning circle
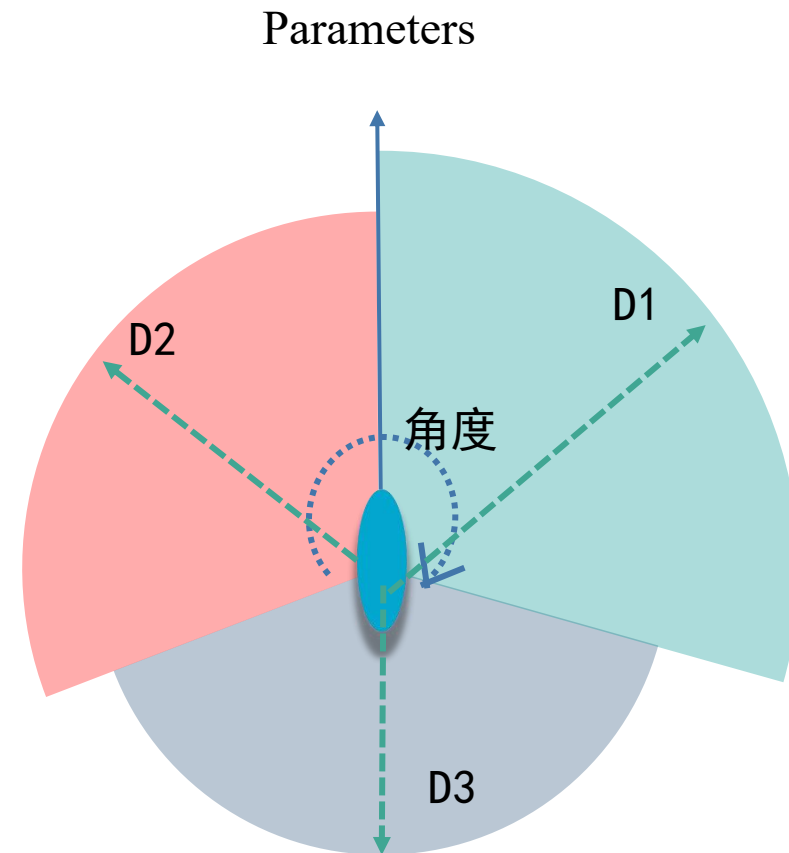
目标物
Objects

环境
Environment

- 全回转推进器
  azimuth-thruster
- 艉侧推
  bow-thruster

动态/静态
Moving/still

风/浪/流
Wind/wave/current

Parameters

D2

D1

角度

D3

(GOODWIN E M.A statistical study of ship domains[J].Journal of Navigation,1975)

目标物
Objects

船只
Ship

漂浮物
Floating objects

落水人员
Man-Overboard
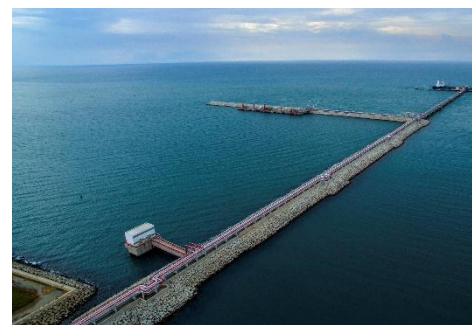
海岸线
Shoreline

岛屿
Island

自主驾驶阶段和人员配备
Detection rate, autonomous level and manning

Autonomous (AI included)

Lookout Assistance	Risk Alert	Autonomous level 1	Autonomous level 2	Autonomous level 3	Autonomous level 4	Autonomous level 5
Visual Detection +Radar + AIS + E-Chart	+Collision risk identification	+Route planning for collision avoidance	+Recommending maneuvering strategy (engine speed/rudder)	+Automatic control & monitored & intervened by crew on board	Equipments maintenance by crew onboard & Monitored and intervened by onshore staff standby	Fully autonomous, unmanned onboard +Onshore staff standby +Contingency plan

Unmanned
99.99%?

Less crew
99.9%?

Periodic monitoring
99%?

Real-time monitoring   85%/95%?

规范及标准需要考虑的内容
Visual Detection Technology for MASS Code: What should be considered?

Topics	Relevant Parameters		Contents
Visual detection technology mandatory for MASS?			Yes or No
Objects	What objects should be detected to ensure navigation safety?		Define type of objects, and relevant dimensions like size, shape, colour, temperature etc.
Look out area for collision avoidance			
Detection rate	For navigation assistance		Within certain range, what level of detection rate is needed for navigation assistance, 95%?
	For autonomous shipping		Detection rate to be defined:99%, 99.9%, or 99.99%?
Communication link	Different routes have different bandwidth requirements		
Detection range	Relative to ship length (L)	With Radar (covering radar blind area and wave interference area)	For different type/sized vessel, lookout distances at various angles should be defined, within which distance, the detection rate of defined objects should reach acceptable detection rate.
		Without radar (covers all lookout area for collision avoidance)	
	Relative to ship speed (V)		
Measuring accuracy	Distance	Distance to object	Relative accuracy as a percentage of distance to ship/ship length Or Absolute accuracy in terms of meters/centimeters, and degree of angle
		Distance to terminal/bank	
	Angle	Relative angle to ship's direction of moving	
		Relative angle to shore line at berthing	
Time delay	For navigation assistance		Time delay of system to detect objects with potential objects should be restricted so as not to affect the usage of the system
	For autonomous shipping		
	For remotely controlled ships		

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迈润航海慧眼
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引领智能航运　保障航海安全
Smart Shipping, Digital Ocean

成为全球船舶智能航行的领导者！

Marautec aspires to be a global leader In navigation safety and autonomous shipping!

Contact us:

T: +86 21 3887 0448

E: Market@marautec.com

A: Room 201, Building B, 3033 East Jinxiu Road, Pudong New Area, Shanghai, China