Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Development of a Digital Fringe Projection Technique to Quantify the Transient Behavior of Wind-Driven Surface Droplet/Rivulet Flows[1] KAI ZHANG, SONG ZHANG, HUI HU, Iowa State University — A novel digital fringe projection (DFP) technique is developed to achieve non-intrusive thickness measurements of wind-driven water droplet/rivulet flows. The DFP 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. The digital projector is used to project a fringe pattern of known characteristics onto a test object (i.e., the water droplet/rivulet on the test plate). Due to the 3D shape profile of the test object, the fringe pattern is deformed seen from a perspective different from the projection axis. By comparing the distorted fringe pattern over the test object and a reference fringe pattern on a reference plane, the 3D profile of the test object with respect to the reference plane (i.e., the thickness distribution of the water droplet/rivulet flow) can be retrieved quantitatively and instantaneously. The DFP system is used to achieve time-resolved thickness distribution measurements of a droplet/rivulet flow driven by a boundary layer wind. The dynamic shape change and stumbling runback motion of the wind-driven water droplet/rivulet flow over the test plate are revealed clearly and quantitatively from the DFP measurement results. Such information is highly desirable to elucidate 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 NASA and NSF.

Hui Hu
Iowa State University

Date submitted: 08 Aug 2012 Electronic form version 1.4