

# Coast guard craft equipped with measurement and feed-back system



# HSC crew exposure to vibration and shock

Conditions at sea

Exposure feedback to crew

How to predict and evaluate crew  
vibration and shock

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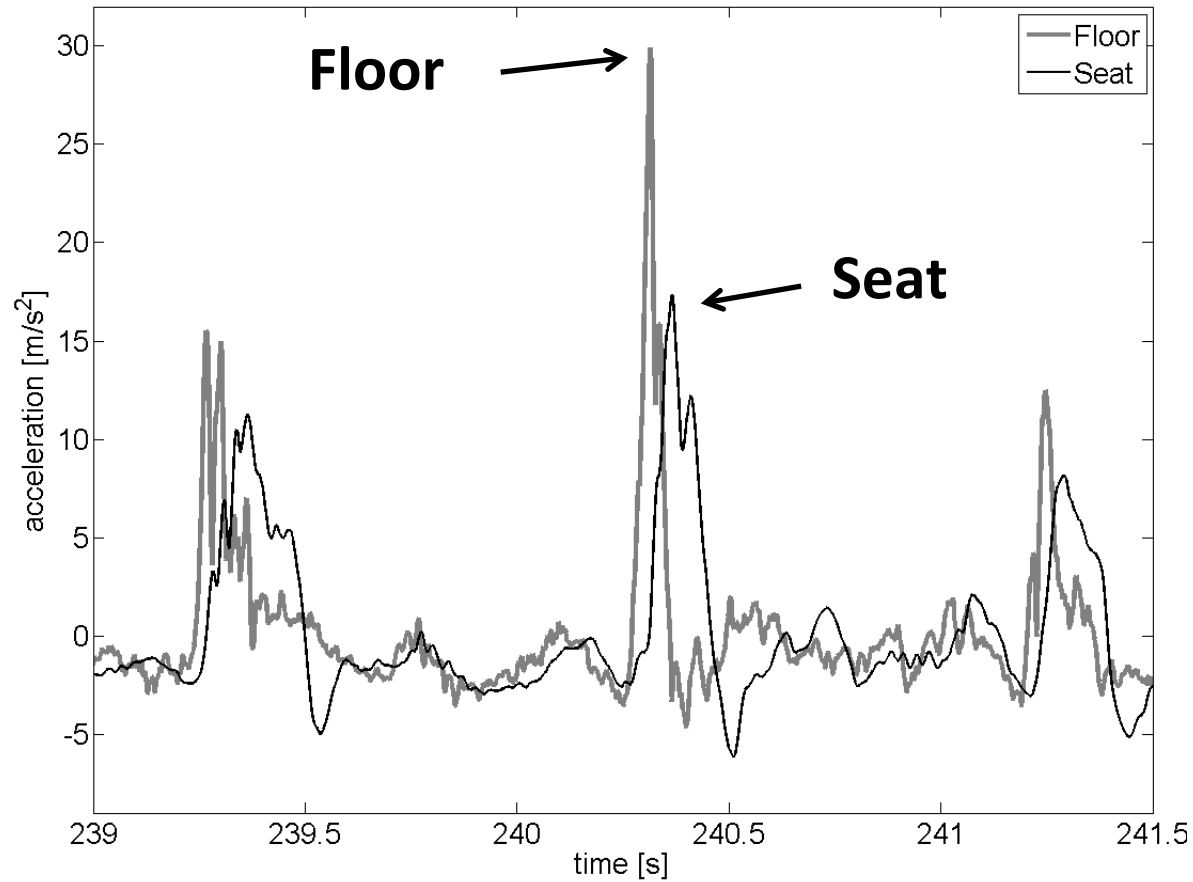
An ordinary day at work:

***How is it?***

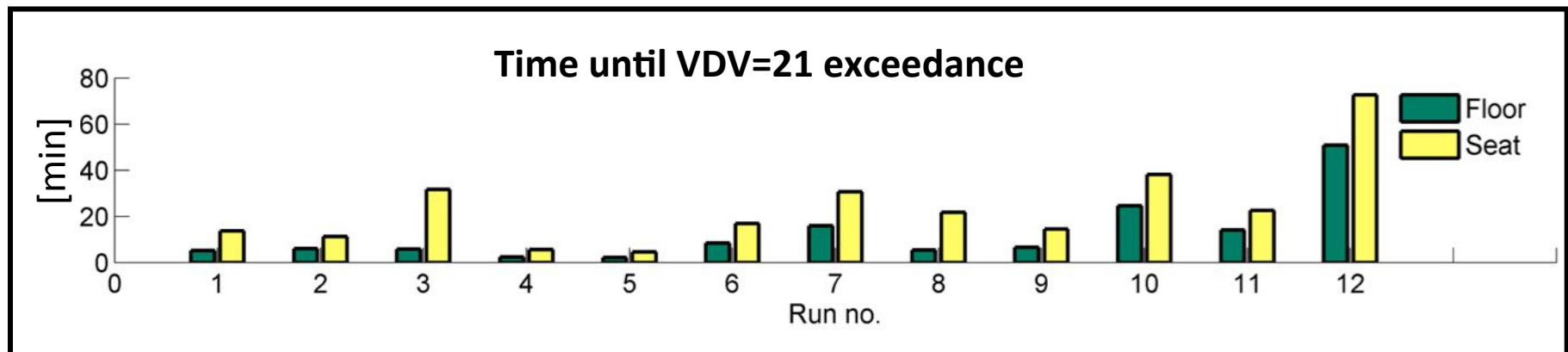


## Recording accelerations:

- 2,5 h at sea
- 12 runs at 40-50 kts
- “Everyday conditions”



