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Results and conclusions

Enhancing Undergraduate Research and Learning Methods on Real-Time Processes by Cooperating with Maritime Industries

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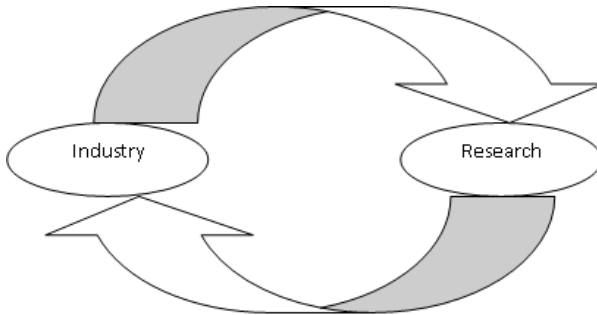European Conference on Modelling and Simulation (ECMS)

27-30 May,2014

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Summary

1. Introduction

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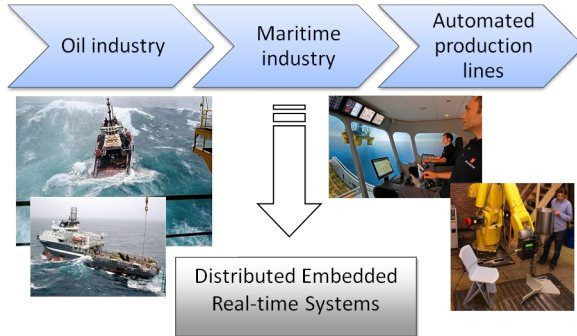Costs, standards and system integration
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Introduction

Industry and research, a quite challenging interaction

- conceptualization and promotion of the linkages
- reciprocal need
- continuous interaction loop

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Introduction

Oil industry → Maritime industry → Automated production lines

Distributed Embedded Real-time Systems

Challenging tasks

- on board ship operations
- surveillance systems
- motion platforms
- offshore crane control

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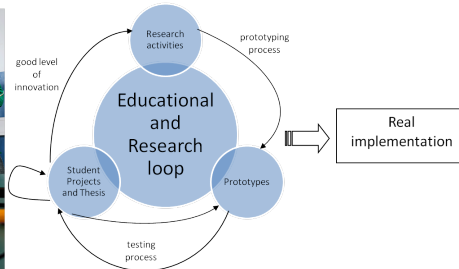
Since 2003, these projects have been part of an innovative educational and research loop and some of them have been followed up with new prototypes and research activities.

Main objectives

- include third year bachelor students into research programs
- improve the students bachelor thesis through cooperation with local industry
- explore the latest technology trends within wireless networks, vision systems, and inertial and remote sensing to develop new research activities

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Pedagogical basis
Technological basis
Main focus
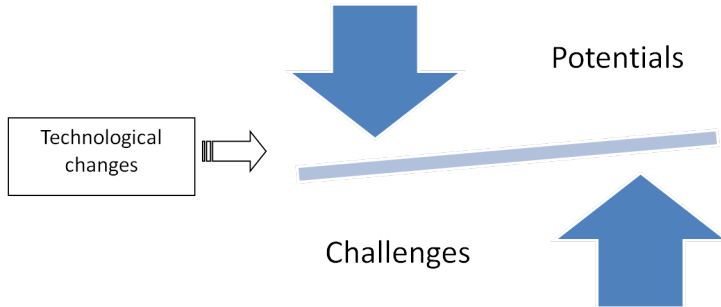
Pedagogical basis

"I didn't actually catch anything, but I do feel I gained some valuable experience."

Learning by doing and operational knowledge[1]

- the basis of this view lies in the concept of implicit learning, which represents a concept of knowledge based on experience, operational knowledge
- knowledge must be made personal through acting
- Action Science or multimodal teaching and learning

[1]Hundeide, K. (1985).Piaget i skolen. Oslo: Cappelen.

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Pedagogical basis
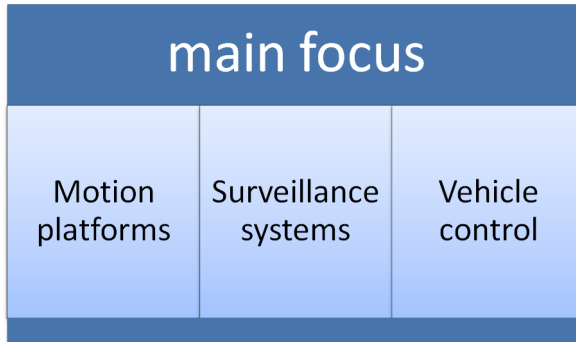Technological basis
Main focus

Technological basis

Technologies and methods changes very fast

- take advantage of the newest technologies
- drive innovations
- anticipate changes

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Pedagogical basis
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Main focus

Main focus

In a coarse generalization, our projects belong to one of three general categories

- motion platforms
- surveillance systems
- vehicle control

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Motion platforms
Surveillance systems
Vehicle control

Motion platforms

Motion stabilization models are challenging problems in all sort of ship activity

- waves impact on the vessel
- need for compensating of the vessel movements
- avoid dangerous situations
- facilitate operations on board

