Computational Imaging for Sensing High-speed Phenomena

Abstract:

Despite recent advances in sensor technology, capturing high-speed video at high-spatial resolutions remains a challenge. This is because, in a conventional camera, the available bandwidth limits either the maximum sampling frequency or the captured spatial resolution. In this talk, I am going to cover our recent works that use computational imaging to allow high-speed high-resolution imaging under certain conditions.

First, I will describe Diffraction Line Imaging, a novel imaging principle that combines diffractive optics with 1D (line) sensors to allow high-speed positioning of light sources (e.g., motion capture markers, car headlights) as well structured light 3D scanning with line illumination and line sensing. Second, I will present a recent work that generalizes Diffraction Line Imaging to handle a new class of scenes, resulting in new application domains such as high-speed imaging for Particle Image Velocimetry and imaging combustible particles. Lastly, I will present a novel method for sensing vibrations at high speeds (up to 63kHz), for multiple scene sources at once, using sensors rated for only 130Hz operation. I will present results from our method that include capturing vibration caused by audio sources (e.g., speakers, human voice, and musical instruments) and analyzing the vibration modes of a tuning fork.