

# DEPARTMENT OF MECHANICAL ENGINEERING

## WILLIAM MAXWELL REED SEMINAR SERIES

### “Research Experiences and Future Directions in Nonlinear Dynamics”

Sam Stanton, Ph.D.

U.S. Army Research Office

**Abstract:** Nonlinearity is often seen as a detriment to dynamical systems design. Nonlinear systems may exhibit unpredictable input-output behavior, frequency-dependent oscillation amplitudes, and instabilities or self-excitation can lead to catastrophic failures. However, in some structures nonlinear behavior may be unavoidable and for certain applications such behaviors may instead be a feature. The primary portion of this talk concerns both the former and the latter with particular attention to the problem of vibrational energy harvesting. Therein, experimental evidence of strong intrinsic nonlinearity within electroelastic cantilever beams necessitates a modeling framework based on first principles to accurately describe higher order elasticity and nonlinear damping effects in real structures. From here, broader implications of the modeling framework concerning aeroelastic energy harvesting and passive nonlinear tuning for vibration control will be highlighted. Next, dynamical systems design to purposefully engage bistability for broadband energy harvesting in harmonic and stochastic environments will be discussed. A bifurcation parameter within the design is shown to be a useful tuning mechanism for enhanced sensitivity to ambient excitation.

In addition, this talk will begin with a brief overview of the Complex Dynamics and Systems Program at the Army Research Office and its efforts encompassing high-dimensional nonlinear systems and embodied dynamics and control. The talk will conclude with a set of future research directions that include nonlinear and non-Hermitian mechatronic lattices, the intersection of counter-diabatic driving and optimal control, and nonlinear mechanical computation.

**Bio:** Dr. Stanton earned his B.S. in Aerospace and Astronautical Engineering from the U.S. Naval Academy and his M.S. and Ph.D. in Mechanical Engineering from Duke University. His professional experiences span active duty as an officer in the U.S. Marine Corps, as a graduate fellow with the CIA, and as a program manager at the Army Research Office. Outside of teaching, research, and work, Dr. Stanton enjoys reading historical fiction and philosophy, sketching, and family adventures.

**Date:** Thursday, Mar. 5<sup>th</sup>

**Place:** CB 122

**Time:** 3PM

**Contact:** Dr. Alexandre Martin 257-4462

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