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New experimental technique for the measurement of the velocity field in thin films falling over obstacles JULIEN R. LANDEL, ANA DAGLIS, DAMTP, University of Cambridge, HARRY MCEVOY, DSTL, STUART B. DALZIEL, DAMTP, University of Cambridge — We present a new experimental technique to measure the surface velocity of a thin falling film. Thin falling films are important in various processes such as cooling in heat exchangers or cleaning processes. For instance, in a household dishwasher cleaning depends on the ability of a thin draining film to remove material from a substrate. We are interested in the impact of obstacles attached to a substrate on the velocity field of a thin film flowing over them. Measuring the velocity field of thin falling films is a challenging experimental problem due to the small depth of the flow and the large velocity gradient across its depth. We propose a new technique based on PIV to measure the plane components of the velocity at the surface of the film over an arbitrarily large area and an arbitrarily large resolution, depending mostly on the image acquisition technique. We perform experiments with thin films of water flowing on a flat inclined surface, made of glass or stainless steel. The typical Reynolds number of the film is of the order of 100 to 1000, computed using the surface velocity, the film thickness and the kinematic viscosity of the film. We measure the modification to the flow field, from a viscous-gravity regime, caused by small solid obstacles, such as three-dimensional hemispherical obstacles and two-dimensional steps. We compare our results with past theoretical and numerical studies. This material is based upon work supported by the Defense Threat Reduction Agency under Contract No. HDTRA1-12-D-0003-0001.

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