Maritime Situational Awareness – Will e-Navigation Lead to Perfect Alarming?

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Solutions for Maritime Situational Awareness

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World Maritime University

Maritime Post-graduate University
Established by IMO in 1983
Focus on Maritime Education, Capacity-Building & Research

Principal Financial Supporters
Government of Sweden
Nippon Foundation, Japan
City of Malmö
e-Navigation - bringing people together

International teams of interdisciplinary, enthusiastic Researchers
Outline

• Introduction
• Present Situation and State of the Art
• IMO and IALA’s e-Navigation initiative
• Improvements needed
• Outlook
From History to Modern ...

Disasters seems to be going on

TITANIC, 1912

Andrea Doria, 1956

Heine - Mataram, 1988

R. Schulte, 2009

Pictures: www.titanicuniverse.com; www.shipfriends.gr
Present situation ...

Maritime Accidents
Present situation ...

• The e-Navigation (R)Evolution: technological Development: substantial changes in ICT (Data exchange – volume, types, almost real-time)

• From VTS to FOC and unmanned ships and autonomous Navigation

Source: www.interschalt.com

Source: www.iunmanned-ship.org
e-Navigation: identified relevant RCOs

RCO 1: Integration of navigation information & equipment including improved software quality assurance
RCO 2: Bridge alert management
RCO 3: Standardized mode(s) for navigation equipment
RCO 4: Automated and standardized ship-shore reporting
RCO 5: Improved reliability and resilience of onboard PNT
RCO 6: Improved shore-based services
RCO 7: Bridge and workstation layout standardization
“Perfect Alarming” – a Conceptual Approach

- **CAUTION**
  to just raise awareness of the bridge team to a certain unusual situation

- **WARNING**
  requiring immediate attention by the bridge team

- **ALARM**
  characterizing conditions requiring immediate action

- What is a “perfect alarm”??

   Quelle: IMO Performance Standards for INS (2007)
Learning from Aviation - TCAS: a sample for ‘Perfect Alarming’?

- TCAS/ACAS II – the “last line of defence” in Aviation provides
  - Intruder warning, 
  - Traffic advisory warning and
  - Resolution Advisory (RA) alarm for clearly defined criteria
Learning from Aviation - TCAS: a sample of ‘Perfect Alarming’?

> 1500 RAs
Mean: 9 RAs per day
Peak: 28 RAs in one day

Source: Thetford (2007)
Applying TCAS to the Maritime Domain
Potential Areas of Water and Dynamic Risk Assessment

Risk of collision using maneuvering area concept

- Simplified approach to quantify the risk of collision using the overlapping area
- Derivation of action limits for ultimate time to take escape action

\[ P_{\text{Collision}} = \frac{N_{\text{Steering options leading to passage without contact}}}{N_{\text{All available steering options}}} \]
Situation dependent alerts for
- Collision & Grounding Avoidance -

**Adaptation of alert thresholds**

**Steering Parameter**
- Rudder angle,
- Engine revolution / power
- Bow-/Aft-thrusters
- ...

**Status Parameter**
- max available rudder angle,
- Time for rudder command
- max engine revolution / power
- Time for reverse engine manoeuvre
- ...

**Actual moving parameter**
- course, speed (x, y)
- ROT, heading, draft,
- Lateral wind area
- ...

**Actual environmental condition**
- Wind (force, direction),
- Depth of water
- Course of fairway
- Aids to Navigation
- targets

**VDR based manoeuvring Data base**
- Manoeuvring data depending on
  - Loading conditions
  - Environmental conditions
  - Steering and Control parameters
  - Steering and control conditions
  - ...

**Fast-time Simulation**

Calculation of:
- Response time according to manoeuvring parameters of the actual conditions
- Safe passing distance according to type of situation and sea area

**Application and Display of adapted CPA-, TCPA-thresholds for situation-dependent Collision alerts**
- caution, warning, alarm

**Institut ISSIMS**

**Innovative Schiffs-Simulation und Maritime Systeme**

**Hochschule Wismar - Bereich See- und Schiffahrtswissenschaften**
Triggering the ‘perfect’ Collision Warning ...

Intelligent Information support before hazardous event
... or a ‘Perfect’ Grounding Alarm’

Manoeuvring advice immediately before contact or grounding
Summary, Conclusions and Outlook

• E-Navigation provides infrastructure to get closer to perfect alarming

• Adapt Technology to Human Operators - HCD/UCD

• Adaptable alert algorithms

• situation-dependent thresholds

• Powerful, robust and reliable sensors

• High quality MET
Thank you for your attention!
Awaiting your questions!

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