Department of Mechanical Engineering
Dissertation Defense

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Title: Image Correlation with Applications for Shape and Deformation Measurements

Date/Time: Thursday, October 30, 2008 at 2:00 pm

Location: 300 Main Street, ME Conference Room (A228)

Committee members: Dr. Michael Sutton – Advisor
Dr. Stephen McNeill – Mechanical Engineering
Dr. Tony Reynolds – Mechanical Engineering
Dr. Juan Caicedo – Civil Engineering

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Abstract

With the recent developments in the field of high speed image acquisitions systems in terms of the speed and image quality, and with the enhancement of the 2D and 3D Digital Image Correlation Methods (DICMs) capabilities it is now possible to measure surface shape and deformations in a wide range of applications, including biomechanics, fracture mechanics, non-destructive evaluation and material property measurements. The method provides the ability to measure displacements with sub-pixel accuracy from digital images by accurately matching subsets from images obtained from the undeformed and deformed states. Up until recently, DIC has been limited to mostly quasi-static and moderately slow strain rate applications. In this work an effort has been made to characterize and calibrate ultra high-speed image acquisition systems using (a) a single camera to acquire 2D surface deformations and (b) two cameras in a stereo-vision system to obtain 3D surface deformations. Both quasi-static (simple translation and uni-axial tension) and dynamic (metal sheet subjected to the dynamic loading conditions) measurements have been obtained to evaluate the potential of DICM in conjunction with ultra high speed camera systems to accurately quantify surface deformations. Information gathered during this work provides a valuable insight on material behavior under the dynamic loading conditions; results have shown that the DICM method is robust for both quasi-static and dynamic applications, confirming its value as a measurement tool for both static and transient measurements.