- Suspension seat reduced accelerations by 50%
- Legislated limit value exceeded after 10-60 min
- Available evaluation measures are of varying quality

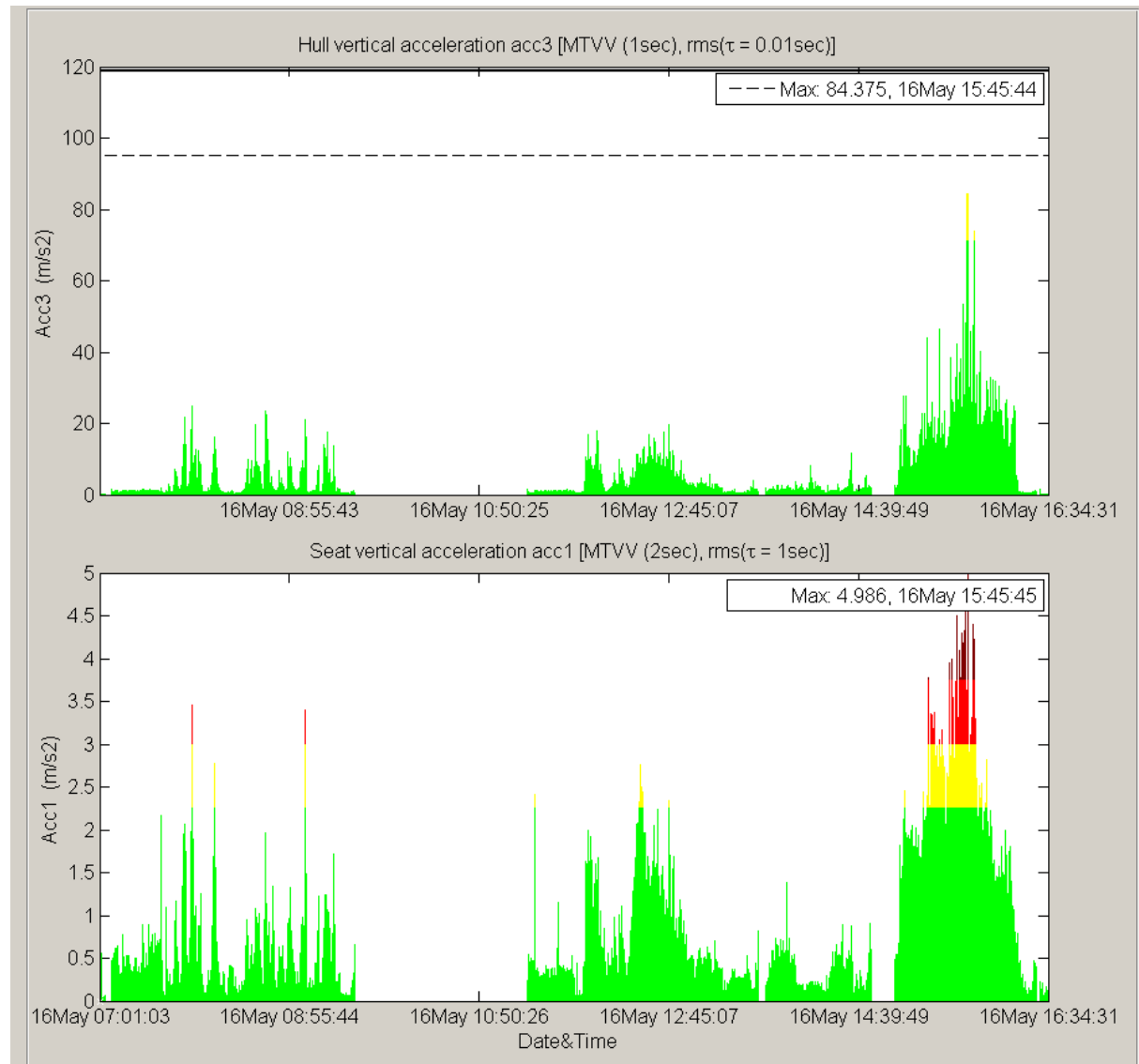


# Coast guard craft equipped with measurement and feed-back system



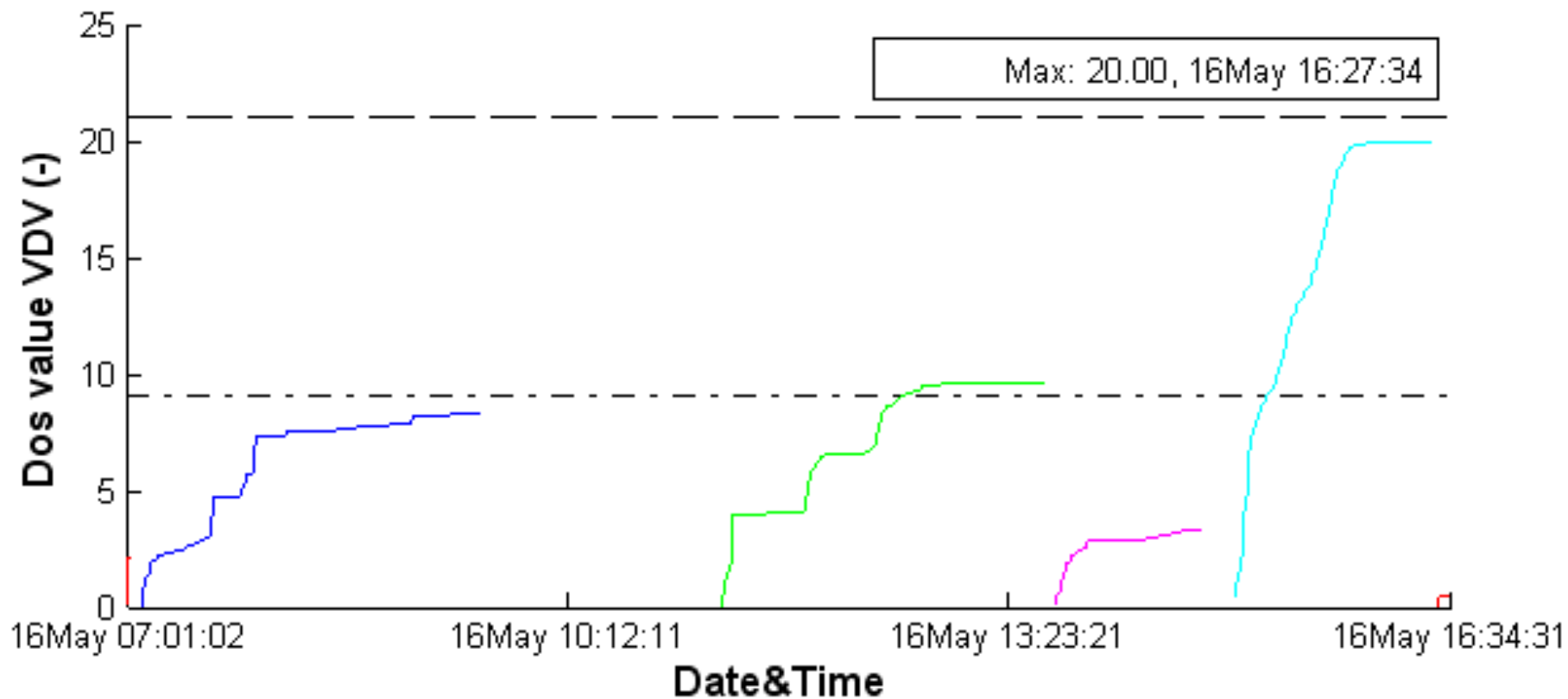
