

SHIP STABILITY, MANEUVERABILITY, CONTROL AND SAFETY

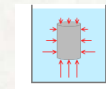
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NOV. 23, 2016

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PRINCIPLE OF ARCHIMEDES (BUOYANCY)



<http://gold.mmc.co.jp/primer/museum/02.html>

<http://wakariyasui.sakura.ne.jp/p/mech/pas/huryoku.html>

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EXPERIMENT(1) PRINCIPLE OF ARCHIMEDES

1. Put stones etc. into a milk pack. Put it into water quietly supported by hands
2. Draw the draught (draft) line, when you feel the balanced point with the weight and the buoyancy
3. Estimate the weight you put into the milk pack.
4. Learn about the significant figures



3

RESULT OF EXPERIMENT(1)

Describe it in your report

What should you check?

- Try to keep photos, sketches etc. as objective as possible

- What did you feel after the experiment?

- What did you take care, when you conduct the experiment?

- The suggestions to make this experiment more interesting or accurate etc.



4

EXPERIMENT (2) STABILITY OF A FLOATING BODY

1. Release the hands
2. and observe what may happen.
3. At the equilibrium (balanced) condition, push the milk pack with you hands a little and then release. Observe what may happen.



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EXPERIMENT (3)

1. Replace stones with water, then observe what may happen



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RESULT OF EXPERIMENT (3)

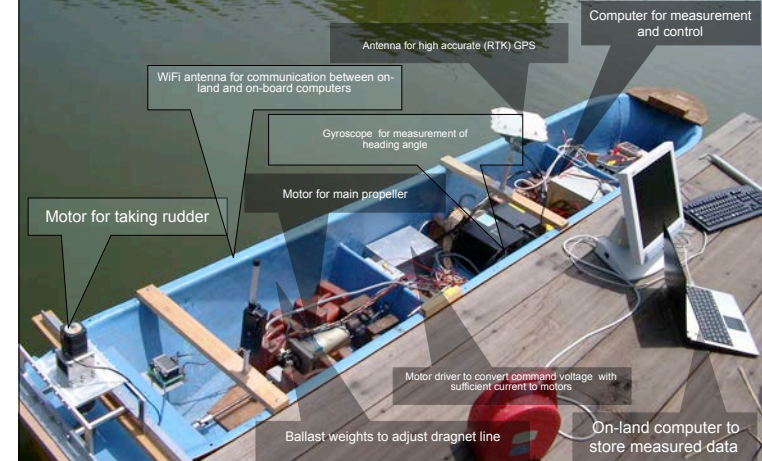
1. Why? - Principle of science



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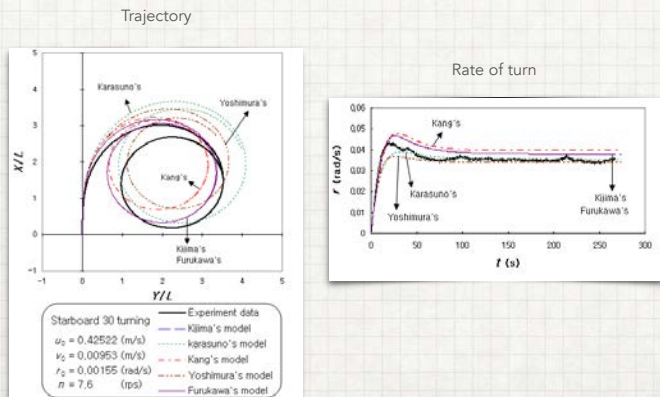
DEVICES WE USE IN THE REAL EXPERIMENT

ACCURACY, REPRODUCIBILITY AND OBJECTIVITY ARE REQUIRED



PRECISE MEASUREMENT IS ONLY POSSIBLE USING THESE DEVICES

GET MORE GENERAL CONCLUSION, COMPARING THE THEORY BEHIND OR WITH COMPUTER SIMULATION



IN REALITY



July 23, 2006

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FEATURE

Cougar Ace: The Great \$103 Million Snafu at Sea

A huge seagoing car carrier tips over in the North Pacific and costs Mazda 4703 cars.

