tegrated Flow Header for the Planar Heat Sink with Transverse and Oblique Channels

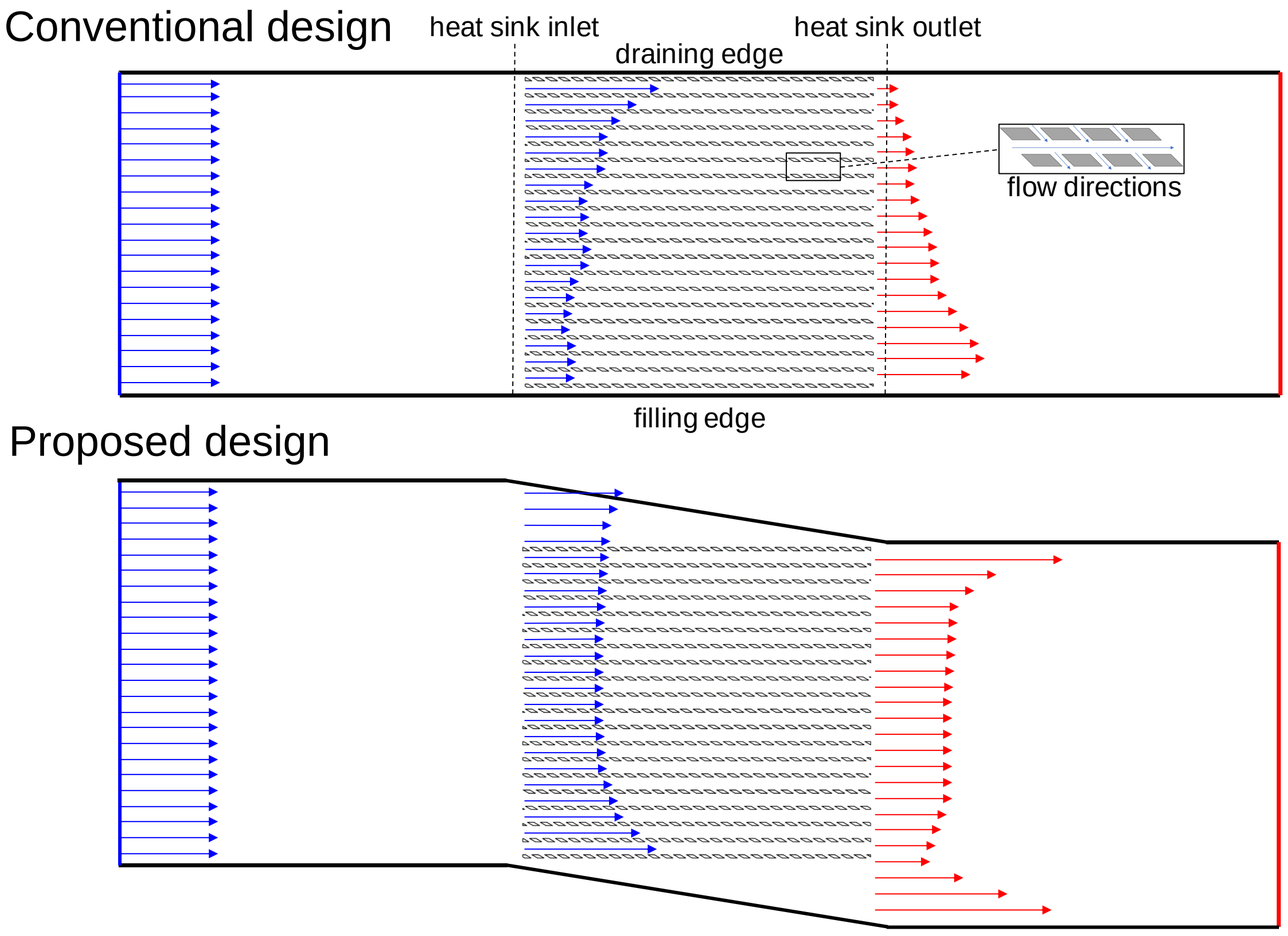
Inventors : Omer Bugra KANARGI, Poh Seng LEE
National University of Singapore

