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## Droplet deformation and breakup in the shoulder region of an aerodynamic surface: Experimental characterization

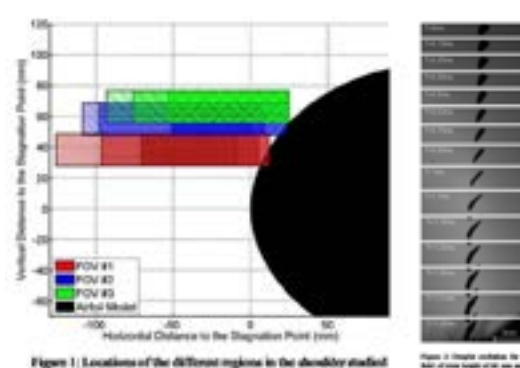
Adelaida Garcia-Magariño<sup>2</sup>, Suthyvan Sor<sup>1</sup> and Angel Velázquez<sup>3</sup><sup>1</sup>National Institute for Aerospace Technology, Spain<sup>2</sup>Isdefe, Spain<sup>3</sup>Technical University of Madrid, Spain

**Statement of the Problem:** To study droplet aero breakup, many theoretical and experimental studies (based, mostly, on shock tube type facilities) have been carried out in nearly constant high flow velocity conditions. However certain applications of aeronautical engineering interest are characterized by accelerating flow profiles and the flow velocity profile has influence on the droplet deformation and breakup processes. Previous studies concern droplets in the stagnation line of the leading edge of an airfoil, while this investigation studies the behavior of the droplets in the shoulder region of an incoming airfoil.

**Methodology & Theoretical Orientation:** Experimental tests were conducted in the rotating arm facility at INTA. A blunt airfoil model of chord 0.47 m was mounted at the end of the rotating arm of length 2.2 m that moved at 50, 70 and 90 m/s. A stream of water droplets of diameter of 1000  $\mu\text{m}$  was allowed to fall in the path of the airfoil. The air velocity observed by the droplets, which was continuously increasing, was characterized using PIV. The phenomenon was recorded by a high-speed camera at 72000 fps using the shadowgraph illumination technique. Droplets trajectories and deformations were obtained in three different regions close to the airfoil shoulder (Figure 1).

**Findings:** The results show that droplets in the shoulder region tend to rotate providing new structures, different from those obtained in the stagnation line (Figure 2). The rotation generates interferences between droplets that have been quantified using an existing theoretical model derived for droplets in the stagnation line.

**Conclusion & Significance:** Deformation of droplets in the shoulder region of an airfoil has been studied for nine cases corresponding to three different airfoil velocities and three fields of view height. In these regions droplets tend to tilt significantly, which causes aerodynamic interferences between consecutive droplets.



### Biography

Adelaida Garcia-Magariño became aerospace engineer in the end of 2009 and started working at INTA in the beginning of 2010 as an external consultant. She has been involved in the NASA/INTA cooperation on Icing (2010-2016), in which she has developed her PhD on droplet deformation, and breakup near the leading edge of an airfoil and has authored more than 10 papers related to Icing Physics. She is now involved in National projects (DFLOW, MEDA, MICRA) funded by the Spanish Ministries of Economy and Competitiveness.

adegarmag@gmail.com