<http://www.caranddriver.com/features/cougar-ace-the-great-103-million-snafu-at-sea>

"snafu: a condition of being mess(US slung)

IT HAPPENS IN KOREA, TOO

Occurred on April 16th, 2014,
304 passengers, mostly high-school students
and crew were killed,
172 survived.



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What may happen on this ship in the next moment?



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• RESULT (1)



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RESULT (2)



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**OUR MISSION IS TO
MAKE SHIPS EFFICIENT
AND SAFE**

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AUTOMATIC COLLISION AVOIDANCE AND MARINE TRAFFIC SIMULATION

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AUTOMATIC COLLISION AVOIDANCE SYSTEM

1987

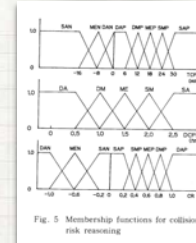


Table 2 Control rules for collision risk reasoning

		T	C	F	A			
S D C F A	SAP	MEP	DAN	SAP	DMP	MEP	DMP	SAP
	DA	SAN	MEP	DAN	SAP	DMP	MEP	DMP
	DM	SAN	SAN	MEP	DMP	MEP	SFP	SAP
	DE	ZAN	SAN	SAN	MEP	DMP	SAP	SAP
	DM	SAN	SAN	ZAN	DMP	SAP	SAP	SAP
	DA	SAN	SAN	ZAN	SAP	SAP	SAP	SAP

18

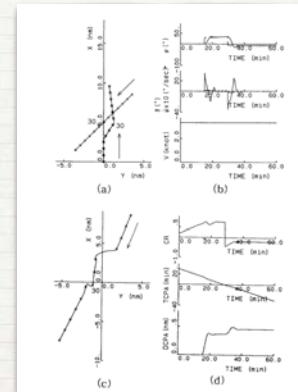
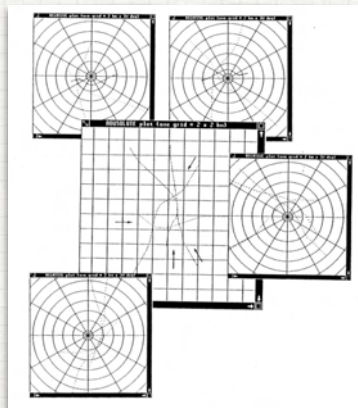


Fig. 14 Simulation of collision avoidance manoeuvre by fuzzy control (Type I)

SHIP AUTO-NAVIGATION FUZZY EXPERT SYSTEM (SAFES)

1990-



19

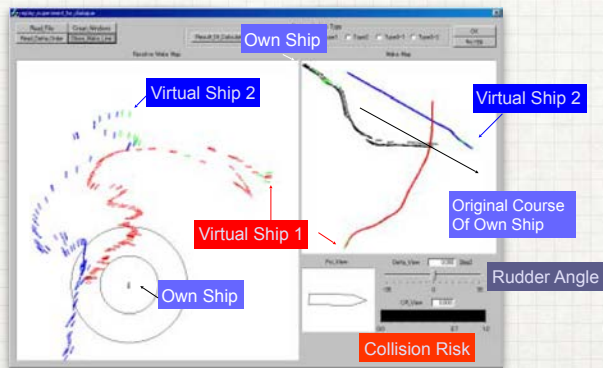
WORLD FIRST EXPERIMENT OF AUTOMATIC COLLISION AVOIDANCE WITH (VIRTUAL) MULTIPLE SHIPS

2002

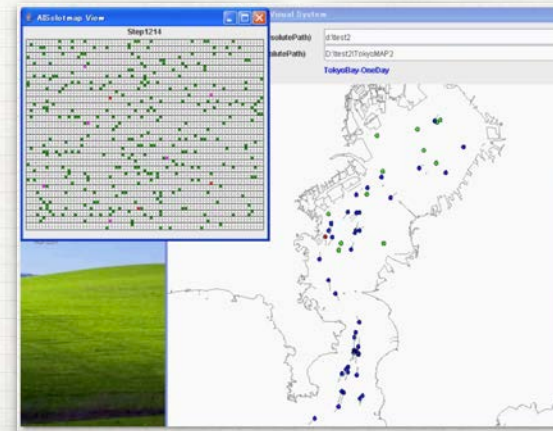


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WORLD FIRST EXPERIMENT OF AUTOMATIC COLLISION AVOIDANCE WITH (VIRTUAL) MULTIPLE SHIPS, 2002

