PROJECT and MASTER THESES 2018/2019

Below you'll find proposed topics for project and master theses. Most of the proposed topics are just sketches. The detailed topics will be made in discussion between student and supervisor.

Most topics can be both project and master thesis. It is most common to have the same main topic for both project and master. Several of the topics might even be continued in a PhD project. Some of the topics are related to ongoing research in the department, others have been proposed by industry or by SINTEF Ocean.

You can also propose own topics. Then, you must find a supervisor who is willing to supervise the topic. The supervisor will have the last word in formulation of the assignment text.

Sverre Steen, http://folk.ntnu.no/sverres

Contents

Detection and delay of flow separation

Flow separation increases the drag of submerged bodies very much. Streamlining the geometry is the usual way of avoiding separation. However, motions and body deformations affect the tendency to separation. When fish and other marine animals are moving, they usually avoid flow separation by utilization of “sensors”. In bio-mimetic underwater vehicles it is of interest to do something similar, and it has been proposed to equip underwater vehicles with arrays of pressure sensors, configurated similar to the sensor lines at each side of a fish.
A related issue is the influence of friction on flow separation. Since flow separation is caused by retardation of the boundary layer velocity very close to the surface of the body, and since friction is also retarding the velocity in the boundary layer, it is likely that decreased frictional resistance will reduce the tendency to separation, which will be another possible benefit of friction reduction technologies.
These issues are suitable for a combined project and master thesis in marine hydrodynamics. The master thesis is planned to be built around model tests in the cavitation tunnel or possibly the large towing tank, while the project thesis will mainly be literature study of the topic.
A cooperation with Univ. of California at Berkeley is planned, and funding for a cooperation, including funding a trip to Berkeley is applied for.

Supervisor: Prof. Sverre Steen

Use of in-service data for performance monitoring of ships

Ships are increasingly equipped with automatic data collection systems to collect a large number of variables describing the performance of the ship and its systems. In a hydrodynamic context, variables such as speed over ground, speed through water, position, wind speed and direction, shaft speed and power, air and water temperature are examples of interesting and commonly collected variables. The collected data are often transferred to the ship operators office for further analysis, but currently, there is a lack of routines and methods to utilize these data in an efficient way.
Ship owners and operators have for a long time tried to monitor the performance of the ships in their fleets in order to detect inefficient operation, and need for maintenance of hull and propulsion system (and more!). The analysis methods have not kept up with the fast development of sensors and data collection systems, meaning that there is a largely untapped potential for development of analysis methods. In cooperation with the ship owners in SFI Smart Maritime www.smartmaritime.no, this project and master thesis shall develop and test methods to analyse in-service data of ships to detect changes in the condition of hull and propeller.

Supervisor: Prof. Sverre Steen

Roll damping to improve energy efficiency of ships in transit

Ships travelling in a seaway tends to roll quite significantly, depending on the wave direction, ship design and use of roll damping devices. Roll is unwanted. However, the roll motion contain energy, and this energy could be converted into useful energy. The aim of the combined project and master thesis is to investigate the potential and possible technical solutions for utilizing this energy.

The project and master thesis will be performed in cooperation with the SFI SMART Maritime www.smartmaritime.no. They can contribute with knowledge and guidance, as well as data from ship operation.

Supervisor: Prof. Sverre Steen

Use of in-service data for determination of attainable speed and sea margin of ships

Ships are increasingly equipped with automatic data collection systems to collect a large number of variables describing the performance of the ship and its systems. In a hydrodynamic context, variables such as speed over ground, speed through water, position, wind speed and direction, shaft speed and power, air and water temperature are examples of interesting and commonly collected variables. The collected data are often transferred to the ship operators office for further analysis, but currently, there is a lack of routines and methods to utilize these data in an efficient way.

It is of interest to ship owners and operators to know which speed they can expect their ship to achieve on different routes and with increasing time since last hull and/or propeller cleaning (the effect of hull and propeller roughness is significant). This can be done with combined theoretical and numerical methods, but it might be more efficient and also more accurate to utilize collected in-service data combined with machine learning methods to arrive at ship specific attainable speed and/or sea margin. A related topic is machine-learning based calculation of added power due to waves.

The project and master thesis will be performed in cooperation with the SFI SMART Maritime www.smartmaritime.no. They can contribute with knowledge and guidance, as well as data from ship operation.

