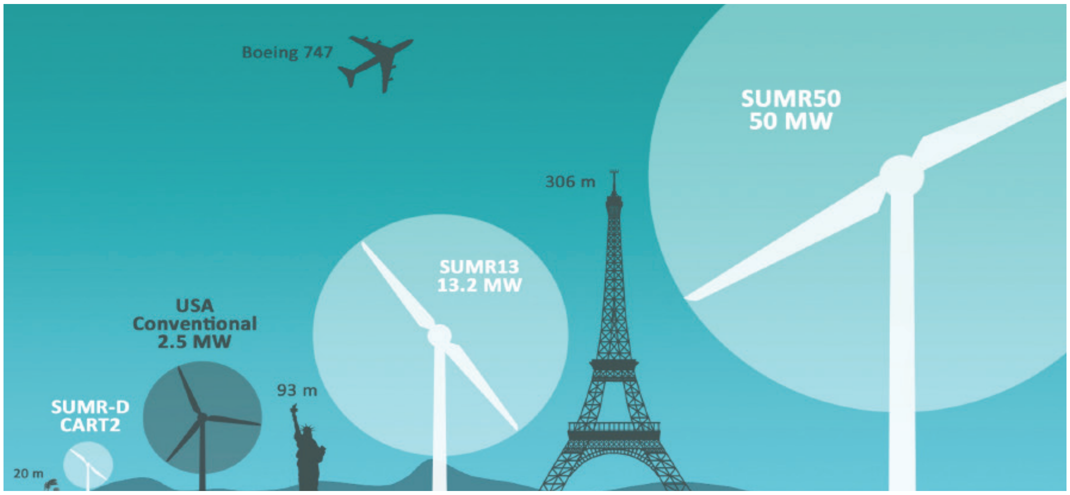
THE WILLIAM E. BOEING DEPARTMENT OF AERONAUTICS & ASTRONAUTICS welcomes

Rolls-Royce Commonwealth Professor **ERIC LOTH**

Chair, Mechanical and Aerospace Engineering Department
University of Virginia



"WILL A SEGMENTED ULTRALIGHT MORPHING ROTOR ALLOW THE WORLD'S LARGEST WIND TURBINE?"

ABSTRACT

To reduce the levelized cost of energy, wind turbines have become larger and larger with rated powers approaching 10 MW per turbine. However, the conventional upwind design is faced with several barriers for sizes much greater for extreme-scales (10 MW). This includes issues associated with increased gravity loads, increased flexibility, and inertial response. Herein, a novel concept is proposed which employs a downwind rotor with blades whose elements are relatively stiff (no intentional flexibility) but with hub-joints that can be unlocked to allow for moment-free downwind load alignment. Aligning the combination of gravitational, centrifugal, and thrust forces along the blade path reduces downwind cantilever loads, resulting in primarily tensile loading for a load-aligned coning angle. The concept is called Segmented Ultralight Moprhing Rotor (SUMR). To quantify potential mass savings, a downwind load-aligning rotor two-bladed was investigated with a near-hub hinge to allow morphing as a function of wind speed. For a 13 MW reference turbine, the morphing rotor had a significantly reduced mass as compared to a conventional design. The morphing schedule results in a downwind coning angle that varied linearly between cut-in and rated conditions. Aeroelastic analysis and unsteady simulations (e.g. at gust and off-design conditions) indicate this concept is feasible and may allow the world's largest wind turbine. However, there are challenges regarding tower shadow, blade segmentation, morphing mechanics and manufacturing. But there are also potential benefits via compressed air energy storage if an extreme-scale concept is achieved.

Monday, February 12, 2018
4:00 - 5:00 pm
Johnson Hall 075
UW Campus, Seattle, WA

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Chair's Distinguished Seminar Speaker

Eric Loth, Ph.D.

Rolls-Royce Commonwealth Professor and Chair of the Mechanical and Aerospace Engineering Department
University of Virginia

Biography

ERIC LOTH received his PhD in Aerospace Engineering at the University of Michigan in 1988 and started his teaching career at the University of Illinois, where he became Professor and Willet Scholar of Aerospace Engineering. He is currently a Rolls-Royce Professor and the Chair of Department of Mechanical & Aerospace Engineering at the University of Virginia. He has interst in fluid-structure interactions and energy systems, and his research on wind energy has been featured in Scientific American, CNBC, USA Today, MIT Technology Review, and Popular Science. Loth has authored over 200 publications and has received honors and awards from NSF, NASA, and the Department of the Navy. He is a Fellow of the AIAA and ASME and was named a Fellow of the National Center for Supercomputing Applications, and a Yip Fellow of Magdalene College of Cambridge University.

The William E. Boeing Chair's Distinguished Seminar Series brings scholars of national and international reputation who have made an impact in the field of aerospace engineering and beyond. This seminar series will cover a diversity of topics of current interest to those in academia, industry and the general public. It is our hope that these seminars will encourage an exchange of ideas and bring aerospace engineering and science to the forefront.

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