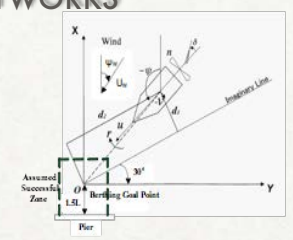
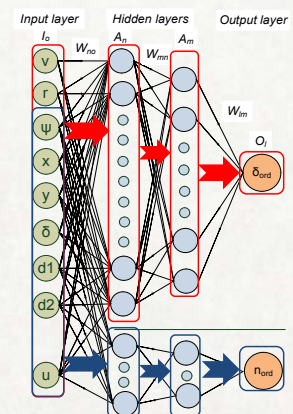


WITH AIS COMMUNICATION SIMULATION
TOKYO BAY, 2006



AUTOMATIC BERTHING/
DEBERTHING

NEURAL NETWORKS



> Mean squared error (MSE) is used as evaluation function and Lavenberg-Marquardt algorithm in training.

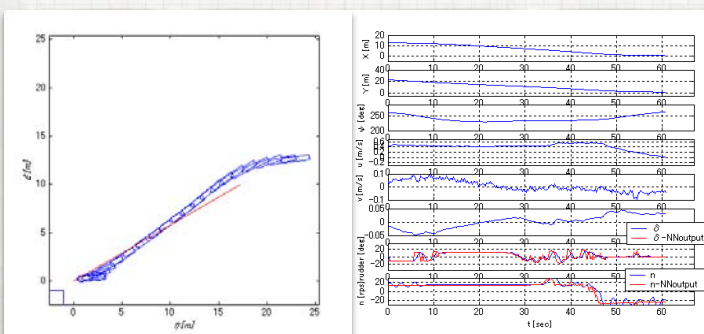
AUTOMATIC BERTHING EXPERIMENT (1993-)



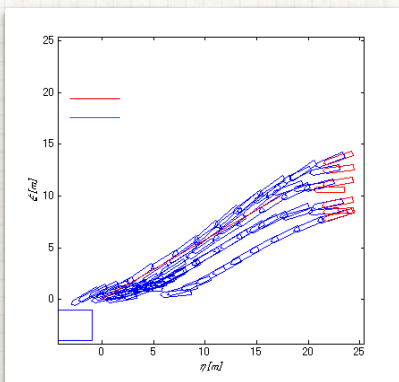
Start

Goal

AUTOMATIC BERTHING EXPERIMENT (2004)

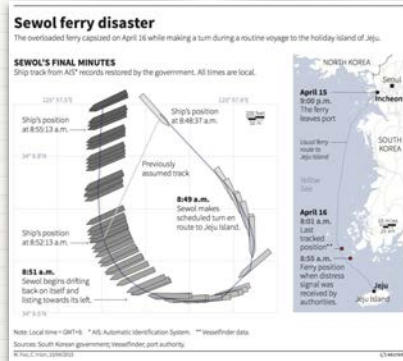


AUTOMATIC BERTHING EXPERIMENT (2004)



INVESTIGATION OF THE
ACCIDENT OF THE KOREAN
FERRY "SEWOL" IN 2014

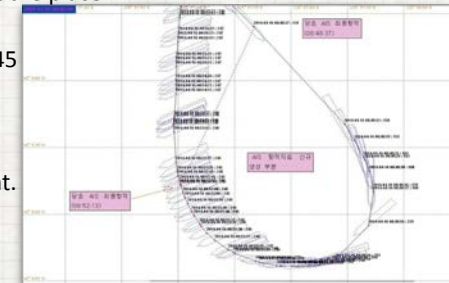
Where did it happen?



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SOME FACTS OF THE INCIDENT

- ✓ Departure was delayed about 3 hours, because of deep fog.
- ✓ The officer ordered the course instead of rudder angle, when it changes the course at the place.
- ✓ It leaned about 45 deg. probably due to turning, then the engine has stopped and drifted by current.



