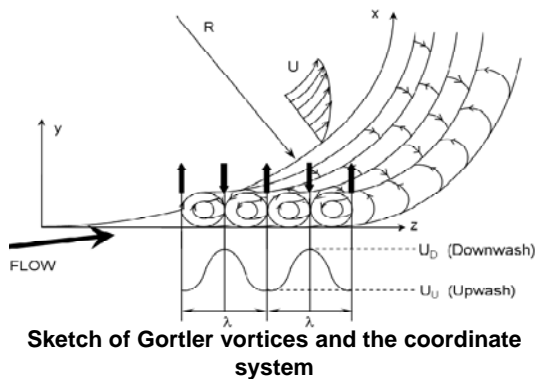


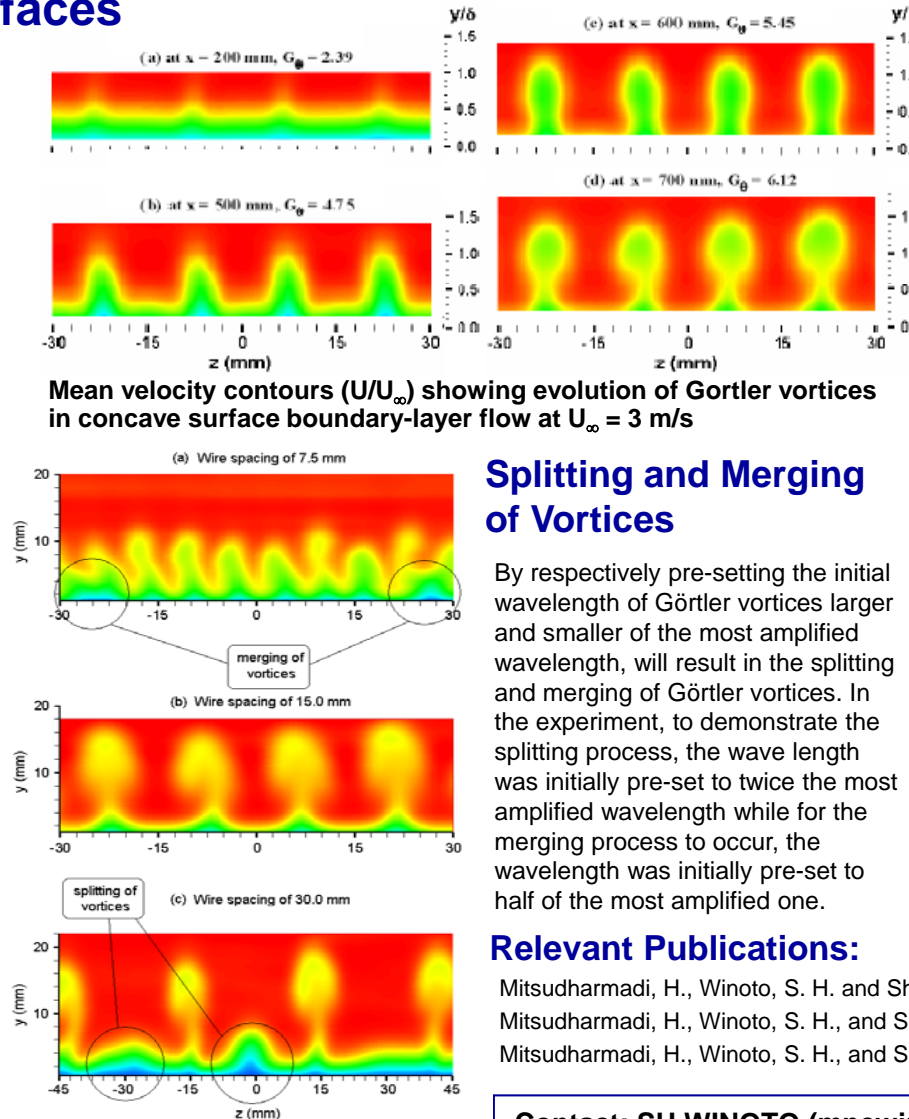
## Flows over concave surfaces

Flow over concave surface is subjected to centrifugal instability which will result in the occurrence of streamwise counter-rotating Görtler vortices in the boundary layer developed along the surface. Because this flow configuration can be found in many fluid engineering applications, such as turbine blades and aerofoils, numerous studies on the vortices have been reported since the first work on this phenomenon by H. Görtler in 1940. This is due to the effects of the vortices on boundary layer development, heat transfer and deposition (where applicable) which are important.



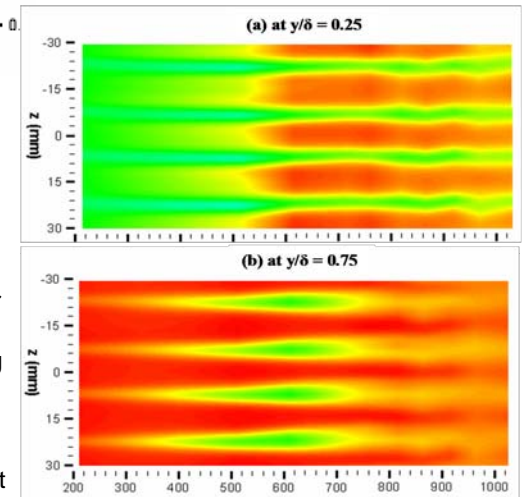
Experimental study is being carried out in laminar boundary layer flows over concave surfaces of different radius of curvature. Unlike naturally developing Görtler vortices with non-uniform wavelengths which make investigation difficult, the wavelengths of Görtler vortices in this experiment are pre-set so to create Görtler vortices with the desired uniform wavelengths. The aim is to develop a method to control the development of the vortices, that is, either to suppress or enhance them.

**Splitting and merging of Gortler vortices**



## Amplification of Vortices

Assuming that only the vortices with maximum amplification will appear in the experiment, a method to predict the most amplified wavelength of Görtler vortices in laminar boundary layer flows over concave surfaces, has been proposed based on the Görtler vortex stability diagram and experimentally confirmed.



**Mean velocity contours ( $U/U_\infty$ ) in the x-z plane at  $U_\infty = 3$  m/s**

## Splitting and Merging of Vortices

By respectively pre-setting the initial wavelength of Görtler vortices larger and smaller of the most amplified wavelength, will result in the splitting and merging of Görtler vortices. In the experiment, to demonstrate the splitting process, the wave length was initially pre-set to twice the most amplified wavelength while for the merging process to occur, the wavelength was initially pre-set to half of the most amplified one.

## Relevant Publications:

- Mitsudharmadi, H., Winoto, S. H. and Shah, D. A. (2004) *Phys. Fluids*, 16, pp3983-3996.
- Mitsudharmadi, H., Winoto, S. H., and Shah, D. A. (2005) *Phys. Fluids*, 17:124102.
- Mitsudharmadi, H., Winoto, S. H., and Shah, D. A. (2006) *Phys. Fluids*, 18: 014101.

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