# The effects of surface roughness on the stability of the Ekman boundary layer and related flows

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**Long Abstract**

## Introduction

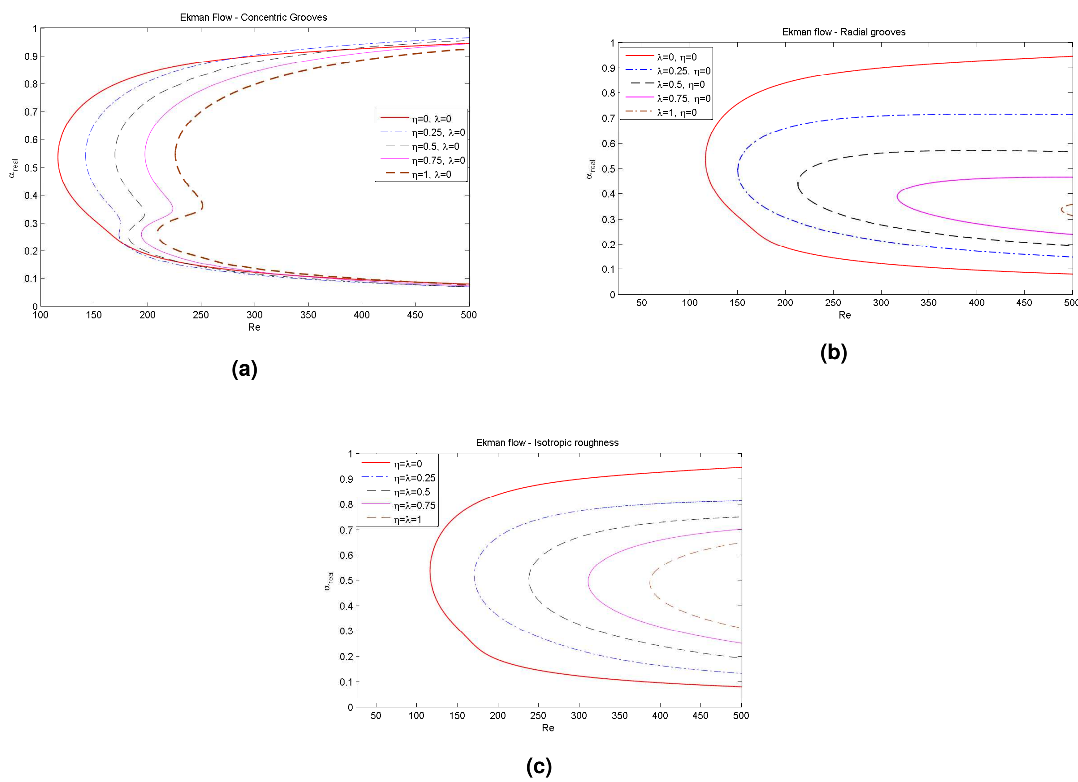


**Figure 1.** Neutral curves of Ekman flow over rough disks. (a) anisotropic roughness - concentric grooves, (b) anisotropic roughness - radial grooves, and (c) isotropic roughness

Carefully designed surface roughness could lead to new drag reduction techniques for flows related to that over a rotating disk. Three well known rotating flows are the Bödewadt, Ekman and von Kármán flows, each distinguished by a different rotation rate of the lower disk relative to the upper fluid. Collectively this family is called the BEK system. In this study, a numerical approach to determine the effects of surface roughness on the convective instability over the lower disk is presented. The work is related to that recently published by Cooper et al. [1] on the rough von Kármán flow.

## 1. Methods

In this present study a partial-slip method is used to model stationary disturbances over disks with both isotropic and anisotropic surface roughness. We begin by finding the mean-flow components on which we perform linear stability analyses using a spectral method involving Chebyshev polynomials.

Figures 1(a) and (b) demonstrate that increased levels of anisotropic roughness (envisaged as a concentrically grooved disk) is retarding the occurrence of the Type I (cross flow) instability mode in terms of the critical Reynolds number, and also narrowing the range of unstable flow parameters for Ekman flow. However, the Type II (streamline curvature) mode is found to be promoted by anisotropic roughness. In contrast, Figure 1(c) shows isotropic roughness (envisaged as a regular distribution of roughness) is strongly stabilising to both Type I and Type II modes for Ekman flow.

The final version of this paper will update the reader on the latest results of our ongoing study.

## References

[1] A. J. Cooper, J. H. Harris, S. J. Garrett, M. Ozkan and P.J. Thomas
*The effect of anisotropic and isotropic roughness on the convective stability of the rotating disk boundary layer*. *Phys. Fluids*, **27**, 014107.