MARQUETTE UNIVERSITY

Colloquium
Electrical and Computer Engineering Department

Infrared Light-Field Imaging System Free of Fixed-Pattern Noise

Friday, October 6th
2:00 pm – 3:00 pm, Olin 202

Immediately followed by a reception in Olin 204
3:00 pm – 3:30 pm

Professor Sergio N. Torres
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ABSTRACT: In this talk, I will give an introduction on longwave infrared (LWIR) and a shortwave infrared (SWIR) light-field (LF) imaging systems and present results that demonstrate two novel capabilities for these systems. First, it is possible to digitally refocus an image to any nearby object planes, with a high signal-to-noise ratio (SNR), that is almost free of fixed-pattern noise (FPN) and blur artifacts. Second, it is possible to achieve multispectral SWIR imaging of a global scene and all the refocused nearby object planes; hence, it is possible to achieve radiometric SWIR refocusing. The integrated LWIR/SWIR LF imaging system is implemented with a LWIR microbolometer CEDIP camera in the 7-12 μm spectral band, a SWIR camera (Xenics, InGaAs photodetector array, 0.9-1.7 μm spectral band), and a high-precision scanning system (Newport). SWIR multispectral capability is achieved with an array of narrow-band SWIR interference optical filters (Intor Inc., 26 spectral channels with a 20nm full width half maximum band). The novelty of the presented research is that FPN (which is due to the low photon energy of IR wavelengths, the IR non-uniform responses of the photodetector array, their dark currents, and the differences within the readout electronics related to pixels or columns) is naturally filtered out by the refocusing process. This is possible because the FPN behaves as an object at a depth of infinity when an IR light field is captured by an imaging system. The applicability of the proposed LWIR- SWIR LF imaging system is tested, in principle, in real applications for which radiometric refocusing with high SNR is required. The selected applications are related to monitoring vegetation for precision farming.

BIOGRAPHY: Sergio N. Torres was born in Concepción, Chile, in 1962. He received the B.S.E.E. degree and the Professional Engineering title in EE from the University of Concepción, Concepción, Chile in 1985 and 1987 respectively. He moved to Dayton, Ohio, in 1994, receiving the MS.EE degree, and the Ph.D. degree in Engineering from the University of Dayton, Dayton, Ohio, in 1997 and 2001, respectively. He has been a faculty member at the University of Concepción, Electrical Engineering Department, since 1987. Dr. Torres has developed optical sensors for the Chilean mining industry, and for the Chilean sea food industry. He has also been continuing his research in infrared image restoration, focusing mainly on infrared microscopic image restoration and its biometric applications. Recently, he has been working on infrared plenoptic systems, with the potential to eliminate FPN through refocusing. He has supervised 11 Ph.D. theses in EE, and 10 MS theses in EE. He has published over 45 papers in mainstream journals, over 55 papers in international conferences, and 4 Chilean and 1 US patents. Dr. Torres is a Fellow of the SPIE, the international society for optics and photonics.