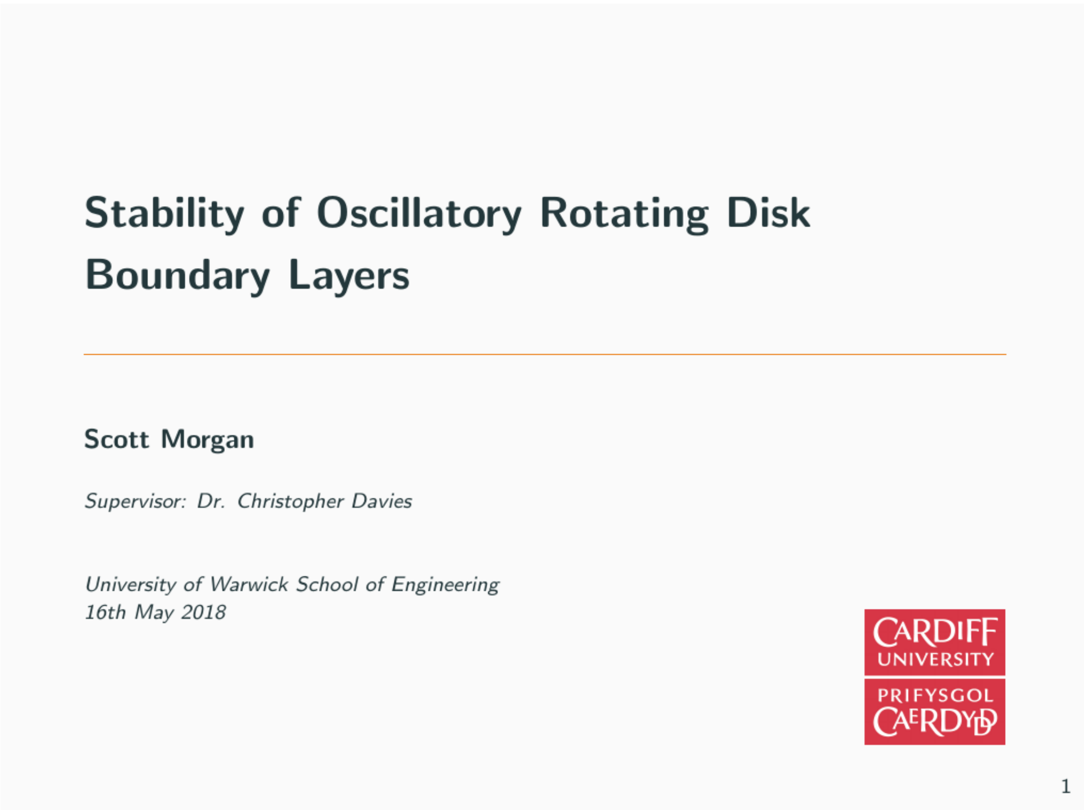
Surface Roughness and the Rotating Disk Boundary Layer

Scott Morgan

Between 1-3 April and 16-17 May 2018, this project consisted of two visits; one to Leicester University (Prof. Stephen Garrett) and the other to Warwick University (Prof. Peter Thomas) to study the concept of developing novel drag reduction techniques by designing surface roughness in the rotating disk boundary layer.

This boundary layer is considered an archetypal model for studying the stability of three-dimensional boundary-layer flows, being one of the few truly three dimensional configurations for which there exists an exact similarity solution of the Navier-Stokes equations. The crossflow inflexion point instability mechanism is common to both the rotating disk boundary layer and the flow over a swept wing, and thus the investigation of strategies for controlling disturbances developing in the rotating disk flow may prove to be helpful for the identification and assessment of technologies that have the potential to maintain laminar flow over swept wings.

Building on links developed through the SIG "Boundary layers and complex rotating flows", and further enhancing partnerships between the three research groups at Cardiff, Leicester and Warwick, this project was successful in developing ideas for future potential projects. Both trips also involved meetings with Dr. Paul Griffiths (Coventry University) who is also conducting research in this field and as part of the project, I was invited to give a seminar talk at Warwick exploring similarities between the roughness studies and the work conducted during my PhD.



The visits themselves consisted of informal discussions and several interesting ideas arising over copious amounts of coffee. The Warwick visit also incorporated a tour of the experimental facility, along with discussions pertaining to potential future collaborative proposals between the computational and experimental departments involved in this project.

Moving forward from these short research visits, the intention in the short term is to submit a paper confirming recent local analyses on surface roughness by direct numerical simulations and in the longer term, to submit a funding application based around the fundamental science of rotating flows with far-reaching implications in wider fluids. I am personally very grateful to the UK Fluids Network for providing the funding to enable these visits.