SEMINAR
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E-1 BUILDING – CRAWFORD AUDITORIUM
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Geometric Reasoning for Sensor Configuration Design

Dr. Xiaoping Qian
GE Global Research Center

Abstract

3D scanning technology using optical methods to acquire an object's 3D shape has becoming increasingly important. It has found applications in various areas ranging from industrial design and manufacturing such as 3D metrology and reverse engineering, to medical analysis and simulation such as organ shape reconstruction and cosmetic surgery, to entertainment such as 3-D animation, and to archiving such as heritage reconstruction.

Fundamental to various 3D scanning applications is sensor configuration design. Sensor configuration design concerning placement of optical sensors and 3D parts can have dramatic effects on the scanning quality, coverage and speed. During the scanning process, light level variation on bare parts often leads to high signal dynamic range (over-darkness or saturation in the digital image data), resulting in poor quality and deficient coverage.

In this presentation, I will present a new method for reducing signal dynamic range in the context of blade shape measurement by optimizing sensor configuration design. This approach transforms the signal dynamic range minimization problem into a geometric distance optimization problem on a unit sphere. It employs geometric reasoning to obtain a near-optimal analytical solution. Novel algorithms based on spherical convex hull are then used to compute the optimal sensor configuration. The method has been validated and is currently used to improve part setups in optical metrology systems and to validate sensor configuration designs for the next generation of 3D optical systems.

The presentation will conclude with some remarks on future work in integrating 3D geometric, topological and physical computing with information technologies for product design and manufacturing.