# 16 May 2013

## Hull

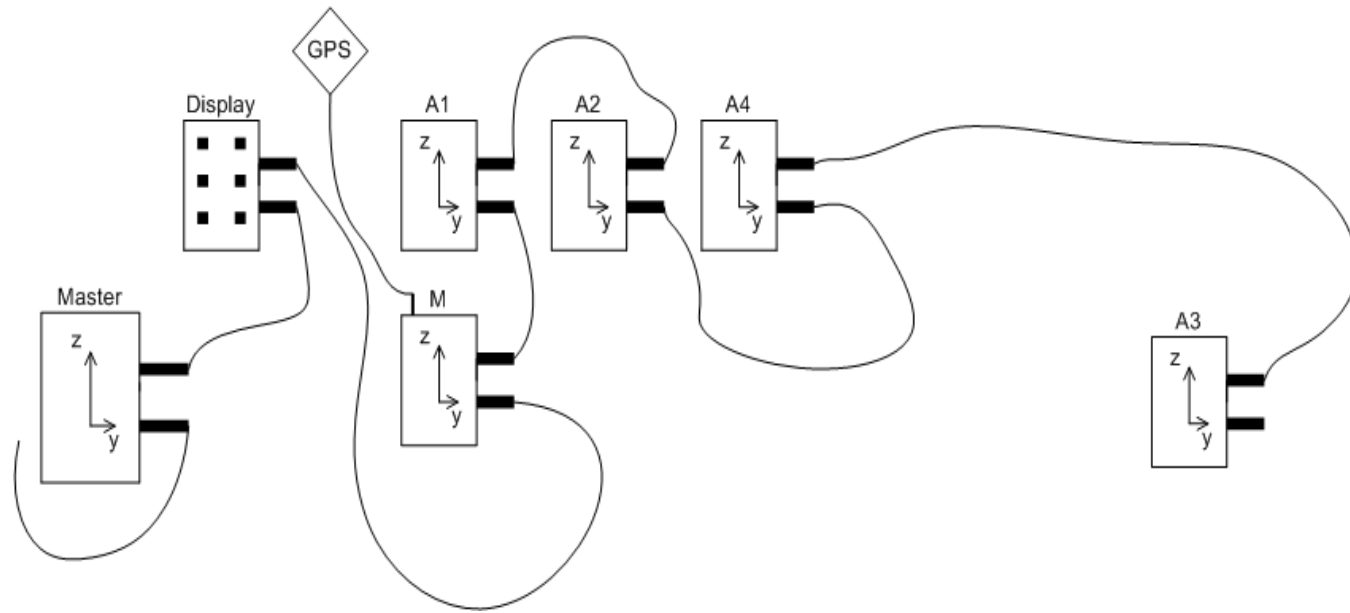


## Coxswain seat

# 16 May 2013, vibration dose (ISO 2631-1)





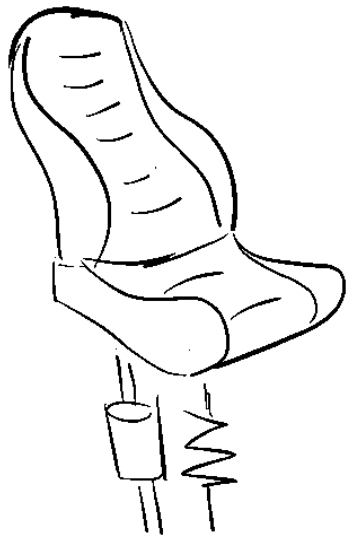


- x, y, z-acceleration at 4 locations
- Motions 6dof
- GPS-data
- Storing raw data (research) and real-time analysed quantities (overview and feedback)
- Display of crew and hull exposure

