Marine Engine Design Optimization

Description of Project
In the ultra-competitive tow-sport boat market, it is critical that engine manufacturers adapt to ever changing market conditions and customer expectations. ILMOR prides itself on producing aspirational and high quality marine engines that incorporate innovative engineering solutions. The focus on continuous improvement ensures elimination of waste and inefficiencies is at the core of the business. Our main customer is MasterCraft – the world renowned and premium marketer of inboard engine tow-sport boats.

The 2018 MDP team will focus on the water cooling sub-system of the engine and deliver an improved validated water pump design.

To increase the speed of development, the new design will be informed by analytical modeling (CFD/FEA) of the existing positive displacement water pump design prior to fabrication and testing of a physical prototype.

Phase I Deliverables
To ensure success, team members will quickly develop an understanding of the unique requirements and best practices of designers in a marine environment. Ilmor will support this process by providing background reading materials, instruction/support from our design team as well as opportunities to experience our engines at work and play on the water.

The student team will develop CFD/FEA model of the current system, validated against Ilmor's historical engine performance data. Variables of particular interest include entry/exit conditions, cavitation risk, impeller blade fatigue, flow characteristics and inlet water pressure sweeps. Students will use this model to inform/improve their optimized water pump design and boat inlet scoop. They will deliver a fully documented water pump design (specifications, parts CAD) before April 10, 2018. (Prototype pump fabrication will be completed by Ilmor during the summer). The key focus should be on efficiency improvements that align maximum pump speed to maximum engine heat rejection (i.e. lower pump speeds). In addition, impeller durability will be improved such that the service life is increased to 75 hours by way of a reduction in cavitation and a reduction in impeller blade tip speeds. The ability to prime a dry pump must be protected.
**Phase II Deliverables**

The students will validate their pump prototype against design requirements through bench and full boat testing. They will use the results to inform improved phase II design recommendations for their water pump.

**Stretch Goals: HIGH SUCCESS**

The students will document and deliver an analytical model proven sufficiently accurate to replace significant physical testing from our design team’s current best practice development process.

The prototype design will improve both the overall cost and manufacturability of the water pump compared to status quo.

**Location**

The majority of the work will take place on north campus during the semester(s). Students will periodically visit the ILMOR engineering group in Plymouth, Mi for technical meetings, presentations. ILMOR’s engineering team will support the team’s on-site testing if requested in their Plymouth facility or on a boat in a local lake.

**Project Sponsor Mentor**

Sponsor:  **Michael Lindberg**

Mike is the Technical Director for ILMOR Engineering in Plymouth with responsibility for all non-IndyCar and marine engine projects. He graduated from Michigan State University with a Bachelor of Science in Electrical Engineering and the University of Michigan Dearborn with a Master’s of Science in Engineering Management. Mike was formerly employed by FCA (17 years) and was the Chief Engineer for the Hellcat and Pentastar engine families. He spends his free time in northern Michigan as an avid boater.
### Project Faculty Mentor

**TBD**

### Key Skills & Project Roles

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<th>Project Roles</th>
<th>Key Skills and/or Knowledge</th>
<th>Likely Majors</th>
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| **Mechanical Design Simulation (2 students)** | Design, development of user requirements, prototype development and validation.  
**Prerequisite:** ME 350 or equivalent | **ME, NAME, ISD-Auto, ISD-GAME** |
| **Heat Transfer and Fluids Modeling (2 students)** | Analytic Modeling and simulation, CFD/FEA | **ME, ChE, AERO, Physics, Math, MICDE** |
| **Naval Architect (1 student)** | **Cavitation theory and best practices** | **NAME** |
| AUTO 503, GAME 503, ME 490, Honors, ME 590 | | |

### Desired Additional Knowledge, Skills and Experience:

CFD, CAD, FEA proficiency. Genuine interest in engine and/or marine design. Interest and ability to quickly develop proficiency of the basics of Marine Design. Mechanical aptitude, not prone to sea sickness (on water testing is a necessary part of the project).
Company Overview

Ilmor began making waves in the marine world in 2002 with engines for the “SuperCat” Racing Series of the American Power Boat Association (APBA). At the same time, we were busy assisting DaimlerChrysler in the development of the V-10 Dodge Viper engine. Our engineers quickly realized the potential to marinize the unique powerplant design of the Viper engine to create high-powered V-10 boat engines. Over the following years, our team of innovative marine engineers made refinements and advancements to deliver even more horsepower and torque from the same lightweight package.

The success of the V-10 engines allowed Ilmor to expand our marine engine line, designing a series of inboard GM-based V-8 engines, each with unique Ilmor developed parts for durability, efficiency and performance.

Today, Ilmor is building a reputation for performance and quality throughout the recreational marine industry. We currently serve as the sole engine supplier for Mastercraft’s full line of inboard tow sport crafts, and with the launch of our revolutionary One Drive/One Touch stern drive solution, we are extending our offerings to include the bow-rider and cruiser markets. Innovative new engine designs continue to take center stage at Ilmor, and continue to showcase our unceasing dedication to excellence in design and engineering, manufacturing and customer service.

Legal Requirements

Citizenship and Right to Work Options

☐ This project is open to all students regardless of citizenship status

Intellectual Property Agreements / Non-Disclosure Agreements (please select)

☐ Students will sign the standard MDP IP/NDA agreement
Internship Information

1. A summer Internship is available for one or two student participants at ILMOR. All students who join the Ilmor team are guaranteed an interview.