fluid dynamics research group

Curtin University

FDRG Seminar

Impulsively excited disturbances in non-uniform boundary layers: spatially inhomogeneous and temporally oscillatory cases

presented by

Dr Christopher Davies
Reader in Applied Mathematics,
School of Mathematics,
Cardiff University

Results will be presented for the linearized disturbance impulse response of non-uniform boundary layers. Two distinct forms of boundary layer non-uniformity have been studied.

Firstly, we consider temporally steady rotating disc boundary layers, where there is a spatial inhomogeneity which stems from the radially increasing circumferential velocity. This turns out to have a very significant impact on the radial propagation of disturbances and their long-term growth behaviour. For example, the introduction of flow control measures such as surface suction, which are chosen to be locally stabilizing, can in fact lead to a global destabilisation. Moreover, this destabilisation may be associated with a novel kind of faster then exponential disturbance growth.

The second type of boundary layer non-uniformity that we will consider allows us to address the effects of base-flow unsteadiness on the global development of disturbances. We conducted simulations for the oscillatory Stokes layer that is driven by the time-periodic in-plane motion of a bounding flat plate. The unsteadiness was found to give rise to multiple wavepackets for the impulse response, which displayed an intricate tree-like spatial-temporal structure. It was also discovered that absolute instability could be promoted by adding a low-amplitude background of noise, in the form of high frequency harmonics to the oscillation of the bounding wall.

For both types of flow configuration, we will illustrate various features of the new patterns of behaviour that were discovered. These had not been anticipated by previous studies for simpler configurations, where a steady in time boundary layer could be treated as being approximately spatially homogeneous, along a dominant propagation direction.

The aim will be to provide an overview and to highlight some of the novelties.

Date:	Wednesday 23rd November
Time:	3.30pm – 4.30 pm
Location:	Building 204, Room 505 Curtin University, Bentley Campus

No RSVP required. For queries please email:
fdrg@curtin.edu.au