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Exploiting Additive Manufacturing for Cooling Turbine Airfoils

Karen A. Thole

Distinguished Professor and Department Head, Department of Mechanical Engineering, Pennsylvania State University, State College, PA

ABSTRACT:

Recent technological advances in the field of additive manufacturing (AM) have widened the design space for complex convective cooling designs. Using additive manufacturing allows for increasingly small and complex geometries to be fabricated with little increase in time or cost. The opportunity for gas turbine designers is to exploit the use of additive manufacturing in re-thinking cooling schemes for components. Interesting roughness features result when using laser powdered bed fusion (LPBF), which is a common additive manufacturing technique. The inherent roughness, in fact, can be used to improve convective heat transfer beyond that of engineered cooling designs. For example, when considering engineering cooling designs such as microchannels and pin fins, the resulting roughness from the additive process significantly enhances convective cooling. Roughness features can be controlled based on build direction, channel shape, and on build parameters.

BIOGRAPHY:

Dr. Karen A. Thole is a Distinguished Professor of Mechanical Engineering and Head of the Department of Mechanical Engineering at The Pennsylvania State University. Dr. Thole's expertise is heat transfer and cooling of gas turbine airfoils through detailed experimental and computational studies. At Penn State, Dr. Thole founded the Steady Thermal Aero Research Turbine Laboratory (START) lab, which houses a unique test turbine facility and is a center of excellence in heat transfer for a major gas turbine manufacturer. Dr. Thole has published over 230 archival journal and conference papers supervised over 65 dissertations and theses. She currently serves as a Governor on ASME's Board of Governors and is a member of NASA's National Aeronautics Committee. She has been recognized by the U.S. White House as a Champion of Change for STEM, the Rosemary Schraer Mentoring Award, and the Howard B. Palmer Faculty Mentoring Award. Dr. Thole also received the 2014 Society of Women Engineer's Distinguished Engineering Educator Award, the 2015 ASME George Westinghouse Gold Medal, the 2016 Edwin F. Church Medal and the 2019 AIAA Air Breathing Propulsion Award. She holds two degrees in Mechanical Engineering from the University of Illinois and a PhD from the University of Texas at Austin.