# DEPARTMENT OF MECHANICAL ENGINEERING
# WILLIAM MAXWELL REED SEMINAR SERIES

## "Using Machine Learning in Physics-Based Simulation of Fire"

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Jensen Hughes

**Abstract:** The National Fire Protection Agency estimates the total cost of fire in the United States at $300 billion annually. In 2017 alone there were 3,400 civilian fire fatalities, 14,670 civilian fire injuries, and an estimated $23 billion direct property loss in the United States. Accurate predictions of detailed fire behavior are needed to support hazard/risk assessments in the wildland urban interface. Fire dynamics is a complex process involving multi-mode heat transfer, reacting fluid flow, and the reaction of combustible materials. Computational fluid dynamics (CFD) fire models are often used in fire protection engineering to predict complex flow fields for smoke control, estimate smoke detector and sprinkler activation times, and predict ignition and flame spread over combustible surfaces. However, the high spatial-temporal resolution comes at a computational cost, where simulation times are often measured in hours, days, or even weeks depending on the simulation.

An alternative method to model fires over large domains that has not been fully explored is to use a machine learning approach, which uses simplified functions to represent underlying connections between data to make estimates of future events. A key advantage of data-driven approaches is the simplified functions can be rapidly evaluated to make new predictions. This type of approach is primarily limited by the amount of data and computational requirements to train the model. Although machine learning has been used in multi-physics applications (such as storm surge, flood inundation, and climate modeling), the predictions have primarily been limited to estimates of a single quantity at a single point. This talk will present recent advancements made in using machine learning to predict spatially and temporally resolved fire behavior over large domains.

**Bio**: Dr. Hodges received his PhD in Mechanical Engineering from Virginia Tech in 2018. He is currently a lead engineer at Jensen Hughes in the Research, Development, Testing, and Evaluation group. His experience spans the topics of machine learning, robotics, multi-spectral optical sensors, remote sensing, and multi-physics modeling. His research interests focus on improving community resilience to natural hazards and changing environmental conditions using multi-scale autonomous and intelligent systems. He is currently involved in the Large Outdoor Fires & the Built Environment permanent working group with the International Association of Fire Safety Science (IAFSS), as well as the Local Fire Exposures working group with the Society of Fire Protection Engineers (SFPE).

**Date: Friday, Mar. 13th**
**Time: 3PM**
**Place: CB 110**
**Contact: Dr. Alexandre Martin 257-4462**

Meet the speaker and have refreshments
Attendance open to all interested persons

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