



Michigan Technological University

Department of Mechanical Engineering – Engineering Mechanics

John O. Hallquist Endowed Chair in Computational Mechanics

2021 Annual Report

Gregory M. Odegard

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Introduction

The purpose of this report is to detail the research activities that were performed with support from the endowed position titled “John O. Hallquist Endowed Chair in Computational Mechanics”. This position has been held since February 4, 2021 by Prof. Gregory M. Odegard of the Department of Mechanical Engineering – Engineering Mechanics (MEEM) at Michigan Technological University. Prof. Odegard is the Director of Research in the department and the Director of the NASA Space Technology Research Institute (STRI) for Ultra-Strong Composite Materials by Computational Design (US-COMP).

Prof. Odegard would sincerely like to thank the Hallquist family for their generous gift. Their continuous support for the MEEM department has made a difference in raising our profile among ME department around the country and has played an important role in improving the educational experience of both undergraduate and graduate students in our department.

Supported students

Because sufficient funds from the endowment were not available in 2021, no funds were spent. The plan moving forward is to start using the funds in 2022 to support PhD student Khatereh Kashmari, who is a PhD student in the MEEM department.

Khatereh has been partially supported by TA/grading assignments in MEEM and the Department at Physics at MTU. However, these funds are not enough to support her as a full-time PhD student. Thus, I plan to use the Hallquist funds to augment this support. Khatereh is hard working and has the potential to make an impact in her research area, and is thus worthy of the Hallquist support.

Resulting research accomplishments

Although Khatereh was not supported with Hallquist funds in 2021, I am including here a summary of Khatereh’s research accomplishments thus far to serve as a preview of the work that will be supported in 2022 with these funds.

Khatereh’s project is in a field of research known as process modeling. The goal of this work is to use computational modeling to optimize composite processing conditions to yield composite components with high levels of strength. Specifically, we use molecular modeling to determine the thermo-mechanical properties of composite materials on the molecular level as a function of processing time. This information is used in further simulations to predict the strength of composite structures. This research is being performed in conjunction with our partners at the University of Massachusetts at Lowell and NASA Langley Research Center.

Khatereh’s specific task in this project is to use molecular simulations to model the high-performance polymer poly-ether-ether-ketone (PEEK). This polymer is used in

many aerospace and other demanding engineering applications. This system is very different than any that have been modelled in the past in this manner. Thus, her work is important in determining a modeling method that is suitable for thermoplastic resins. The goal is for her research to eventually lead to improvements in the mechanical performance of PEEK-based composite materials in the future. Currently, she is preparing her first journal manuscript that shows that the processing conditions have a significant impact on the performance of PEEK resins.

Please don't hesitate to contact Prof. Odegard with any questions that you may have regarding this research or the use of the endowment funds. It is hoped that we can put this gift to use in the best possible way to facilitate our department's growth in research to be more globally competitive.