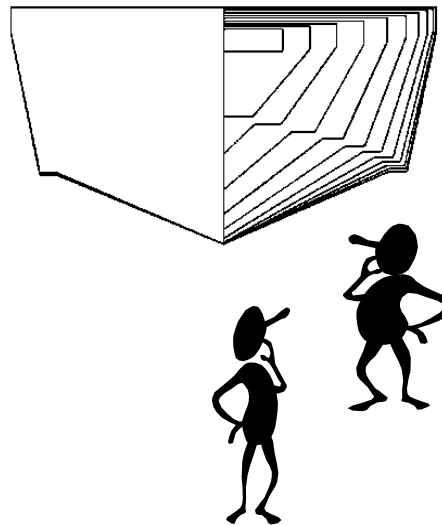


- Permanent on-board system
- Evaluation of hull loads & working conditions
- Continuous feedback to crew





**Suspension seat**



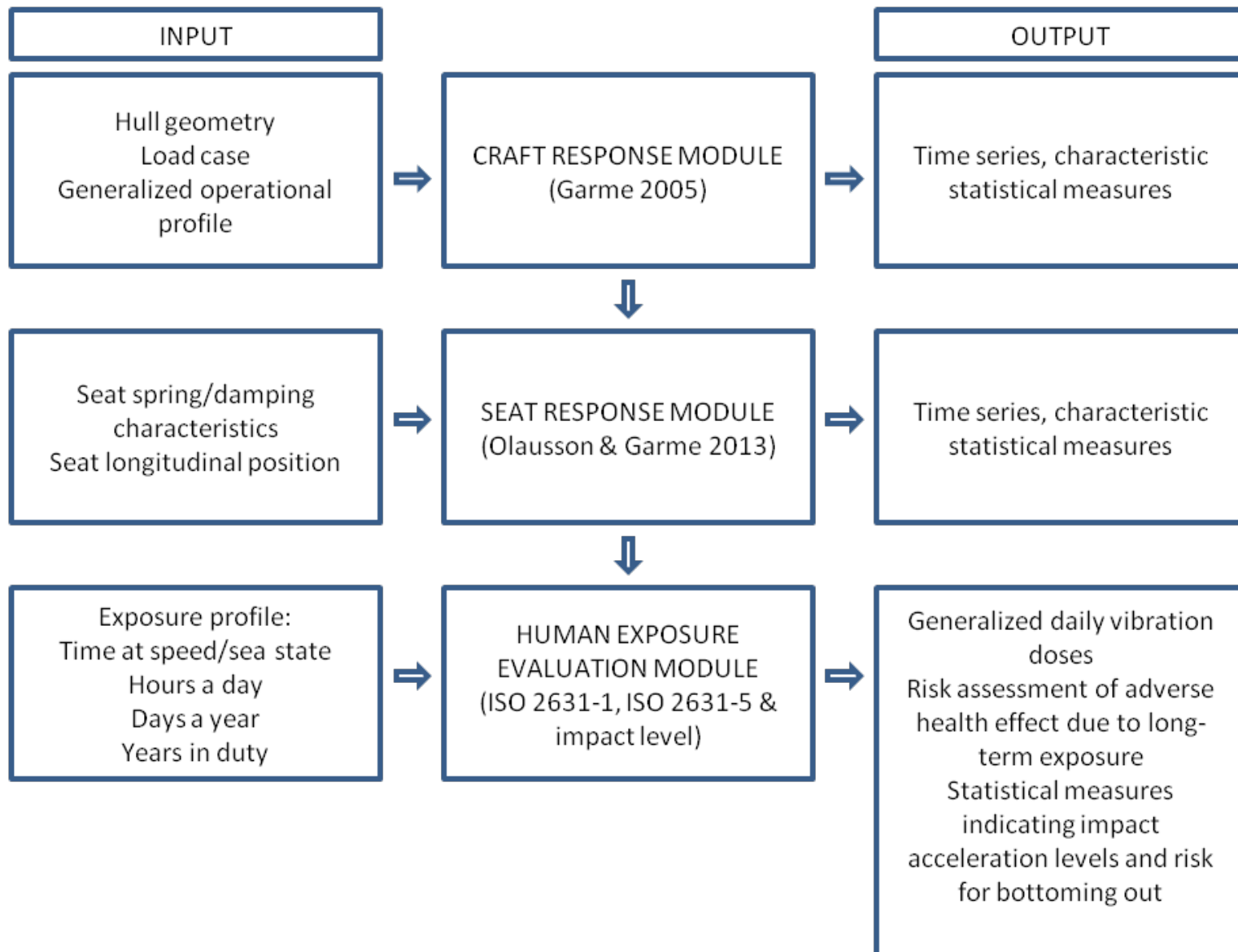
**Ship design**

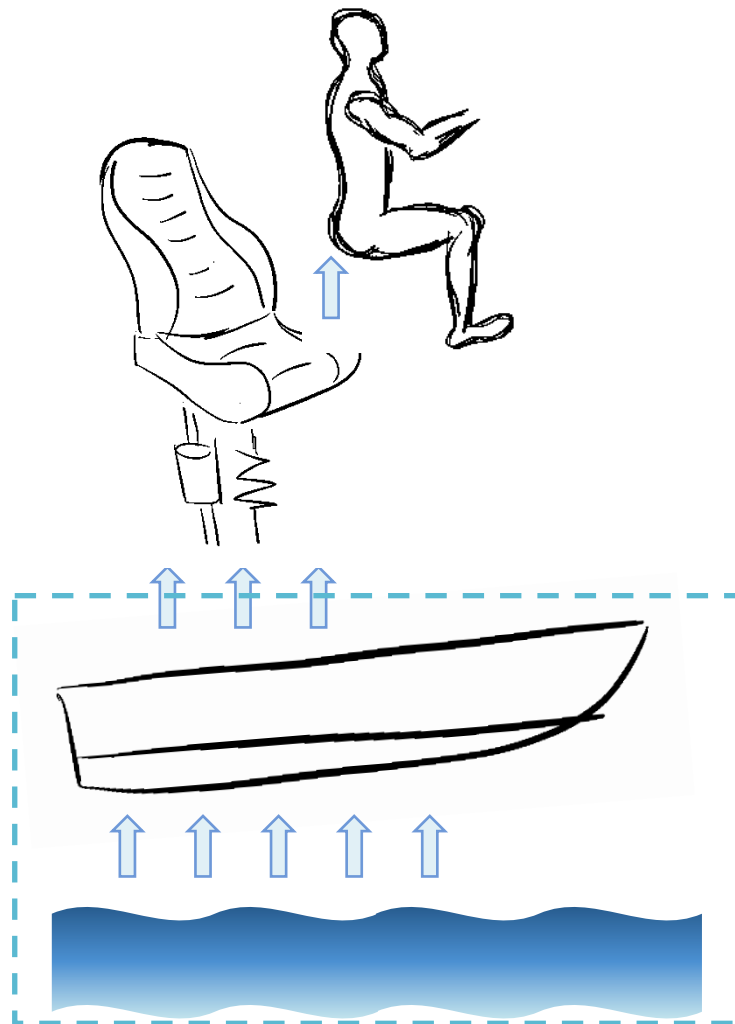


