# DEPARTMENT OF MECHANICAL ENGINEERING
# WILLIAM MAXWELL REED SEMINAR SERIES

## "Nature-Inspired Stiffening and Inflatable Structure in Novel-concept Airplane Design"

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**Abstract:** The development in the manufacturing technologies allows us to employ nature-inspired stiffening in airplane design for improving aircraft performance. Nevertheless, these shape structures increase the complexity of the studied models, resulting in a computationally expensive design modeling problem. For an affordable design analysis, separating modeling approaches were proposed for a robust and cost-effective structural analysis of nature-inspired shape stiffening in wing skin design using curved stringers. Curved stiffeners were able to mitigate structural deformation peak (modify mode shape wavelength) for improving structural performance of structures subjected to both thermal and mechanical loads. The nature-inspired shape internal structural layout was able to achieve a lightweight structural design through a multidisciplinary design, analysis and optimization (MDAO) study where the test validated aeroelastic models were used. An additional benefit was observed by using both natural shape internal layout and nonuniform sized flaps in improving the aircraft performance through a multiobjective optimization study. The developed MDAO framework was leveraged and improved for a lightweight, tethered inflatable wing airplane design. The structural model considering the stiffening effect due to pressure induced prestress was studied and validated through experimental tests. The influence of tether and pressure induced prestress stiffening on inflatable wing's structural and aeroelastic responses was investigated using the improved MDAO tool.

**Bio**: Dr. Wei Zhao is currently a Research Associate in the Kevin T. Crofton Department of Aerospace and Ocean Engineering at Virginia Tech. He received his Ph.D. in Aerospace Engineering at Virginia Tech in August 2017. Dr. Zhao's research focus is on composite structures, inflatable wings, aeroelasticity and multidisciplinary design, analysis and optimization. He has published 11 journal articles, 8 of them as the first-author, on aerospace structures and novel-concept airplane designs. In addition, he has published more than 20 conference papers in various American Institute of Aeronautics and Astronautics (AIAA) organized conferences; two of which were by invitation in the AIAA SciTech forum. Dr. Wei Zhao actively participates in various professional services including serving as reviewers for around 20 different journals, and various AIAA organized professional conferences. Dr. Zhao is currently a professional member of AIAA. He has also chaired an AIAA SciTech 2021 forum session on composite structural design, analysis and tests. He is now serving as a topic editor on composite laminated structures for Journal of Composite Science.

**Date: Friday, Apr. 14th** **Time: 2:00PM EST**

**Place: https://uky.zoom.us/j/92940732923** **Contact: Dr. Alexandre Martin 257-4462**

Attendance open to all interested persons

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