A multi-scale methodology to assess the cavitation erosion risk on a twisted hydrofoil

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ABSTRACT

The aim of the current paper is to evaluate the cavitation erosion on a Delft twisted hydrofoil using an Euler-Lagrange methodology. The transport equation modelling approach is introduced to handle the macroscopic liquid-vapor mixture, which is regarded as a homogeneous continuum. The Keller-Herring equation and bubble motion equation are used to track the bubble's dynamics and trajectory. A two-way coupling method is employed to describe the interaction between the mixture and bubbles. A newly developed Lagrangian erosion model is used to assess the cavitation erosion on the hydrofoil. The numerical results are in good agreement with the experimental test data. The quantitative statistical results reveal the evolution characteristics of cavitation erosion. The relationship between macroscopic cavitation structure and potential erosion sensitive zone reveals the risk intensity of cavitation erosion at different stages of cloud cavitation. This study contributes to a deeper understanding of the mechanism of cavitation damage from a multi-scale perspective.

REFERENCES

[1] Z. Y. Wang, H. Y. Cheng, and B. Ji, "Euler–Lagrange study of cavitating turbulent flow around a hydrofoil," *Phys. Fluids.*, Vol. 33, pp. 112108, (2021).

[2] Z. Y. Wang, H. Y. Cheng, and B. Ji, "Numerical prediction of cavitation erosion risk in an axisymmetric nozzle using a multi-scale approach," *Phys. Fluids.*, Vol. 34, pp. 062112, (2022).