Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Development of a Digital Image Projection (DIP) Technique to Quantify Wind Driven Water Droplet/Rivulet Flows over a NACA 0012 Airfoil[1] HUI HU, KAI ZHANG, Iowa State University — A digital image projection (DIP) technique is developed to achieve non-intrusive thickness measurements of wind-driven water droplet/rivulet flows. The DIP technique is based on the principle of structured light triangulation in a similar manner as a stereo vision system but replacing one of the cameras for stereo imaging with a digital projector. A grid pattern of known characteristics is projected onto a test object (i.e., the droplet/rivulet over the test plate). Due to 3D shape profile of the test object, the projected grid pattern is deformed seen from a perspective different from the projection axis. By comparing the distorted image over the test object and a reference image, the 3D profile of the test object with respect to the reference plane (i.e., the thickness distribution of the droplet/rivulet flow) can be retrieved quantitatively and instantaneously. The DIP system is used to quantify the dynamic shape change and stumbling runback motion of the wind-driven water droplet/rivulet flows over a NACA0012 airfoil. Such information is highly desirable to elucidate the underlying physics to improve our understanding about the surface water transport process pertinent to ice formation and accretion over aircraft wings in atmospheric icing conditions.

[1]The research work is funded by NSF and NASA.

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Date submitted: 19 Jul 2013 Electronic form version 1.4