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Heat Transfer and Ice Accretion on Aircraft Wings in Supercooled Clouds

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ABSTRACT

The purpose of this presentation is to discuss the problems and challenges involved in modelling heat transfer and ice accretion on aircraft wings in supercooled clouds. Both the rime and glaze ice accretion regimes will be discussed. The presentation will also discuss the challenges involved in dealing with supercooled large droplets (SLDs). These are droplets that are 50 microns or larger and present extra challenges as they are more likely to break up, splash, and run back as they impact the wing surface. Results will be presented for the local collection efficiency, the water film thickness, and the heat transfer rate. A dynamic mesh strategy is employed to unsteadily account for the changes in the ice profile and its impact on the air and droplet flow by continuously reconstructing the computational grid at each time-step through smoothing and layering mechanisms. All main icing modules including the airflow field, droplet trajectory, icing thickness profile, and mesh management are fully coupled within the same computational framework without resorting to any external tools. Classical icing theory is employed to model the ice roughness, and a convective film heat transfer coefficient is computed based on the surface heat flux and a recovery temperature which considers the dissipative heat release in the boundary layer in the vicinity of the wing surface. With the implemented strategy and calculating the convective heat transfer coefficient, the water film thickness is also calculated along with the ice shape.

BIOGRAPHY

Dr. SA Sherif is Professor of Mechanical and Aerospace Engineering at the University of Florida. He is a Life Fellow of ASME, a Life Fellow of ASHRAE, a Fellow of the Royal Aeronautical Society, a Fellow of the American Society of Thermal and Fluids Engineers (ASTFE), an Associate Fellow of AIAA, a Vice President of Commission B-2 on Refrigerating Equipment of the International Institute of Refrigeration, a Member of the Advisory Board of Directors of the International Association for Hydrogen Energy, and a Founding Member of the Board of Directors and Vice President for Programs of ASTFE. He is the 2013-2014 Chair of the ASME Heat Transfer Division and the 2002-2003 Chair of the ASME Advanced Energy Systems Division. He currently serves as Editor-in-Chief of the ASME *Journal of Solar Energy Engineering* (2020-2025). He served as Editor-in-Chief of the ASME *Journal of Thermal Science and Engineering Applications* (2014-2019). He also served as Associate Editor, Subject Editor, or a Member of the editorial board of 28 other archival journals. Dr. Sherif has 160 refereed journal papers, one book, 20 edited bound volumes, 24 book chapters, 175 conference papers, 230 technical reports, and two US patents.