**Planning**

→ How to predict (and evaluate) working conditions?

# High-speed craft are advanced technical systems... ...in which **human** is a part

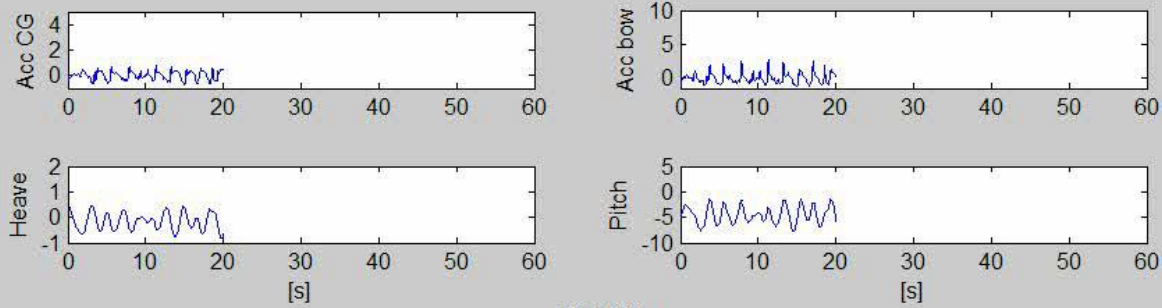




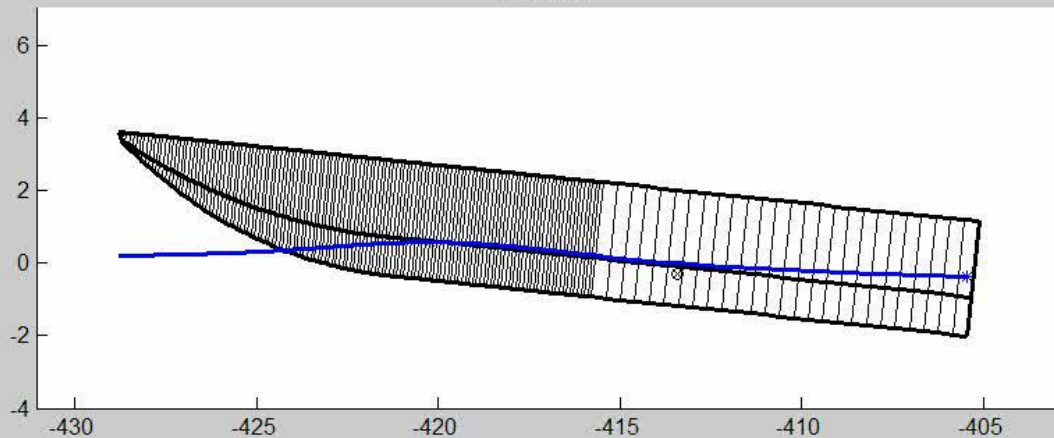
**Step 1:**  
Craft response  
(to irregular waves)

