--Proceedings of CHT-15
ICHMT International Symposium on Advances in Computational Heat Transfer

May 25-29, 2015, Piscatway, USA

CHT-15-192

Some effects of Görtler flow secondary instabilities in the heat transfer

Vinicius Malatesta [*,§], Leandro F. de Souza[**]
*Mobility Engineering Center, Federal University of Santa Catarina, Santa Catarina, Brazil
[**]Dept. Applied Math. and Statistics, University of São Paulo, São Carlos, São Paulo, Brazil
[§]Correspondence author. Email: vinicius.malatesta@ufsc.br

ABSTRACT: The centrifugal instability mechanism in boundary layers over concave surfaces is responsible for the development of counter-rotating vortices, aligned in the streamwise direction, known as Görtler vortices. These vortices create two regions in the spanwise direction, the upwash and downwash regions. The downwash region is responsible for compressing the boundary layer towards the wall, increasing the drag coefficient and the heat transfer rate. The upwash region does the opposite. The Görtler vortices distort the streamwise velocity profile in the spanwise and the wall-normal directions. These distortions generate inflections that are unstable to non stationary disturbances giving rise to secondary instabilities. In these flows the secondary instabilities can be of varicose or sinuous mode. The present paper analyses the heat transfer in a flow over a concave wall subjected to secondary instabilities. The research is carried out by a Spatial Direct Numerical Simulation. The results show that the flow with Görtler Vortices enhances the spanwise average heat transfer rate. The rates can reach higher values than the turbulent ones. The higher heat transfer is caused by the mean flow distortion induced by the vortices. This is observed before high-frequency secondary instabilities sets in. The secondary instabilities keeps the heat transfer rate in values higher than turbulent ones in a small region. After this region the heat transfer rate has a tendency to reach the turbulent values.