

Development of a Model Scale Autopilot Foiling Craft

Background

Hydrofoils are a current hot topic in the marine industry both in high performance sailing and in new passenger transport systems in conjunction with electric propulsion. In foiling the wetted surface area of the vessel and thus its resistance is drastically reduced. Foiling is not a new technology, but its development has stopped in 80s because of a few accidents (safety issues) and high maintenance costs. The recent developments in the fields of material science (e.g. composite materials) and also system control methods (sensors and digitalization) has brought foiling into the centre of attention again. With foiling we can reduce the energy consumption of the power boats by 80% which is unbeatable by any other resistance reduction technique! This huge potential for power reduction is one of the main motivations for the commercial shipping to take advantage of this technology, especially for electric vessels. However, one of the challenges with foiling is the craft stability in waves and rough seas. The ride stability and safety of the vessel are two important factors which should be considered in the design of foiling craft.



Figure 1. Different types of high-speed foiling craft

Objective

The objective of this pre-study project is to develop and build a model scale foiling boat equipped with an autopilot control system that can actively control the ride stability. The existence of such a model allows testing different concepts for hydrofoil arrangement and relevant system control strategies.

Method

This project is a continuation of an earlier project. The model developed/build in that project is shown in Figure 2.

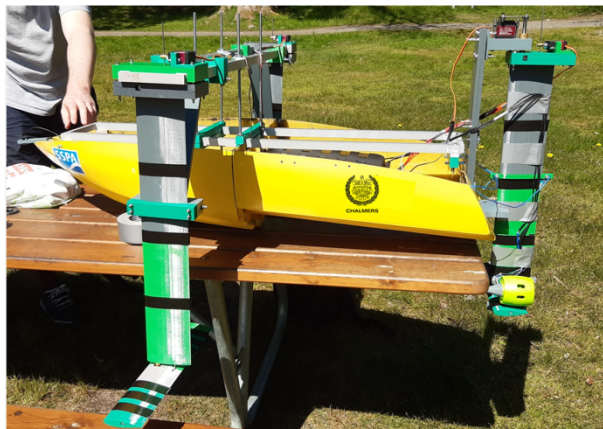


Figure 2. A foiling boat built by MSc students at the department of Mechanic and Maritime Sciences

The goal of the current project is to modify/improve an existing design in three steps:

1. **Hydrofoil System Design:**

The existing concept for the hydrofoil system shall be further developed. This includes the design of hydrofoils as well as the hydrofoils arrangement.

2. **Autopilot - System Control**

An active control system is planned to be used for controlling the dynamics of the model in waves. There is no off-the-shelf autopilot system for foiling craft. The students shall develop an autopilot concept for controlling the foiling boat dynamics and demonstrate that on a model scale foiling craft.

3. **Model Building**

Eventually, the concept will be demonstrated on a model foiling craft. The hull and hydrofoils are planned to be 3D printed. Then the actuators and the control system will be integrated to demonstrate the auto-pilot system. An electric propulsion system will be utilized to propel the foiling craft.

Prerequisites

The project is a multidisciplinary project and students from different fields are needed in the team. The tasks in the project can be divided into two main categories, (1) mechanical system development (2) control system development. The students involved in these tasks should have basic understanding of a mechanical system including static and dynamic loads/moments and behaviour of a mechanical system, system control as well as model manufacturing techniques.

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Target group

Maskinteknik (TKMAS), Automation & mekatronik (TKAUT), Teknisk fysik (TKTFY)

Group size

4 - 6 students

(Projektet kan ej fördubblas)