Aalto University
School of Engineering

Marine Technology Research Unit
Pentti Kujala
Professor

Aalto University, School of Engineering
Department of Applied Mechanics

Aalto University

- TKK, HKKK and Taik were combined for **foundation based** Aalto University in the beginning of 2010
- 300 professors, other personel 4300, students 18000
- From 2011 there are 6 schools in Aalto University
  - Economics (Jyrki Wallenius)
  - Design (Helena Hyvönen)
  - Engineering (Gary Marquis)
  - Electronics (Tuija Pulkkinen)
  - Chemistry (Outi Krause)
  - Basic science (Ilkka Niemelä)

Investment for future:

- **Basic funding + 100 MEUR**
- **Own equity 200 MEUR + 500 MEUR**
- **Buildings 300 MEUR**

Aalto University in a nutshell

Aalto University, Marine Technology

Aalto University

School of Engineering

Department of Applied Mechanics

Marine Technology

Department of Applied Mechanics

- 8 professors + 2 distinguished professor (FiDiPro)
- A total staff of 100+, of which 28 are doctoral students
- Large experimental facilities (2 model basins, 3 wind tunnels)
- Research focus areas
  - Arctic marine and ice technology
  - Advanced structures
  - Flow modelling
- Teaching
  - Marine technology
  - Aeronautical engineering
  - Solid mechanics
  - Fluid mechanics

Department focus areas and professors 2012

Modelling and simulation of materials, structures and flows

Flow Modelling

Advanced Structures

Arctic Marine and Ice Technology

Marine Technology

Jerzy Matusiak

Jani Romanoff

Heikki Remes

Pentti Kujala

Fluid Mechanics

Timo Siikonen

Solid Mechanics

J.N. Reddy

Grzegorz Glinka

Jukka Tuhkuri

Arttu Polojärvi

Aeronautical Engineering

Olli Saarela

1 open postions:

- Ship hydrodynamics

Key focus areas of Marine research group

- Holistic safety modeling
- Advanced structural modeling
- High strength steel applications
- Cruise and Ferry Experience
- Arctic technology

Co-operation on Research Group Level
Ship Safety

Pentti Kujala

Simulation of Traffic

2 post docs
6 doctoral students
Merikotka co-operation

Jani Romanoff

Structural Safety in Accidents

1 doctoral student

Jerzy Matusiak

Ship Dynamics

1 doctoral student

Heavy increase of oil transport

SYKE, VTT, 2008

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Present status – the oil tankers traffic in the Gulf of Finland

http://www.marinetraffic.com/ais/

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On avarage more than 3000 ships bound to the Gulf of Finland monthly.

Winter will increase the risks

Source:Finstaship

Merikotka- Meta model

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Source:Lehikoinen, 2010)

Aalto Ship Structures Group
Vision 2020

Arctic Research at AppMech in a Nutshell

Topics

- Ice mechanics: ridges, pile-up, fracture, multi-scale, in-house FEM-DEM code
- Ships: loads, statistics, safety

Resources

- 2 professors, 2 lecturers
- 4 full-time doctoral students
- School focus area, Tenure proposals

Infrastructure: 40m x 40m ice basin

Main partners

- Universities in Trondheim, St.John's, St.Petersburg
- National and international research institutes, authorities, associations. Companies.

LRET, Center of Excellence for Arctic shipping and operarations (see next page)

Other: POAC'13 in Aalto

LRF New Center of Excellence Participants and Key personnel

Professor **Jukka Tuhkuri**
Aalto University,
Numerical ice load modeling

Professor **Pentti Kujala**
Aalto University,
Chair

Professor **Faisal Khan**
Memorial University
Safety and risk modeling

Professor **Sören Ehlers**
NTNU,
Modeling of structural-ice interaction

Professor **Brian Veitch**,
Memorial University
Safety and risk modeling

Professor **Sakari Kuikka**,
Helsinki University,
Modeling of environmental effects

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Aim and budget of the new LRF Center

- Holistic treatment of the design relevant features of ships and shipping and their identification to ensure safe arctic operations and transport
- Funding for 5 years, 2013-2018, 2.5 Meuro
- Funding enables 8 doctor thesis
- 1st center of Excellence by LRF in Scandinavia
- The only center related to Artic activities