AIS record of "Sewol"

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MODEL SHIP MODEL SHIP (SCALE 1/75)



L (O.A.)	1.9 [m]
L (P.P.)	1.76 [m]
Bm	0.29 [m]
dm	7.67 [m]
Cb	0.46

The model is too small to install high accuracy instruments.

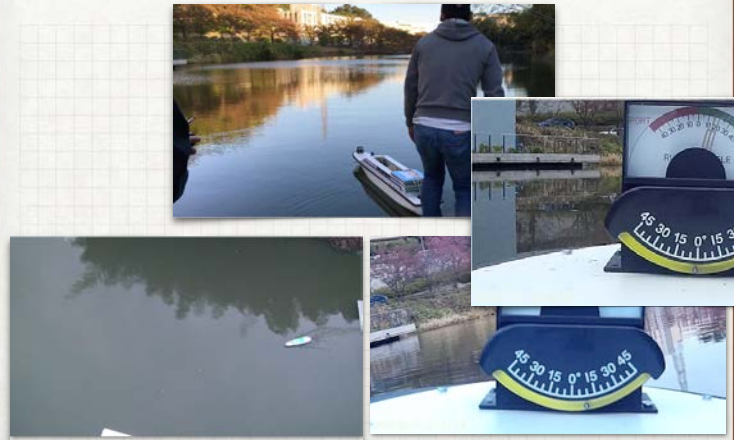
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MEASUREMENT SYSTEM (2) - DIRECT ROLL ANGLE MEASUREMENT -



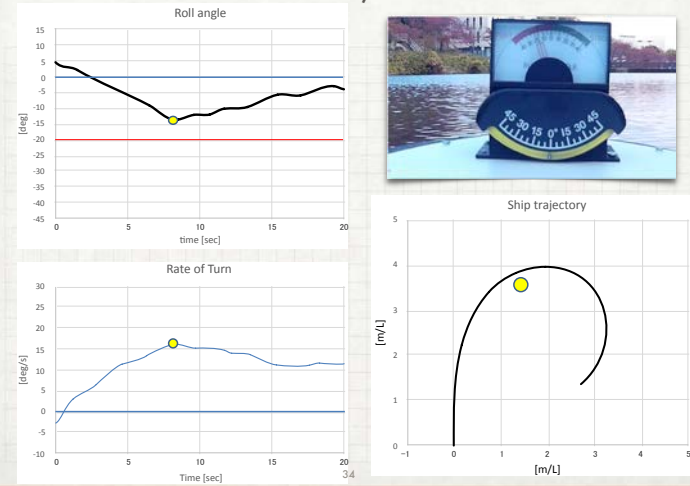
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TOP-VIEW, SIDE-VIEW AND ON-BOARD CAMERAS



