

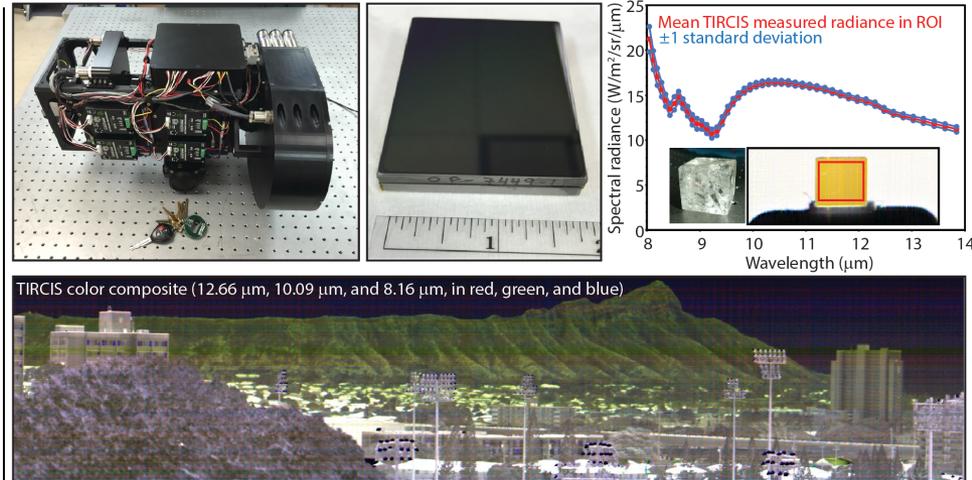


Thermal Infra-Red Compact Imaging Spectrometer (TIRCIS)

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Objective

- Develop a prototype of a hyperspectral thermal infrared imager for Earth surface remote sensing from a small satellite platform to achieve:
 - 120 m spatial resolution from an altitude of ~500 km
 - 40 spectral bands between 8-14 microns
 - peak SNR of 1000:1
- Technologies include uncooled microbolometers and a Fabry-Perot interferometer in an instrument with one moving part, a mass of <10 kg, and a peak power requirement of <10 W



Clockwise: TIRCIS; interferometer; SiO₂ spectrum derived from TIRCIS image of a quartz cube (inset); TIRCIS image of Diamond Head, Honolulu.

Accomplishments

- Demonstrated the TIRCIS prototype (mass = 16 kg, size = 56×36×28 cm, peak power = 26 W), via flight testing from a light aircraft. Demonstrated a path towards uncooled, high spectral resolution LWIR imaging from LEO.
- Quantified spectro-radiometric performance of the TIRCIS measurement approach, assessing trades between spectral resolution and SNR vs. wavelength determined by varying angle of the resonance cavity between the reflecting plates:
 - Configuration #1: 17 spectral bands (44 cm⁻¹, 8-14 mm), peak SNR (@ 300 K) 600:1; NEDT <1 K for all 17 bands, <0.3 K for 11 of 17.
 - Configuration #2: 50 spectral bands (9 cm⁻¹, above right), peak SNR (@ 300 K) 200:1; NEDT <1 K for 30 bands, and <0.5 K for 19 bands.
 - Performance model indicates that 30 spectral bands would yield narrow band NEDT of 0.4-1.0 K across the entire 8-14 mm interval.
- Developed the TIRCIS performance model to predict the SNR assuming a 5 and 15 mrad etalon and the FLIR Photon 320 FPA. The model showed first order agreement between observations and performance model predictions.
- Investigated onboard data processing solutions using a space-relevant onboard computer and exploiting heterogenous architectures. It was concluded that data collected by hyperspectral instrument can be processed in fractions of second using a combination of GPU and FPGA processing.

Co-Is/Partners: Paul Lucey (UHM),
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TRL_{in} = 4 TRL_{out} = 6