DEPARTMENT OF AEROSPACE ENGINEERING

FMLAB

Computer Vision Algorithms Application for Tracking and Characterization of Non-Spherical Bubbles in Cavitating Flows

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In [1], computer vision (CV) algorithms have been employed to non-intrusively extract quantitative data from high-speed imaging of the bubble spatial–temporal evolution, breakup dynamics, and cavitation inception mechanisms in aviation fuels flowing in a stable liquid state inside the diverging portion of a CD nozzle. In this project, we reproduced these algorithms and further extended them with new bubble tracking capabilities by adapting Kalman filter-based existing CV functions from MATLAB Computer Vision Toolbox. The novel procedure was first tested and validated in a controlled set of toy problems that simulated various scenarios of bubble kinematic behavior, including tracking bubble rapid growth and collapse that was simulated via the Rayleigh–Plesset equation. Then, we utilized our tracking code on existing experimental data from [1]. Our extended CV procedure allows us to obtain unprecedented new quantitative data on non-spherical bubble kinematics that could not be obtained previously with [1]; these include monitoring bubble size evolution along Lagrangian paths of each individual bubble after the breakup. This information has great importance in characterizing and modeling complex bubble dynamics mechanisms in cavitating flows.

References

[1] I. Gluzman and F. O. Thomas, "Characterization of bubble dynamics in the nozzle flow of aviation fuels via computer vision tools," Int. J. Multiph. Flow, p. 104133, 2022.

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