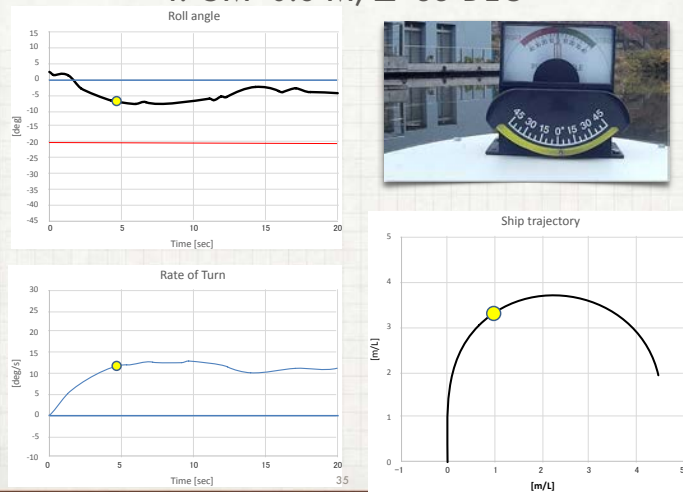
33

2. $GM=0.9 M, \Delta=35 \text{ DEG}$



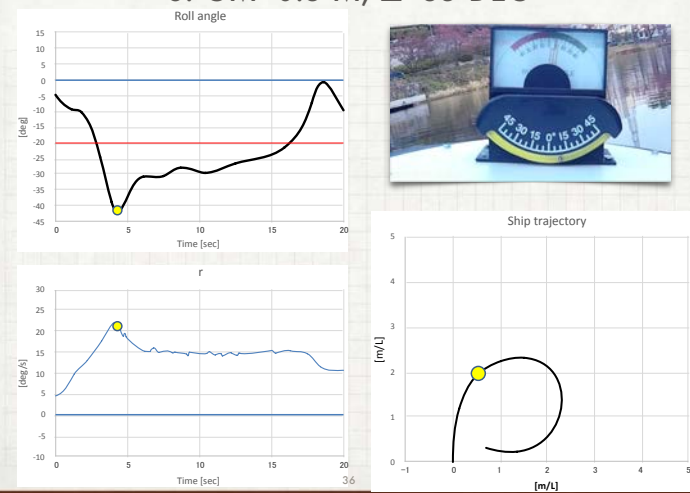
34

4. $GM=0.6 M, \Delta=35 \text{ DEG}$



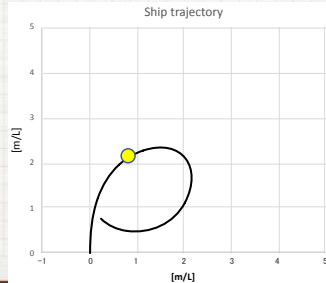
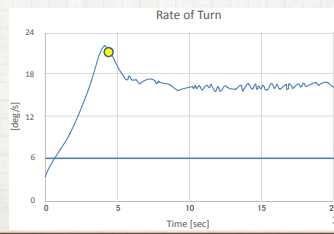
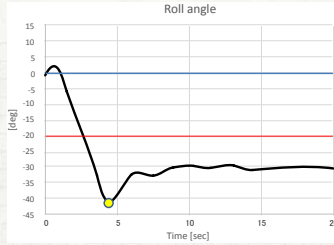
35

6. $GM=0.3 M, \Delta=35 \text{ DEG}$



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8. $GM=0.2\text{ M}$, $\Delta=35\text{ DEG}$



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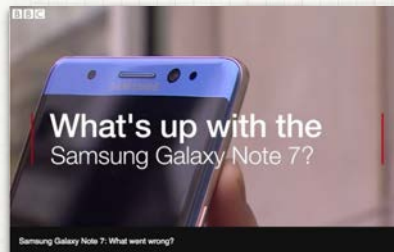
CONCLUSIONS OR SUGGESTIONS



DREAMLINER: BOEING 787 PLANES
GROUNDED ON SAFETY FEARS



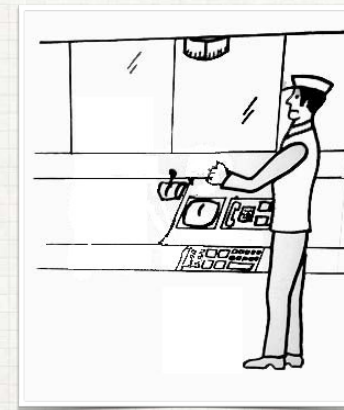
SAMSUNG PERMANENTLY STOPS
GALAXY NOTE 7 PRODUCTION



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PAST SHIPS

- CONTROLLED BY HUMAN, BUT HUMAN MAKES MISTAKES



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PRESENT SHIPS

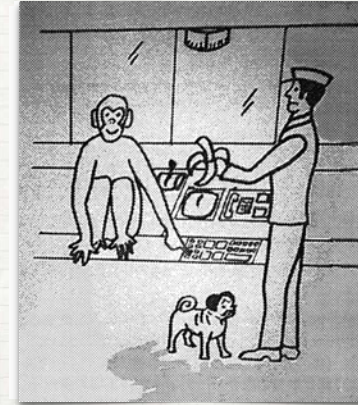
- CONTROLLED BY MACHINE, BUT STILL HUMAN MAKES MISTAKE



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FUTURE SHIPS

- HUMAN - AUTOMATION - SURVEILLANCE SYSTEM



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