Supervisor: Prof. Sverre Steen.

Model testing of flexible ship propellers

Currently, ship propellers are usually made of NiAlBronze, and most design are so stiff that elastic deflection is not taken into account in hydrodynamic design. However, if the propeller blades are made of composite material, such a carbon fibre composite, the blades might be sufficiently flexible so that the flexure has to be taken into account in the hydrodynamic design. Moreover, if the fibres of the composite blades are oriented in a smart way, the blades can be made to flex in such a way that the lift (force) is reduced when the lift is large, by making the blade twist so that the angle of attack is reduced at high load. In this way, cavitation at high load can be reduced, and the propeller will adapt to the inhomogeneous wakefield typically found behind ships.

The topic of the combined project and master thesis is how a flexible propeller can be model tested to validate it's performance in behind-ship condition. To measure the deflection while the propeller is rotating, a novel optical measurement technique will be applied. The tests will be performed in the newly refurbished large cavitation tunnel. The project will mainly be a literature study on flexible propeller and model testing of these, in addition to planning the tests to be performed in the master thesis. The master thesis is about planning, performing and analyzing the tests. Assistance in setting up and using the optical measurement technique will be given.

The combined project and master thesis is performed in cooperation with the research project KPN Fleksprop, which is a cooperation between SINTEF Ocean, Rolls-Royce Marine and NTNU.

Supervisor: Prof. Sverre Steen
Advisor: Luca Savio, SINTEF Ocean

Potential benefit of controllable pitch propellers for ships operating in off-design conditions

The pros and cons of Fixed Pitch (FP) and Controllable Pitch (CP) propellers (FPPs and CPPs) is a frequently discussed topic concerning powering-speed performance, maneuverability and propulsion machinery.

The most suitable type of propeller is specific to the ship type, its operational profile and the characteristics of the prime mover. The ship's power system has also important technical and cost considerations that influence on the propeller choice and vice versa.

The Safe Return to Port regulations (SRtP) became mandatory in July 2010, and are applicable for Passenger ships having a length of 120 m or more, or having three or more vertical fire zones. The regulation also applies to special purpose ships intended to carry more than 240 persons in total.

The overall intentions with the SRtP regulations are to increase the vessels' robustness and ability to safely return to port unsupported after an incident of fire or flooding, and thus reduce the likelihood of evacuation. This means that a twin-screw ship shall be able to generate sufficient thrust to propel the vessel at a given speed and against a wind condition with only one active propulsor.

According to IMO and in compliance with SRtP, it is required to calculate and document that the ship, with the propulsion power and thrust during an incident as described above with one propulsion unit out of order, the operational propeller system shall be able to propel the ship at speed of 6 knots against a Beaufort 8 sea condition. (IMO MSC.1/Circ.1369 App.1 Interpretation 18)

With a fixed-pitch propeller, the high torque required to rotate the propeller at low speed in heavy sea is often a critical parameter when designing the system to satisfy the safe return to port requirements.

Also, use of CP propeller might be beneficial for propulsive efficiency during heavy sea operation.

The objective of the combined project and master thesis is to do case studies of some different ships to check if there is a benefit from use of CP propeller under various operating conditions.

The project and master will be done in cooperation with Rolls-Royce Marine, who can provide data for case vessels, including data from operation of the ships.

Development of simplified methods for ship powering performance calculations

NTNU is developing a computational model for the fuel consumption and emissions to air from the world shipping fleet. The model is using AIS data for the world fleet, combined with a database with ship information (main dimensions, main engine size etc.). Since there is an enormous number of ships, CFD and other complicated models for computing the required propulsion power for the observed speed of each individual ship cannot be used, and experience shows that the commonly used simple empirical models like Hollenbach and Holtrop aren't suitable for all relevant ship types and sizes. At the same time, there are large amounts of in-service data available that might be used to develop improved empirical models. The objective of the combined project and master thesis is to identify or develop and subsequently validate suitable ship powering performance models suitable for use in the mentioned global fleet emissions calculation.

The project and master thesis will be performed in cooperation with the SFI SMART Maritime www.smartmaritime.no. They can contribute with knowledge and guidance, as well as data from ship operation.

Supervisor: Prof. Sverre Steen
Advisor: prof. Anders Hammer Strømman (EPT - IndEcol)