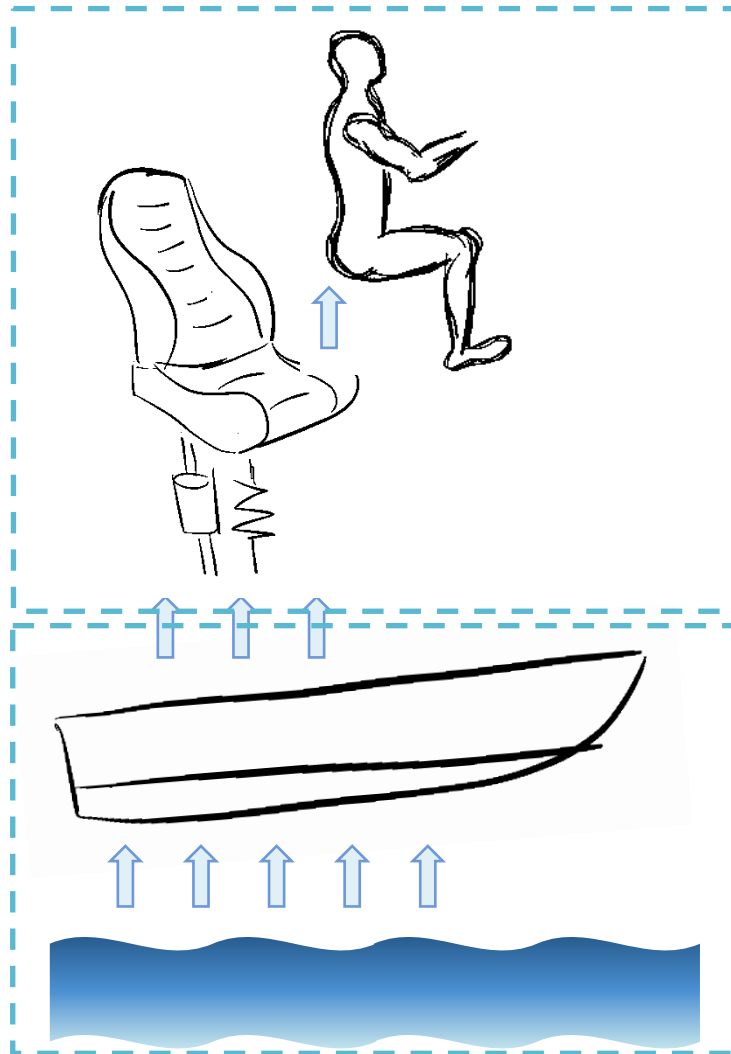
# Step 1: Craft response module

-Hull geometry, load case, speed and sea state

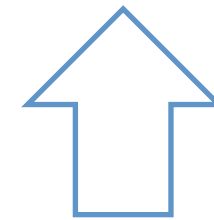


M20 40 kn





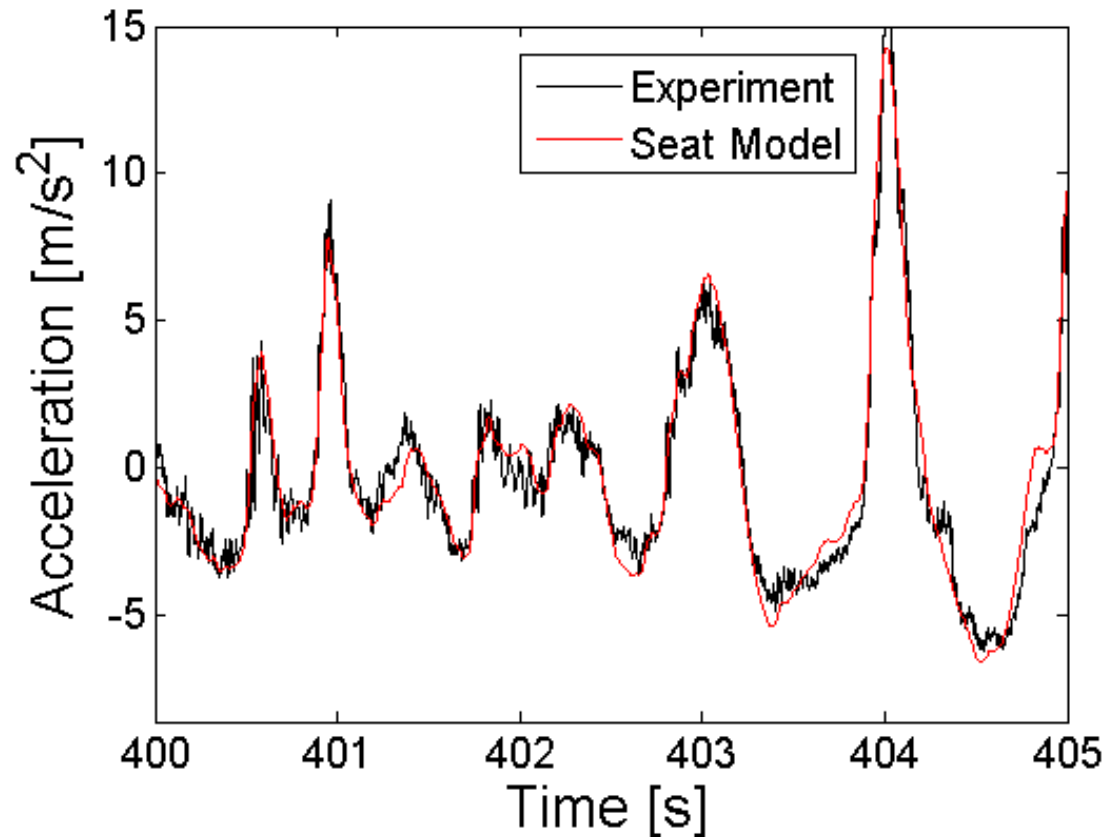
**Step 2:**  
Seat & human response (to  
craft accelerations)



