Enhancing Vessel Fuel Efficiency through a Machine Learning-Based Energy Management System

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MARINE & MARITIME INTELLIGENT ROBOTICS

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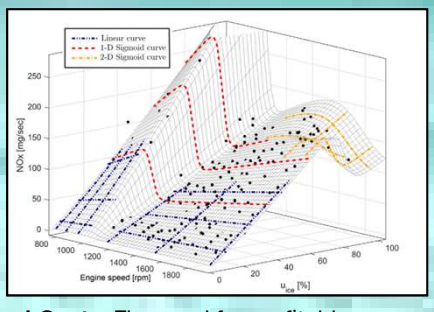
Introduction

The maritime industry is currently facing increased pressure in order to improve efficiency of fuel and to lessen discharges because of environmental alarms and sever protocols. Hybrid propulsion systems with a combination of diesel engines with electric motors are offering a encouraging solution. Optimizing such systems mostly necessitates advanced control strategies in order to manage complex relations between numerous components like thrust, crank, generation, and energy storage systems (ESS). This thesis suggests developing an Energy Management System (EMS) for vessels by means of machine learning techniques in order to improve overall fuel efficiency and operational performance.

Motivation

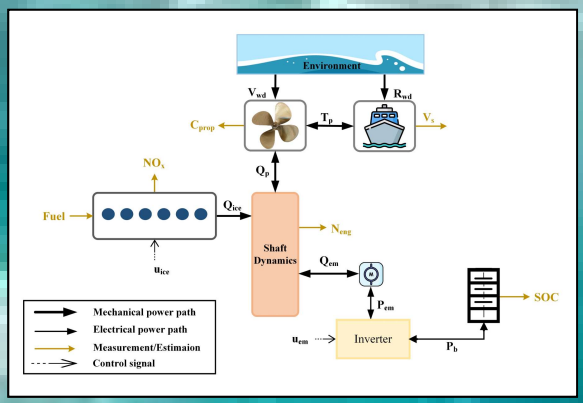
- **Environmental Regulations:** Severer regulations claim noteworthy decreases in vessel emissions.



- **Rising Fuel Costs:** The need for profitable energy management solutions is supplementary is endlessly critical.
- **Operational Efficiency:** Guaranteeing effective operations devoid of any negotiation in vessel performance.
- **Technological Advancement:** Emergent embracing of hybrid propulsion systems demands forward-thinking for energy management solutions.

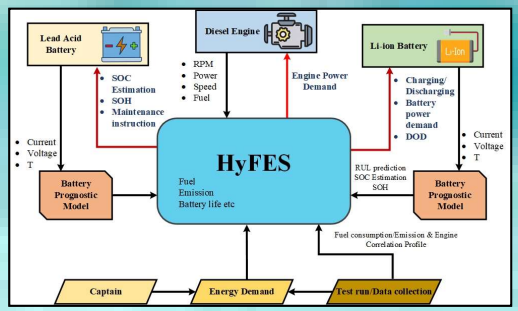
Background

- **Hybrid Propulsion Systems:** Such systems incorporate diesel engines along with electric motors by plummeting fuel consumption and emissions.
- **Energy Storage Systems (ESS):** Critical for handling distribution of energy in hybrid propulsion systems.
- **Machine Learning in Maritime:** Leveraging operational data in order to foresee and to optimize usage of energy is more and more common.



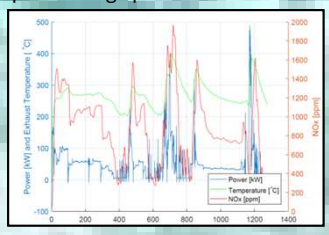
State of the Art

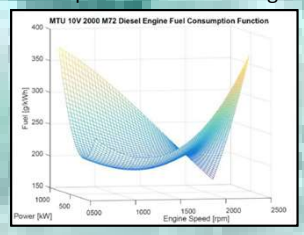
- **Energy System Optimization:** Existing systems such as Hybrid Fusion Energy Management System (HyFES) use data-driven tactics in order to optimize energy performance and to reduce emissions.
- **Predictive Energy Management:** Up-to-the-minute systems combine analytical control tactics in order to balance fuel emissions and consumption.
- **Machine Learning Integration:** Merging simulation models along with machine learning improves energy management proficiencies in large vessels.
- **Operational Data Utilization:** Machine learning techniques are working to forecast operational demands and to optimize energy usage.



Contribution

- **Propose an EMS:** Design an Energy Management System that is based on vessel's operational profile and on physical power system components.
- **Enhance Fuel Efficiency:** Cultivate approaches in order to mend fuel efficiency without causing compromise on operational dynamics.
- **Implement Machine Learning:** Apply machine learning for processing operational data and foresee optimal control strategies.





- **Control Strategy:** Develop and implement a control strategy that improves power-split choices among the internal combustion engine (ICE) and electric motor (EM).
- **Expected Outcomes:** Intention for noteworthy drops in fuel consumption and in emissions, authenticated over simulation and experimental testing.

Conclusion

This thesis will travel around integration of machine learning along with advanced control tactics in order to develop a robust Energy Management System for hybrid propulsion vessels. The main goal line is to improve efficiency of fuel and environmental performance by providing a ascendable solution for maritime industry.

References

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