

Superfast 3D shape measurement with application to flapping wing mechanics analysis

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Seminar host: Eliot Winer**

Abstract

Accurate measurements of object geometric motion/deformation are of great importance to a variety of applications including manufacturing, robotics and mechanics analysis. In our research, we aim to simultaneously achieve high-speed and high-accuracy 3D shape measurements, and further, develop dynamic 3D shape analysis techniques for measuring bio-inspired flapping wing mechanics. We have innovated technologies to achieve high-accuracy 3D shape measurements via the superfast (kHz) binary defocusing technique. In particular, we have reached up to 70 μm accuracy for macro-scale [e.g. 150 mm(H) \times 250 mm(W) \times 200 mm(D)] 3D measurements; and 10 μm accuracy for medium-scale [e.g. 10 mm(H) \times 8 mm(W) \times 5 mm(D)] 3D measurements. With the technology developed, we have successfully measured 3D of a flying robotic bird with rapidly flapping wings [25 cycles/second], using an image acquisition rate of 5000 frames/second. Recently, we are developing computational frameworks for performing mechanics analysis on the flapping wings with hopes that such insights can aid scientists working in bio-inspired robotics. In this talk, I will introduce: 1) our work towards achieving superfast high-accuracy 3D shape measurement; 2) our recent work on mechanics analysis of rapidly flapping wings. I will also present my proposed research plan at Iowa State University. Specifically, I will explore applications of dynamic 3D shape measurements in the areas such as flexible assembly, bio-inspired design and quality inspection. I will also talk about my educational philosophy and interests at Iowa State University.

Bio

Beiwen Li is currently a Ph.D. candidate and Lambert Fellow at Purdue University. He received his M.S. and B.S. degrees from Iowa State University and Beihang University, respectively. His research interests include superfast (kHz) 3D imaging, multi-scale 3D optical metrology, 3D optical sensing, machine vision, online inspection, and flapping wing mechanics analysis. He has published 15 journal papers, co-authored two book chapters and filed one patent application. One of his journal articles was selected as a cover page highlight. Mr. Li received different awards including Dean's Fellowship from Iowa State University and the Lambert Fellowship from Purdue University. Mr. Li was also awarded the Optics and Photonics Education Scholarship by SPIE.

This seminar counts towards the ME 600 seminar requirement for Mechanical Engineering graduate students.

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