Laminar-Turbulent Transition of Boundary-Layer Flow over Rough Rotating Disks

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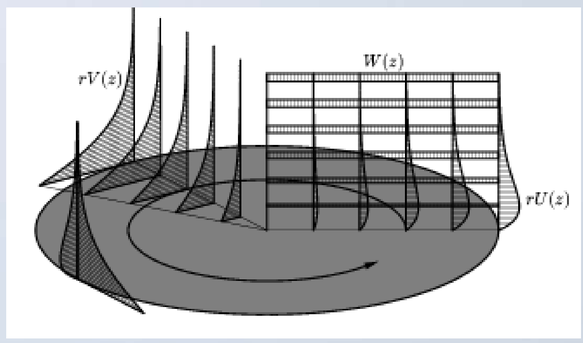
Boundary-layer flow is the fluid motion in the immediate vicinity above a solid wall. Laminar-turbulent transition refers to that process whereby an initially regular flow becomes chaotic.

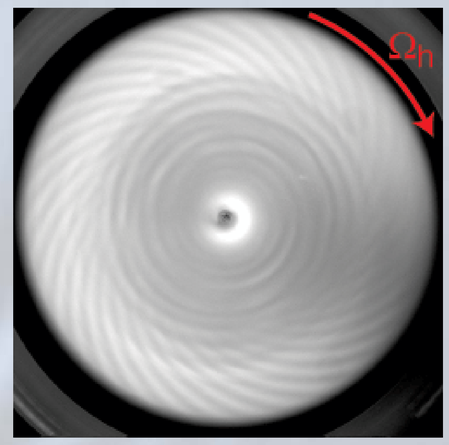


Velocity profile over rotating disk

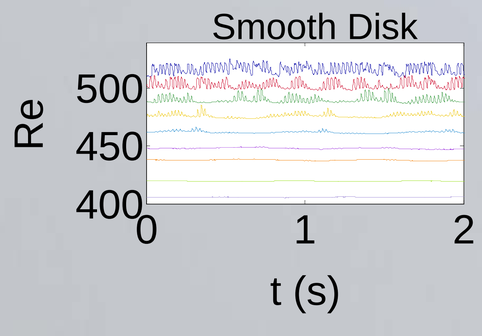
Trailing vortices Boeing 777-236

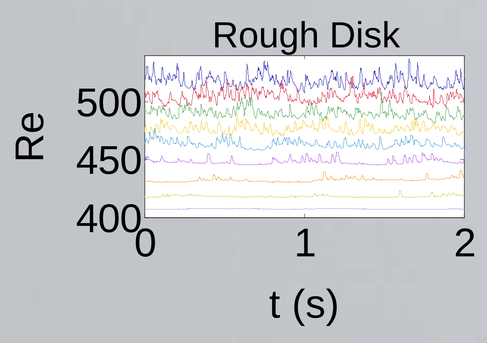
Flow dynamics in the boundary layer are of crucial importance to performance characteristics of cars, boats and aeroplanes. Wall roughness can crucially affect boundary-layer flows. Smooth surfaces usually result in smaller drag forces.

For several decades the rotating-disk boundary layer has been the paradigm employed to study fully three-dimensional boundary-layer flow (for example: on aero-plane swept wing). We studied the effects of wall roughness on the rotating-disk boundary-layer flow.



Formation of vortices above rotating disk





The interpretation of the experimental results obtained (left: velocity profiles, right: amplitude frequencies), suggest the existence of a completely new boundary layer transition route for fully three-dimensional boundary-layer flows, and thus probably for the wings of aeroplanes.