**Step 1:**  
Craft response  
(to irregular waves)

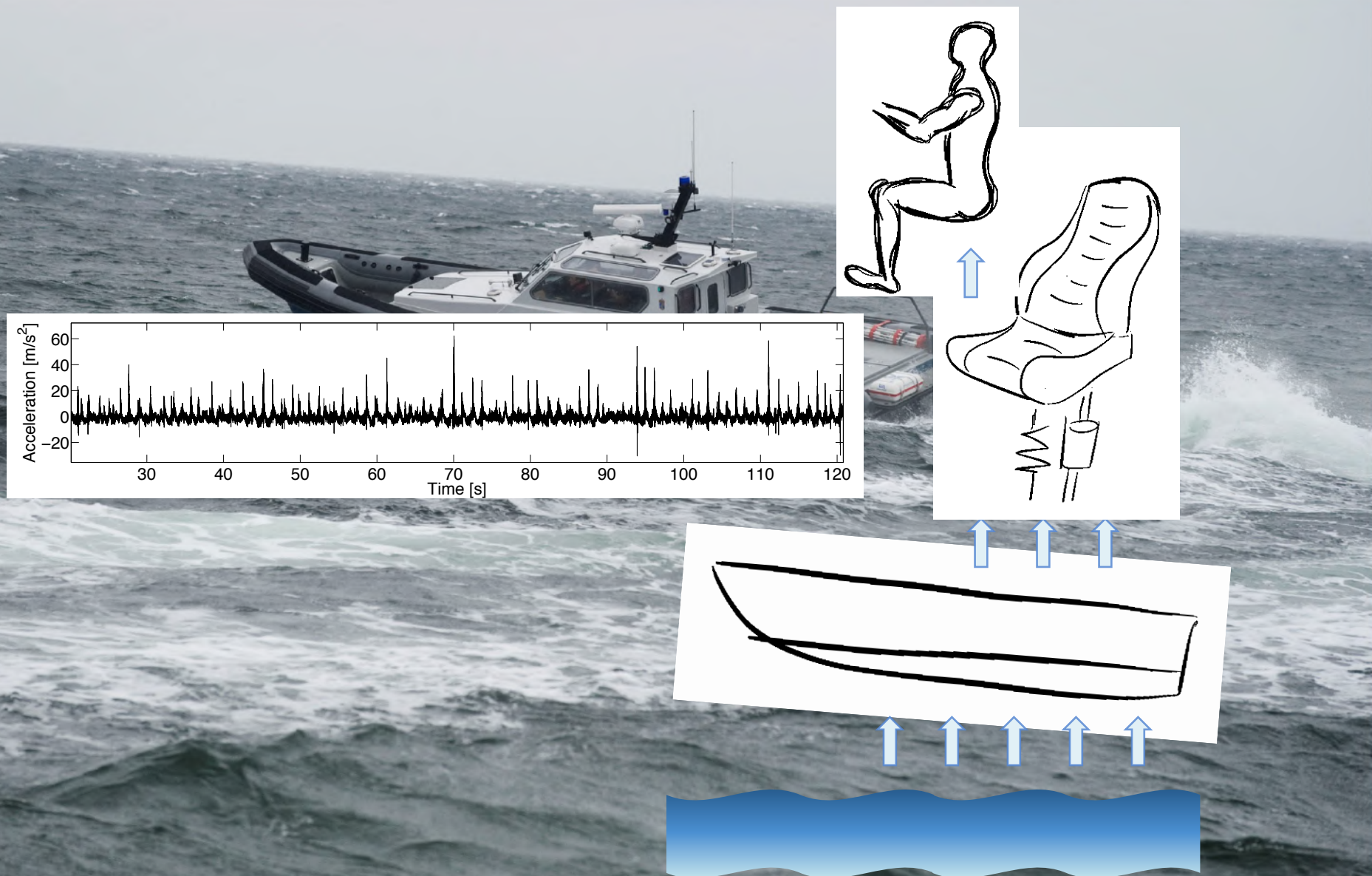
# Step 2: Seat response module

-seat parameters, location, exposure time,...

