Indo/US Collaborative Research Grants

National Science Foundation of US and Technology Innovation Hubs of India

सत्यमेव जयते

Title: Single-shot and compact 3D endoscopy using dual pixel sensor
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The invention of endoscope has enabled the visualization of the gastrointestinal track, the joints, and other organs and cavities in the human body. This minimally invasive imaging procedure can provide crucial information for bleeding management and early detection of diseases such as esophageal cancer. With the rising popularity of minimally invasive surgery (MIS), endoscopy is used to provide visual guidance for a wide range of procedures from biopsy to robot-assisted surgery. The current standard endoscopy provides full HD to up to 4K high resolution imaging in 2D. However, depth information is lost. To fill this research gap, the collaborative project aims to develop a novel dual-pixel based high-resolution endoscope and a novel machine learning framework and algorithm to simultaneously extract depth and texture information from the endoscope feed in real-time. Dual-pixel sensors provide two views (left and right view) of the same scene, as if they were images from the left and right halves of the imaging lens in a single-shot setting. The depth cue is encoded the stereo-like disparity of the two views. The core novelty lies in usage of these dual-pixel sensor images to extract out depth and texture information from the endoscopy scene. To further improve texture recovery for high defocus regions, we propose the use of coded aperture masks along with dual-pixel sensors to jointly recover high-resolution depth and textures maps.

Figure 1 (L) Dual-Pixel Image Formation Principle [Ref.]. (R) Example reconstructed depth from DP images (real experiments)

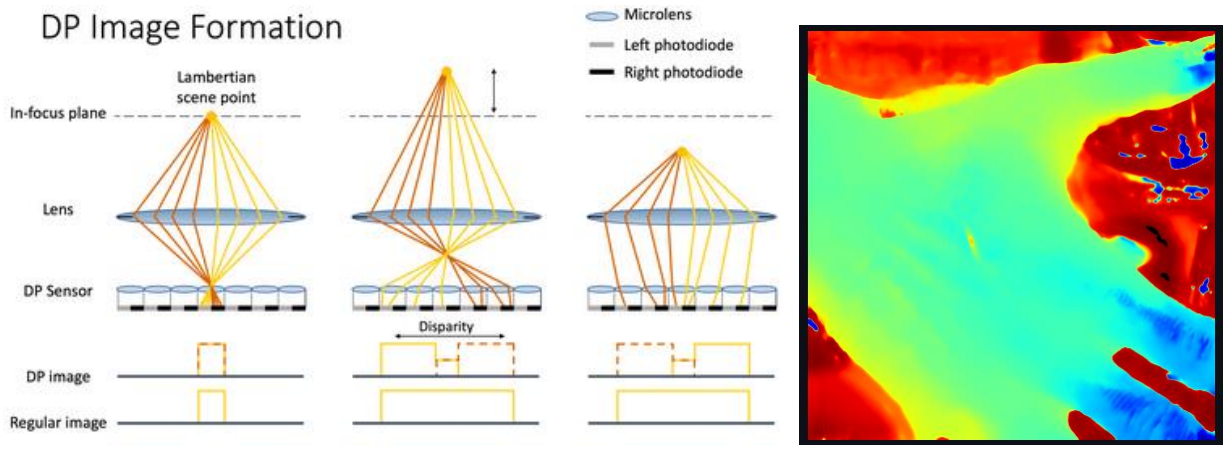

Figure 2 Experimental prototype setup (in-progress)