Industry Problem

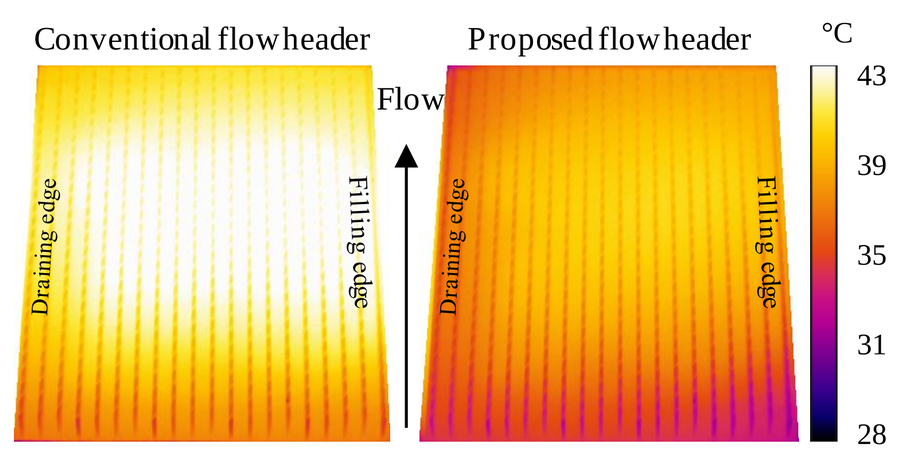
Thermal and hydraulic performances of a multichannel heat sink depend on how uniform the flow is distributed to the channels. Flow is to be properly manifolded at the heat sink inlet to ensure a uniform distribution. For the conventional straight channel heat sink, a good manifold is supposed to deliver flow to each and every one of the channels at equal rates. However, enhanced fin designs alter the flow field by inducing unusual flow phenomena, in some extreme cases, triggering maldistribution/migration of the flow through the heat sink. The planar heat sink with transverse and oblique channels provides remarkable improvement in the heat transfer performance, while at the same time it suffers from severe flow migration, especially at high flow rates.

Solution

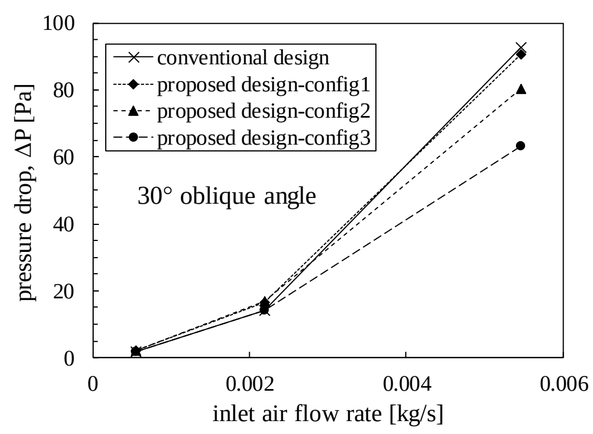
NUS researchers designed and implemented a novel inlet and outlet flow header for the planar heat sink with transverse and oblique channels (a.k.a. the oblique-finned heat sink in the literature). Even if the incoming flow is perfectly uniform at the inlet of the flow domain, the flow migration induced by the oblique channels result in a flow drainage near “the draining edge” and a flow accumulation near “the filling edge”. The resulting maldistribution of the flow compromises the thermal-hydraulic performance. The proposed flow header results in a more favorable distribution of flow through the planar oblique-finned heat sink, improving the thermal and/or hydraulic performances. The proposed solution can be implemented to planar oblique-finned heat sinks in macro/mini/micro dimensions for air or liquid cooling applications.



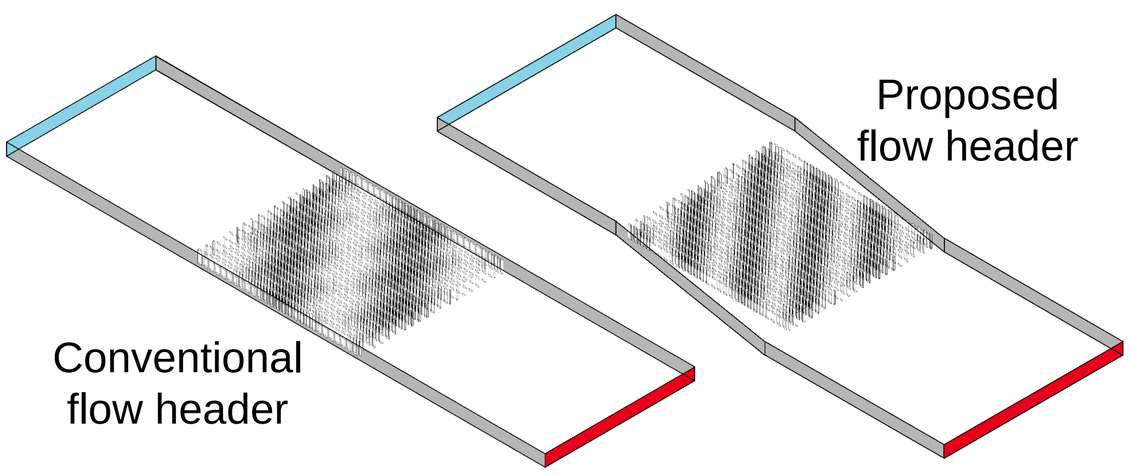
Comparison of heat sink inlet/outlet velocity profiles of the conventional and proposed flow headers



Comparison of heat sink wall temperature distributions (air cooling, infrared temp. meas.)



Comparison of pressure drops of air flow (numerical simulations)



Value Proposition

- Simple modification of the flow domain of the planar heat sink with transverse and oblique channels
- ❑ Applicable to air or liquid cooling in macro/micro dimensions
- ❑ Maintain lower heat sink temperature
- ❑ Improve temperature uniformity of the heat sink
- ❑ Decrease pressure drop penalty of the flow

For more information, contact:
NUS Industry Liaison Office, Mr Ma Mun Thoh
:+65 6516 6506
: ilommt@nus.edu.sg
: ilo.nus.edu.sg
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