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# Numerical Evaluation of Laminar Flow Heat Transfer Behavior in Triangular Pin-Fin Array Configurations

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## Abstract

This study numerically investigates the heat transfer characteristics of laminar forced convection in triangular pin-fin arrays for heat sink applications. Triangular configuration is analyzed with a uniform hydraulic diameter of 3.3 mm, pitch of 6.6 mm, and pitch-length-to-width ratio (PL/PW) of one. Numerical simulations are performed using ANSYS Fluent 2020 on a two-dimensional computational domain, with air as the working fluid at approach velocities ranging from 0.165 m/s to 4.5 m/s. Simplifying assumptions include steady-state laminar flow, negligible compressibility effects at low velocities, and isothermal fin surfaces due to the high thermal conductivity ratio of aluminum to air. Validation of the numerical model was conducted using circular pin fins, ensuring accuracy and reliability. Results are presented in terms of average Nusselt number as a function of Reynolds number for triangular pin fins, with findings showing that the Nusselt number for triangular pin fins is significantly higher than that for circular pin fins under identical conditions, including air velocity, pressure, and fin temperature. This demonstrates the enhanced heat transfer capability of triangular pin-fin arrays, and staggered triangular arrays exhibit competitive efficiency compared to conventional pin-fin geometries, highlighting their potential for compact and efficient thermal management in electronic and industrial applications.

## Keywords
Triangular Pin-fin, Heat Sink, Laminar Flow, Computational Fluid Dynamics (CFD), Nusselt Number