



John and Cathi Drake Endowed Chair in Mechanical Engineering 2023 Annual Report Summary

Gordon Parker

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Introduction

Thank you for creating and continuing support of the John and Cathi Drake Endowed Professor in Mechanical Engineering. The funds have impacted the lives of over a hundred students and made meaningful advances in dynamic system and control research. I especially want to thank you for your engagement through our meetings and with our students. The lasting impact is real and vital.

Research

We continued progress in Marine Renewables, Diesel Aftertreatment, and Naval Technologies with a mix of graduate and undergraduate students.

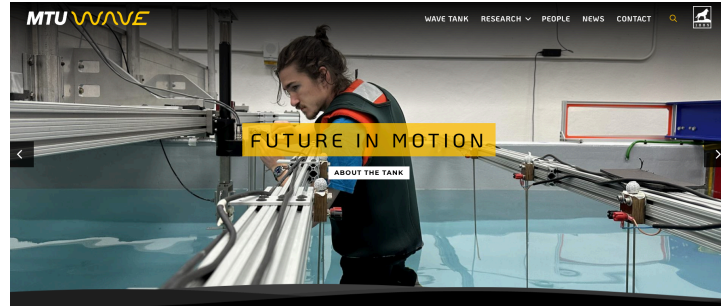
Naval Technologies

We've been working on control strategies for Naval applications for many years, starting with cranes and moving into 3D printer vibration isolation in the past few years. Recently we are developing a new research area that uses process monitoring and machine learning to help guide equipment maintenance. The U.S. Navy calls its program Condition-Based Maintenance Plus (CBM+). The John and Cathi, Drake Chair funds, have been essential, providing student support during gaps between funding increments and travel expenses for new project development, including the new CBM+ topic.

Marine Renewable Energy

Funds from the John and Cathi Drake Chair position supported this area in several ways, including improving safety, providing outstanding experiences for undergraduate and graduate students, and creating a novel low-friction WEC ideally suited for

fundamental research. Our MTU Wave tank is now a DOE TEAMER facility which increases our visibility and provides a DOE funding mechanism to collaborate with others. Several proposals were written this year, with a few being given unofficial approval and being negotiated. Five other faculty, Jungyun Bae, Hassan Masoud, MK Park, Wayne Weaver, and Shangyan Zou, are actively engaged in this area and use the MTU Wave facility. I'm encouraged that this area will continue to grow.



Our new website showing Luke Schloemp working on the buoy dynamometer.

Diesel Engine Aftertreatment

This summer, we'll start the final year of a U.S. Department of Energy (DOE) project to improve the design of a diesel engine aftertreatment device called the Diesel Oxidation Catalyzed Filter (DOCF). It simultaneously (1) captures particulate matter, (2) converts engine out CO into CO₂, (3) increases exhaust gas temperature by burning fuel injected into the exhaust stream to a level where the captured PM can be safely oxidized, and (4) converts the engine out NO to NO₂ which further oxidizes the captured PM. The motivation for the project is to help the off-road diesel industry field aftertreatment systems that use less precious metals - platinum and palladium. The project lead is the U.S. Pacific Northwest National Laboratory (PNNL) with several industry partners. Michigan Tech's role is both engine testing and modeling the device so that an optimal catalyst distribution can be found.