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# SIBLEY SCHOOL OF MECHANICAL AND AEROSPACE ENGINEERING

## COLLOQUIUM SERIES

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### *The Shoelace Catastrophe (or a Knotty Problem on a Shoestring)*



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Tuesday, September 3, 2019, 4:00 pm | B11 Kimball Hall  
Refreshments at 3:30 pm | 116 Upson Hall

#### **ABSTRACT**

The accidental untying of a shoelace while walking often occurs without warning. Modeling and simulating the unraveling is an exceptionally difficult task in part because of the wide range of length scales, time scales and parameters. Finding external funding to examine the problem is arguably an even harder problem.

In this talk, we present a set of hypotheses for the series of events that lead to a shoelace knot becoming untied. First, the repeated impact of the shoe on the floor during walking serves to loosen the knot. Then, the whipping motions of the free ends of the laces caused by the leg swing produce slipping of the laces. This leads to eventual runaway untangling of the knot. As demonstrated using slow-motion video footage and a series of experiments, the failure of the knot happens in a matter of seconds, often without warning, and is catastrophic. The controlled experiments showed that increasing inertial effects of the swinging laces leads to increased rate of knot untying, that the directions of the impact and swing influence the rate of failure, and that the knot structure has a profound influence on a knot's tendency to untie under cyclic impact loading. The research was conducted over a period of three years on weekends and spare time using borrowed equipment and laboratory space.

This talk is based on a paper, coauthored with Christopher Daily-Diamond and Christine Gregg, published in the Proceedings of the Royal Society: <http://bit.ly/KnotFailing> that captured widespread media attention.

#### **BIOGRAPHICAL SKETCH**

Oliver M. O'Reilly is a professor in the Department of Mechanical Engineering at the University of California at Berkeley. His research and teaching feature a wide range of problems in the dynamics of mechanical systems. He received his B.E. in Mechanical Engineering from the National University of Ireland, Galway (NUIG). Subsequently, he received his M.S. and Ph.D. degrees in Theoretical and Applied Mechanics from Cornell University in 1988 and 1990, respectively. He was a postdoctoral researcher at ETH-Zürich from 1990-1992. O'Reilly has received multiple teaching awards, including the Distinguished Teaching Award from U.C. Berkeley, published over 90 archival journal articles, written multiple textbooks and is a co-inventor on two patents. His latest book, coauthored with Alyssa Novelia and Khalid Jawed is a Primer on the Kinematics of Discrete Elastic Rods (Springer, 2018).