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Elasticity Estimation of Thin Flap Using Optical PIV Velocity Fields JOHN WESTERDALE, Arizona State University, MAREK BELOHLAVEK, EILEEN MCMAHON, PANUPONG JIAMSRIPONG, Mayo Clinic Arizona, JEFFERY HEYS, Montana State University, MICHELE MILANO, Arizona State University — We estimate the elasticity of a thin, cellulose acetate flap using forcing data derived from optical particle imaging velocimetry (optical-PIV) velocity fields. The flap is fixed on one end to a stand submerged within a PIV tank and deformed using a water jet pulse. PIV is then performed at the interface between the thin sheet and water jet throughout the deformation cycle; the resulting velocity field allows the determination of instantaneous pressure measurements via Poisson's equation. An optimal estimation technique utilizing ensemble Kalman filtering is coupled with a finite element analysis program to determine the sheet's elasticity. Results show good agreement with actual elasticity measurements for both homogeneous and non-homogeneous elasticity sheets. In addition, we performed a quantitative study to determine the optimal vector density for a given element size to achieve an accurate elasticity estimation value. Considering the success of this technique using optical-PIV, it should also be possible for in-vitro elasticity estimates based on ultrasound-PIV measurements.

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