Review of *A boundary integral equation approach to computing eigenvalues of the Stokes operator* by T. Askham and M. Rachh

Summary

This manuscript presents a boundary integral equation technique for computing the eigenvalues and eigenfunctions for Stokes boundary value problems. The eigenvalue problem involves a Helmholtz type problem where the waves speed is dependent on the number of the eigenvalue in question. Spacial discretization techniques such as finite element and finite difference methods will have trouble solving for large eigenvalues due to the pollution effect. By using boundary integral approach, the presented work is able to avoid this problem. The manuscript provides proofs that the eigenvalues of the associated integral equation are the same as those of the boundary value problem and number results illustrating the performance of the proposed technique.

Given the novelty of the proposed method, this referee recommends the manuscript for publication once the comments below are addressed.

Specific Comments

(1) In the abstract and introduction the authors talk about the so-called pollution effect with no reference to the Helmholtz problem or what high frequency regime means for this problem. Thus unless the reader has experience with Helmholtz problems (may not be the case for people interested in Stokes problems), they will not understand the associated numerical challenges. This should be clarified.
(2) On page 3 line 31, what is meant by "current grid?"
(3) On page 5 line 36, should $\exists \phi_0$ read $\exists \phi_0 \in X$?
(4) On page 28 line 38, is the linear system C_k^N also discretized with generalized Gaussian quadrature?
(5) In Figure 6, a plot of $O(N \log N)$ would be more helpful than $O(N)$ since that is the expected scaling.