**XI International Conference on Computational Methods in Marine Engineering**

# Cavitating flow past a circular cylinder in the Drag Crisis Regime

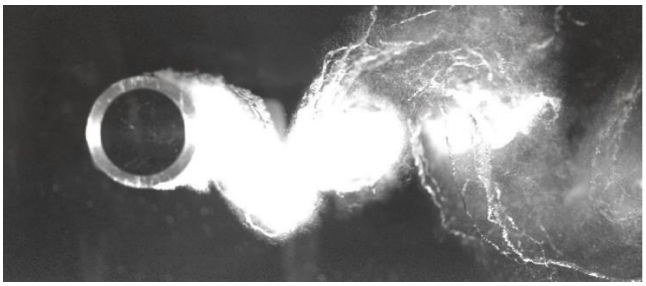
V. Massip[1], B. Lescanne[1] and P. Bot[1,*]

[1] Arts et Métiers Institute of Technology, IRENav, CC600 29240 BREST Cedex 9, France.

[*] Corresponding Author: patrick.bot@ecole-navale.fr.

## ABSTRACT

The flow around a circular cylinder is a classical case study in fluid dynamics that received a lot of attention and gave rise to a huge amount of literature, because it shows a complex and rich behaviour (see for example Zdravkovich 1997 for a review). A well-known phenomenon that contradicts common intuition is the so-called *Drag Crisis*: a sudden drop of the drag coefficient when the Reynolds number reaches a critical value of order $10^5$ (the exact value depends on the geometry, free stream turbulence and surface roughness, see Achenbach 1971). Cavitation is another phenomenon largely studied in hydrodynamics, particularly on highly loaded lifting surfaces such as propeller blades and hydrofoils (Brennen 1995). Cavitation around circular cylinders has been studied in the past (e.g. Gnanaskandan 2016, Brandao 2020), but no information is given on the effect of cavitation on the drag crisis phenomenon. This work presents an experimental investigation of cavitation in the flow around a circular cylinder in the critical regime ($Re \sim 10^5$). In such conditions, the cylinder undergoes strong fluctuating forces and classical force measuring systems commonly used in hydrodynamic tunnels are not appropriate, as they are violently shaken and may be damaged. A more robust system to measure the hydrodynamic forces was then developed by setting strain gauges directly on the cylinder itself. Cavitation is also visualised with high-speed cameras. It is shown that with a little of cavitation (cavitation number $\sigma$=3.5 and 3), the drag coefficient is reduced in the subcritical regime, and the drag crisis is slightly anticipated: critical Reynolds number $Re_c=2.5\ 10^5$, compared to $Re_c=2.7\ 10^5$ in the non-cavitating flow. When cavitation is strongly developed, in the supercritical regime ($Re_c > 2.5\ 10^5$; $\sigma$=2.5), the drag coefficient is much higher than without cavitation.



**References**

E. Achenbach. Influence of surface roughness on the cross-flow around a circular cylinder. Journal of Fluid Mechanics, **46**:2, 321‑335, 1971.

F.L. Brandao, M. Bhatt, K. Mahesh. Numerical study of cavitation regimes in flow over a circular cylinder. J. Fluid Mech., 885:A19. 2020. doi:10.1017/jfm.2019.971

C.E. Brennen. Cavitation and Bubble Dynamics. New York: Oxford University Press, 1995.

A. Gnanaskandan and K. Mahesh. Numerical investigation of near-wake characteristics of cavitating flow over a circular cylinder. J. Fluid Mech 790, 453{491, 2016.

M. M. Zdravkovich, Flow around Circular Cylinders, Fundamentals, (Oxford University Press, Oxford, Vol. 1, 1997.