Heat Transfer in a Channel with Pin-Fins and Impingement

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Abstract

Pin-finned channels are commonly used in many heat exchange applications such as gas turbine cooling and thermal management of electronics. Pin fins increase the surface area for cooling and increase unsteadiness and turbulence that contribute to greater heat transfer. Another commonly used heat exchange technique is impingement cooling where a series of impingement holes are used to inject coolant on a facing plate. High heat transfer rates are encountered at the impingement location. In this approach, however, the downstream jets are adversely impacted by the crossflow. In this presentation we will first review the essential flow and heat transfer physics of the pin-fin and impingement cooling configurations using Large Eddy Simulations (LES) results as the data base for understanding the physics.

Combining pin-fins and impingement through innovative configurations may provide an opportunity for overcoming the adverse crossflow impacts as well as synergistically benefiting from both enhancement modalities. A new approach called incremental impingement has been recently proposed that shelters the impingement jets immediately behind the pin-fins to ameliorate the crossflow effects. The hole sizes and distributions can be used to tailor the heat transfer rate distributions. Results from detailed LES simulations will be shown to quantify the role of “sheltering” the jets and the effect of the hole sizes and their distributions.