Scenario based risk management

Aalto Ice Tank

The Tank

- 40m x 40m x 2.8m

Model Ice

- As the dimensions of the models are scaled, also the model ice properties must be scaled (ethanol).
- Typical model ice thickness 20 – 60 mm

Typical tests

- Ships in ice: resistance, operability, loads
- Structures in ice: loads, ice behavior
- Ice mechanics: ridge formation, ice-ice friction
- Multipurpose: also open water tests, and waves

Member of Hydralab IV (EU funding scheme)

Aalto large scale research infrastructure

Upgrading the tank is necessary during 2014

- Cooling system
- Equipment

Co-operation on Aalto Level
Cruise and Ferry Experience

DESIGN

Prof. Eero Miettinen &
Prof. Teemu Kurkela•
Postdoc•
Markus Ahola•
Antti Kauppi•
Candidate thesis•

TECHNOLOGY

•Prof. Pentti Kujala &
Prof. Jani Romanoff
•Postdoc
•PhD
•Pia Tulimaa
•Candidate thesis

•Candidate thesis
•Anni Ahola
•PhD
•Postdoc
•Prof. Markku Tinnilä

ECONOMICS

Cruise & Ferry Virtual Reality Teaching Environmen

Aalto University

•Virtual reality improves quality of marine technology education in to the next level

•Students can see the factors influencing the adequacy of the multi-disciplinary solution (e.g. conflict between architecture vs. structural design)

•Students can experience the 3D-designs instantly in realistic setting instead traditional small scale 2D-projections.

•This means that the student can for example walk in his/her design and experience the real measures, shapes, lights, materials and structural solutions.

RESEARCH: KOLMEN KOPLA (triad)

•Joint master theses project connecting marine engineering, economy, design and architecture in passenger ship context

•Three theses from equivalent topic from three different p

•First (2009) Kolmen kopla researched passenger ship co
•Service experience value
•Pleasant space experience
•Longitudinal strength perspectives
•Awarded by Tuula Teeri from the quality multidisciplinary collaboration

•Second (2011) Kolmen kopla concentrate
•New consumer driven business model for
•Modular cabin layout solution
•Design drivers of cabin area desi

•Current Kolmen kopla concentrates o
• New business models for future customers
• Utilisation of modular cabin layout solutions for future customer groups
• Optimised structural solutions

Publications

Teaching (2 year plan)

Co-operation at International Level

Nordic Master Program on Maritime Engineering

Nordic Master in Maritime Engineering
Department of Applied Mechanics; Pentti Kujala (resp. prof.)

The specialty of this Program:

- joint program between Nordic Five Tech universities on maritime engineering
- combines the individual strengths of each university to form a complete curriculum on design, construction, operation and analysis of ships and offshore structures
- 1+1 year structure with co-supervision of Master's thesis and double degree awarded from both universities

Course topics:

- specialization topics: passenger ships (Aalto), ship design (Chalmers), ship operations (DTU), small crafts (KTH), ocean structures (NTNU)
- computational and experimental fluid dynamics, structural design, passenger ship design, yacht and small crafts, ship operations, decision making, emissions to atmosphere and sea, composites, offshore structures and operations, winter navigation

Preliminary requirements for the students:

- Bachelor’s Degree in Naval Architecture or Mechanical Engineering

Number of students

First work place, 2005-2013

DeltaMarin	15
Napa	16
STX,Turku	11
Muut	11
Arctech Helsinki	9
Wärtsilä	8
Aalto	7
Foreship	7
ABB	6
Aker Arctic	7
Elomatic	4
DNV	4
STX,Rauma	3
Merivoimat	3

Marioff	2
Surma	2
Almaco	2
Neste	2
VTT	2
SYKE	1
Onnettomuustutkinta	1
Finstaship	1
ILS	1
Eniram	1
Technip	1
Sandvik	1
Lloyds	1
A&W Energy	1

Full scale measurements onboard SA Agulhas II

- Leave Cape Town, 27 Nov 2013
- Antarctica 24th December, 2013
- Back to Cape Town 13th Feb, 2014