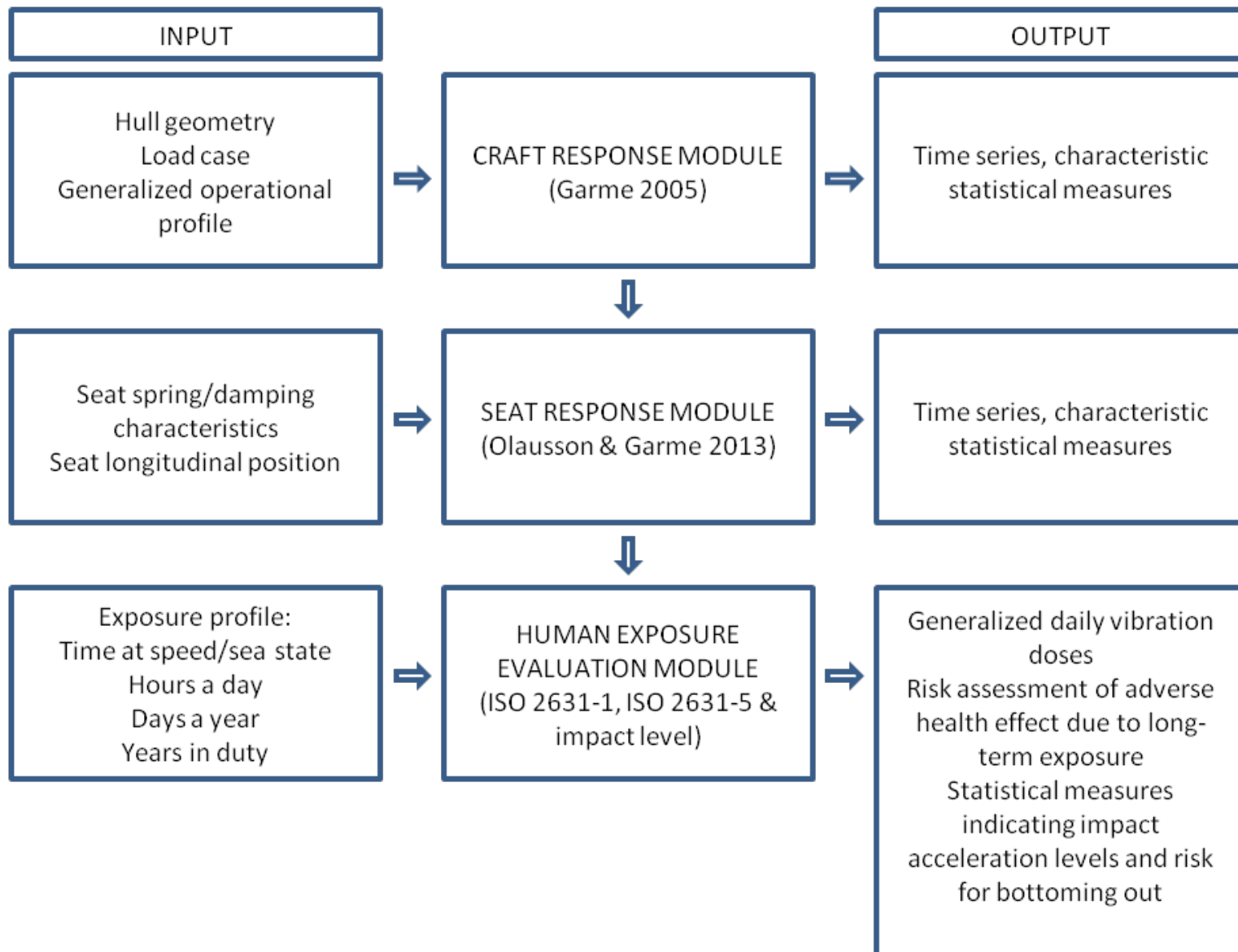




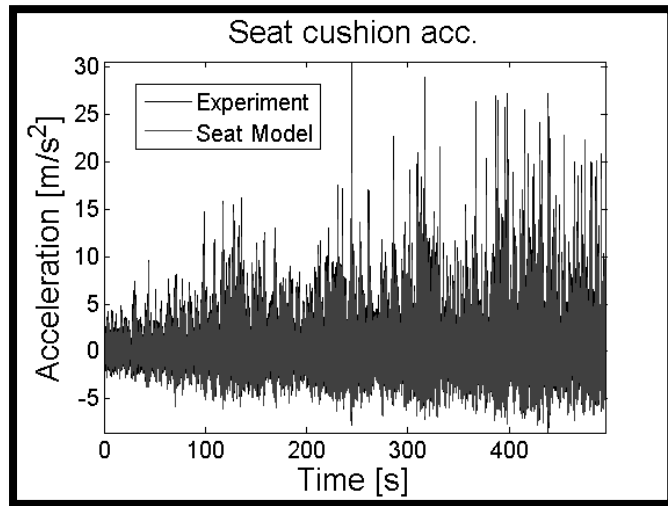
# Step 1 & 2 simulate crew exposure to vibration and shock



# Simulation based design

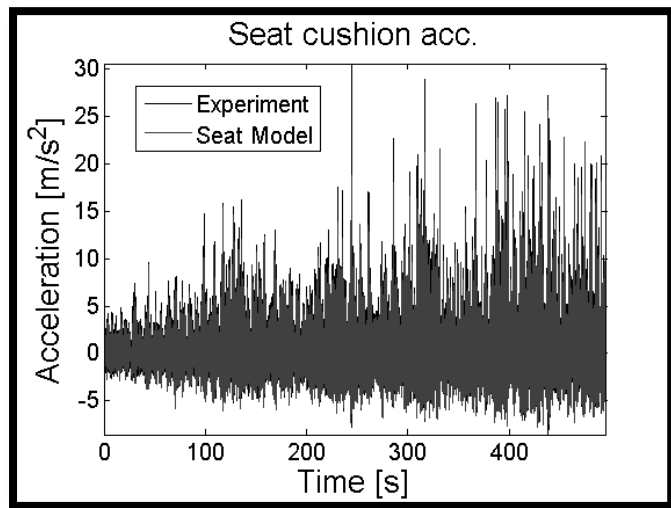


# How to predict and **evaluate** crew vibration and shock



1. Craft **operational profile**
2. Appropriate **evaluation methods**
3. Understanding of **risk for injuries**

# How to predict and **evaluate** crew vibration and shock



1. Craft **operational profile**
2. Appropriate **evaluation methods**
  - Statistical method addressing impact loads are under development
3. Understanding of **risk for injuries**
  - Craft accelerations and human response will be collected during offshore race



# HSC crew exposure to vibration and shock

## Conditions at sea

- need for better evaluation methods and understanding of risk for injuries

## Exposure feedback to crew

- now in coast guard HSC

## Predict and evaluate crew vibration and shock

- long term measurements & operation profile, craft and seat simulation models, impact measure under development, offshore race data a step towards better understanding of human endurance



The presentation is based on the following papers:

- Garme K., Burström L. & Kутtenkeuler J., *Measures of Vibration Exposure for High Speed Craft Crew*, Journal of Engineering for the Maritime Environment, Vol.225, No.4. 2011.
- Olausson K. & Garme K., *Prediction and evaluation of working conditions using suspension seat modelling*, Journal of Engineering for the Maritime Environment, Published online 2014.
- Olausson K. & Garme K., *Simulation-based assessment of HSC crew exposure to vibration and shock*, accepted for Proc. 12<sup>th</sup> int. conf. on Fast Sea Transportation, FAST13, Amsterdam the Netherlands, 2013.