Vortex shedding leading to heat transfer rise in the vicinity of a rotationally oscillating heated plate

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The study of the vortices generated in the vicinity of rotationally oscillating flat plates presents an interest due to the enhanced local flow and surface thermal characteristics. This research is conducted to examine the impact of vortex shedding on the heat transfer rate in the vicinity of a rectangular flat plate of 0.3 m x 0.2 m at ambient conditions. The plate is rotated from rest, back and forth, over amplitude of 90° angle about a fixed edge; each face was heated with a constant heat flux. The computational fluid dynamics (CFD) software Fluent 6.3 was utilized to simulate the flow induced by the oscillatory motion of the plate, using the dynamic mesh method. Flow visualization techniques with smoke particles were utilized to analyze the flow nature around a fabricated laboratory model. During rotational oscillations of the plate, the local surface temperature was documented using small size J-types thermocouples. It was found from both experimental and computational methods that strong vortices developed over the plate's surface near its free edges, during flapping cycles. At end strokes, the shedding of these vortices disturbs significantly the plate's boundary layer leading to heat transfer enhancement at these locations. The time dependent surface temperature is characterized by a symmetrical spatial distribution. It increases through a transitory periodic phase before reaching steady periodic oscillations. This result can be useful in microelectronics cooling or in bioengineering to understand the importance of the flapping of elephants' pinnae in body heat dissipation.

Recent Publications


Biography

Moise Y Koffi completed his PhD in the year of 2014 from the City University of New York-Graduate Center. He is an Assistant Professor and Engineering Coordinator in the Mathematics Department of CUNY-Hostos Community College. He is the author of several publications and conference presentations in reputed journals. His investigation model is based on computational fluid dynamics (CFD) for the analysis of flow parameters and local surface thermal characteristics in the vicinity of flat and rotating devices. His research explores new locomotion and cooling techniques used in microelectronic applications as well as biological systems.

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