Topological fluid mechanics of the formation of the Kármán-vortex street

We explore the two-dimensional flow around a circular cylinder with the aim of elucidating the changes in the topology of the vorticity field that lead to the formation of the Kármán vortex street. Specifically, we analyse the formation and disappearance of extremal points of vorticity, which we consider to be feature points for vortices. The basic vortex creation mechanism is shown to be a topological cusp bifurcation in the vorticity field, where a saddle and an extremum of the vorticity are created simultaneously. We demonstrate that vortices are first created approximately 100 diameters downstream of the cylinder, at a Reynolds number, ReK, which is slightly larger than the critical Reynolds number, Recrit~46, at which the flow becomes time periodic. For Re slightly above ReK, the newly created vortices disappear again a short distance further downstream. As is further increased, the points of creation and disappearance move rapidly upstream and downstream, respectively, and the Kármán vortex street persists over increasingly large streamwise distances.

General information
Publication status: Published
Organisations: Department of Applied Mathematics and Computer Science, Mathematics, University of Manchester, Ecole Centrale de Lyon
Contributors: Heil, M., Rosso, J., Hazel, A. L., Brøns, M.
Pages: 199-221
Publication date: 2017
Peer-reviewed: Yes

Publication information
Journal: Journal of Fluid Mechanics
Volume: 812
ISSN (Print): 0022-1120
Ratings:
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 3.33 SJR 1.591 SNIP 1.702
Web of Science (2017): Impact factor 2.893
Web of Science (2017): Indexed yes
Original language: English
Keywords: Topological fluid dynamics, Vortex shedding, Vortex streets
Electronic versions:
div_class_title_topological_fluid_mechanics_of_the_formation_of_the_karman_vortex_street_div.pdf

DOIs:
10.1017/jfm.2016.792
Source: FindIt
Source-ID: 2350153412
Research output: Contribution to journal › Journal article – Annual report year: 2017 › Research › peer-review