Seminario:

Modeling, Simulation and Motion Control of Marine Vehicles

Lunes 3/12 – 15 hs – Aula 01 (Pellegrini 250)

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Abstract

In this seminar some of the typical application problems of motion control of marine vehicles are briefly introduced. Models for describing the motion of ships and other marine structures in six and four degrees of freedom (6- and 4-DOF) are given; these include hydrodynamic effects, propulsion system, control surfaces and actuators. An introduction to the probabilistic description of the elevation of the sea and ocean waves as well as their effect on the motion of the ships is given, with emphasis on simulation for control applications. Finally, a particular motion problem, "Rudder Roll Stabilization", is addressed.

Introduction

Motion control of marine vehicles is a field that provides the control engineer with a large number of interesting and challenging control problems. The reasons for attempting to control and reduce the motions of a ship are as varied as the types of ships. For instance, in cruise ships, excessive motion interferes with recreational activities of passengers. In war ships, it can seriously degrade the combat readiness of the crew as well as affect the performance of weapon systems. In container ships, it may produce cargo damage since the load is subject of large accelerations. finally, offshore platforms, pipe-laying ships and drill ships require a very small motions to perform many different task. Thus, automatic control systems have a dramatic impact on reliability and performance of marine vehicles, and as in any other brunch of applied control, mathematical modeling and simulation has proved to be crucial to the success of control strategies in this area.

Seminar outline and contents

- Ship motion control problems.
- Deterministic motion description: dynamics and kinematics of ships.
  - Models in 6-DOF, and simplified 4-DOF models for surface ships.
  - Hydrodynamic models of forces and moments.
  - Propulsion system devises and their interaction with the hull.
  - Control surfaces: rudders and fins.
  - State space models: linear an non-linear.
  - A Matlab/Simulink toolbox for simulation and control of marine vehicles.
  - Example: multipurpose naval vessel.
- Random Motion due to waves.
  - Description of different sea patterns: regular, irregular, short and long crested.
  - Simple harmonic progressive waves.
  - Probabilistic description of sea elevation: Wave spectral density functions.
  - Ship motion in seaway.
- Rudder Roll Stabilization
  - Introduction to the problem.
  - Linear Fundamental limitations.
  - Constrained control solutions.