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Motion platforms
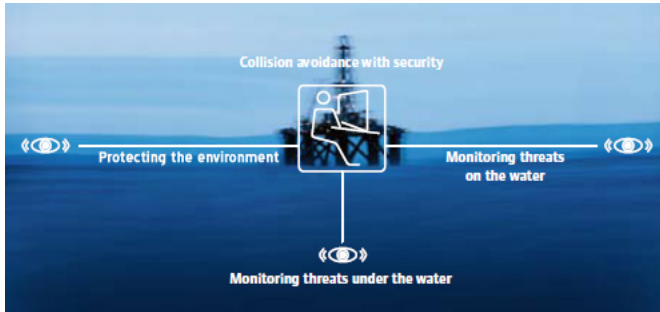Surveillance systems
Vehicle control

Motion platforms

An example of a transformation of a coordinate basis in 3 DOF from a given position to an arbitrary new one is given by the following transformation matrix:

$$\mathbf{P}_{pr} =$$

$$
\begin{bmatrix}
\dfrac{L}{2}\cos\theta - \dfrac{\sqrt{3}L}{6}\sin\phi\sin\theta & -\dfrac{L}{2}\cos\theta - \dfrac{\sqrt{3}L}{6}\sin\phi\sin\theta & -\dfrac{\sqrt{3}L}{6}\sin\phi\sin\theta \\[3mm]
\dfrac{\sqrt{3}L}{6}\cos\phi & \dfrac{\sqrt{3}L}{6}\cos\phi & -\dfrac{\sqrt{3}L}{3}\cos\phi \\[3mm]
\dfrac{L}{2}\sin\theta + \dfrac{\sqrt{3}L}{6}\sin\phi\cos\theta & -\dfrac{L}{2}\sin\theta + \dfrac{\sqrt{3}L}{6}\sin\phi\cos\theta & -\dfrac{\sqrt{3}L}{3}\sin\phi\cos\theta
\end{bmatrix}
$$

Motion platforms

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Motion platforms
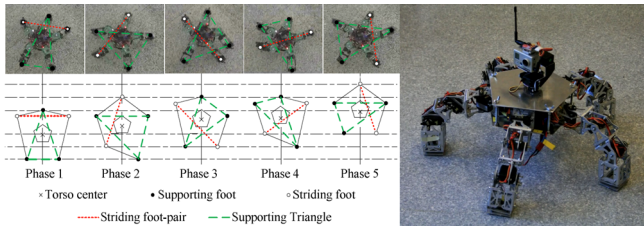**Surveillance systems**
Vehicle control

Surveillance systems

In many situations of potential dangerrous or advanced operations

- need for close and continuous inspection
- extend the natural sight of an operator
- survey difficult and critical operations
- rescue operations

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Surveillance systems
Vehicle control

Vehicle control

Phase 1   Phase 2   Phase 3   Phase 4   Phase 5
×Torso center   • Supporting foot   ○Striding foot
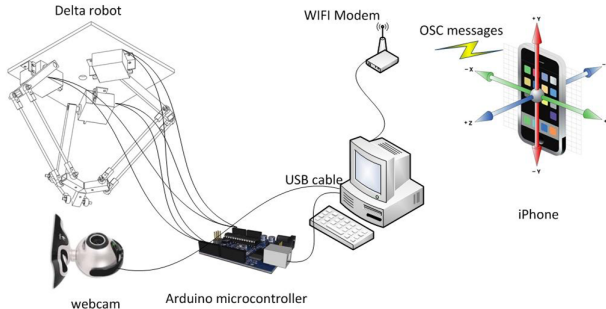-----Striding foot-pair   − −Supporting Triangle

Mobile robots are used for numerous purposes

- combine advanced technologies into an integrated system
- object search and recognition
- image acquisition and analysis
- inertial sensors
- remote controlled systems

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System architecture
The importance of cost and system integration
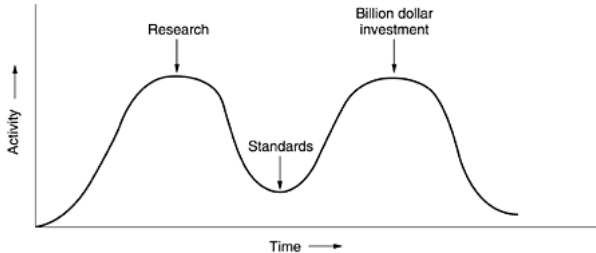
System architecture

Client server architecture

- communication and implementation
- concurrent applications
- flexible and reilable OS
- software libraries

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System architecture
The importance of cost and system integration

Apocalypse of the two elephants

The time at which a standard is established is absolutely critical to its success[1]

- If they are written too early, before the research is finished, the subject may still be poorly understood, which leads to bad standards
- If they are written too late, so many companies may have already made major investments in different ways of doing things that the standards are effectively ignored (standard de facto)

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[1] Computer Networks Fourth Edition by the god of undergrad CS texts, Andrew Tanenbaum, Published by Prentice Hall ISBN 0-13-066102-3

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Results

Projects and publications

- approximately 200 projects
- 12 scientific publications on international conferences and journals

A rewarding bonus

- European Conference on Modelling and Simulation, ECMS, host (May 27 - 30 2013)

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Conclusions

To summarize our activities

- impressive results from an educational point of view
- implementation of project with systematic follow-up of the most innovative ideas
- close collaboration with local industries
- students training in scientific thinking
- scientific publications

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Thank you for your attention