THE WILLIAM E. BOEING DEPARTMENT OF

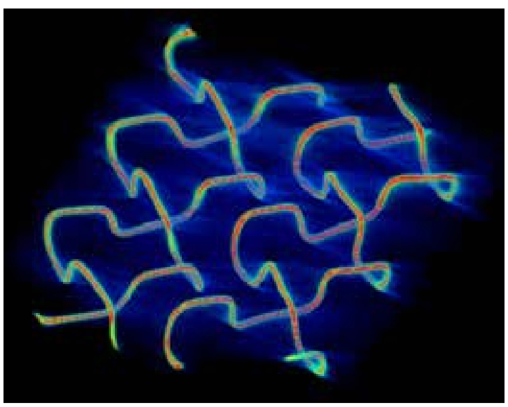
AERONAUTICS & ASTRONAUTICS

... welcomes ...

PHILIPPE H. GEUBELLE

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Multifunctional Microvascular Composites: Computational Analysis and Design



Inspired from many living organisms, microvascular composites form a new class of fiber-reinforced polymeric matrix composites that contain a circulatory system made of an embedded network of microchannels. Based on the choice of the fluid circulating in the microvascular network, a wide range of multi-functionalities are being considered for these materials, including autonomic healing of internal damage, switching embedded antennas, and active cooling for high temperature applications. A recent development in the manufacturing of this class of composites, based on specially treated sacrificial fibers that are woven in the original fabric, undergo the composite cure cycle before undergoing a vaporization process, has led to the creation of microvascular networks that are integrated directly into the composite microstructure. This technology is being considered for a variety of active cooling applications, including skin materials for hypersonic aircrafts, actively cooling of car batteries and radiative cooling of nanosatellites.

This new manufacturing process provides a lot of flexibility in the configuration of the embedded network. To assist with the material design process, a novel numerical tool based on an interface-based generalized finite element method (IGFEM) has been developed to model accurately and efficiently the impact of the coolant flowing through the microchannels on the thermal field in the composite. A gradient-based shape optimization scheme is then used together with the IGFEM solver to optimize the configuration of the embedded microchannel network based on a variety of objective functions and constraints. Various 2D and 3D configurations of the microchannels are investigated and compared, based on their thermal and flow efficiency and on their impact on the structural integrity of the composite. We also optimize the microchannel network for redundancy.

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DEPARTMENT OF AERONAUTICS & ASTRONAUTICS
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Monday, January 30, 2017 @ 4:00pm
Electrical Eng. Bldg. Rm 105 | UW Seattle

Visitor RSVP: contact@aa.washington.edu

THE WILLIAM E. BOEING DEPARTMENT OF
AERONAUTICS & ASTRONAUTICS

... Distinguished Guest Speaker ...

PHILIPPE H. GEUBELLE

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Bliss Professor and Head
Aerospace Engineering Department

Originally from Belgium, Philippe Geubelle got his M.S. and Ph.D. in Aeronautics at Caltech in 1989 and 1993, respectively. After a year as Postdoctoral Research Associate at Harvard, he joined the University of Illinois at Urbana-Champaign in January 1995, where he is currently Bliss Professor and Head in the Department of Aerospace Engineering, with joint appointments in Mechanical Science and Engineering, at the National Center for Supercomputing Applications and at the Beckman Institute of Advanced Science and Technology. He is also serving as Director of the Illinois Space Grant Consortium and Board President of the National Space Grant Foundation.

His research interests pertain to the theoretical and numerical treatment of complex problems in solid mechanics and materials, and, in particular, the multidisciplinary computational analysis and design of multifunctional, biomimetic materials, fracture mechanics, multiscale modeling of heterogeneous materials, composite manufacturing, and thin films for MEMS and microelectronics applications. Other research activities include computational aeroelasticity, structural/acoustic coupling and parallel programming.

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 monthly seminars will encourage an exchange of ideas and bring aerospace engineering and science to the forefront.

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