Abstract Submitted
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Vortex Design Problem[1] BARTOSZ PROTAS, McMaster University — In this investigation we are concerned with a family of solutions of the 2D steady–state Euler equations, known as the Prandtl–Batchelor flows, which are characterized by the presence of finite–area vortex patches embedded in an irrotational flow. We are interested in flows in the exterior of a circular cylinder and with a uniform stream at infinity, since such flows are often employed as models of bluff body wakes in the high–Reynolds number limit. The "vortex design" problem we consider consists in determining a distribution of the wall–normal velocity on parts of the cylinder boundary such that the vortex patches modelling the wake vortices will have a prescribed shape and location. Such inverse problem have applications in various areas of flow control, such as mitigation of the wake hazard. We show how this problem can be solved computationally by formulating it as a free–boundary optimization problem. In particular, we demonstrate that derivation of the adjoint system, required to compute the cost functional gradient, is facilitated by application of the shape differential calculus. Finally, solutions of the vortex design problem are illustrated with computational examples.

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Bartosz Protas
McMaster University

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