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Enhancement of heat transfer by clamped flags in a Poiseuille channel flow. JAE BOK LEE, SUNG GOON PARK, BOYOUNG KIM, HYUNG JIN SUNG, KAIST — A pair of flexible flags clamped vertically in a heated channel was numerically modeled to study an enhancement of heat transfer by the clamped flags in a Poiseuille channel flow. The penalty immersed boundary method was adopted to analyze the fluid–structure–thermal interaction between the surrounding fluid and the clamped flags. The dynamics of the clamped flags was categorized into three distinctive modes: a flapping mode, a fully deflected mode, and an irregular mode. The distinctive modes that depended on the relationship between the hydrodynamic force and the restoring force displayed different movement patterns. The flapping mode provided superior thermal performance to the other modes. Vortices generated from the flapping flags swept out the thermal boundary layer and entrained the fluid near channel walls into the channel core flow while passing through the wake periodically. Compared to rigid flags, the flapping flags significantly improved the thermal efficiency. In addition, the effects of channel height and Reynolds number on the thermal efficiency were explored to obtain an optimal parameter set, which presented the highest thermal performance in present study. The flexible flags regarding the optimal parameter set showed an increase of up to 230% in net heat flux, compared to the baseline flow. Dynamic modes decomposition (DMD) method was adopted to examine the correlation between the vorticity and temperature fields.

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