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

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Summary

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Introduction

Industry and research, a quite challenging interaction

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

Challenging tasks
- on board ship operations
- surveillance systems
- motion platforms
- offshore crane control
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
**Pedagogical basis**

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

Technological basis

Technologies and methods changes very fast
- take advantage of the newest technologies
- drive innovations
- anticipate changes
In a coarse generalization, our projects belong to one of three general categories:

- motion platforms
- surveillance systems
- vehicle control
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
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:

$$
\begin{bmatrix}
\frac{L}{2} \cos \theta - \frac{\sqrt{3}L}{6} \sin \phi \sin \theta & -\frac{L}{2} \cos \theta - \frac{\sqrt{3}L}{6} \sin \phi \sin \theta & -\frac{\sqrt{3}L}{6} \sin \phi \sin \theta \\
\frac{\sqrt{3}L}{6} \cos \phi & \frac{\sqrt{3}L}{6} \cos \phi & -\frac{\sqrt{3}L}{3} \cos \phi \\
\frac{L}{2} \sin \theta + \frac{\sqrt{3}L}{6} \sin \phi \cos \theta & -\frac{L}{2} \sin \theta + \frac{\sqrt{3}L}{6} \sin \phi \cos \theta & -\frac{\sqrt{3}L}{3} \sin \phi \cos \theta
\end{bmatrix}
$$
In many situations of potential dangerous or advanced operations

- need for close and continuous inspection
- extend the natural sight of an operator
- survey difficult and critical operations
- rescue operations
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
Vehicle control
Client server architecture

- communication and implementation
- concurrent applications
- flexible and reliable OS
- software libraries
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).

\(^1\) Computer Networks Fourth Edition by the god of undergrad CS texts, Andrew Tanenbaum, Published by Prentice Hall ISBN 0-13-066102-3
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)
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
Thank you for your attention