Proceedings of the Canadian Society for Mechanical Engineering International Congress 2022
CSME Congress 2022
June 5-8, 2022, Edmonton, AB, Canada

Flow Stability in a Heated Channel with Longitudinal Grooves

S. Panday[1] & J.M. Floryan[2]
[1,2]Department of Mechanical and Materials Engineering,
Western University, London, Ontario, N6A 5B9, Canada.
*e-mail spanday2@uwo.ca

ABSTRACT

Streaks can play a vital role in mixing intensification. The formation of streaks and rolls can be controlled by utilizing spatially distributed heating patterns. The combination of these heating patterns in addition to the surface topographies results in pattern interaction problems and has the potential to create streaks with the minimum energy expenditure. It is known that the use of longitudinal grooves leads to chaotic stirring due to the recently discovered instability waves. Such stirring can prove to be beneficial for mixtures of delicate constituents. Here, a linear stability analysis has been performed to search for critical conditions required for the onset of similar instabilities in streak structures in a heated longitudinal grooved channel. A spectrally accurate algorithm has been developed for the stability analysis. The algorithm relies on the combination of Fourier expansion in horizontal directions and Chebyshev polynomial in the normal direction and uses Immersed Boundary Conditions (IBC) method to handle geometric irregularities at the boundary. The algorithm is suitable for studying three-dimensional disturbances in the form of traveling waves.