Engineers develop technique that enhances thermal imaging and infrared thermography for police, medical and military use

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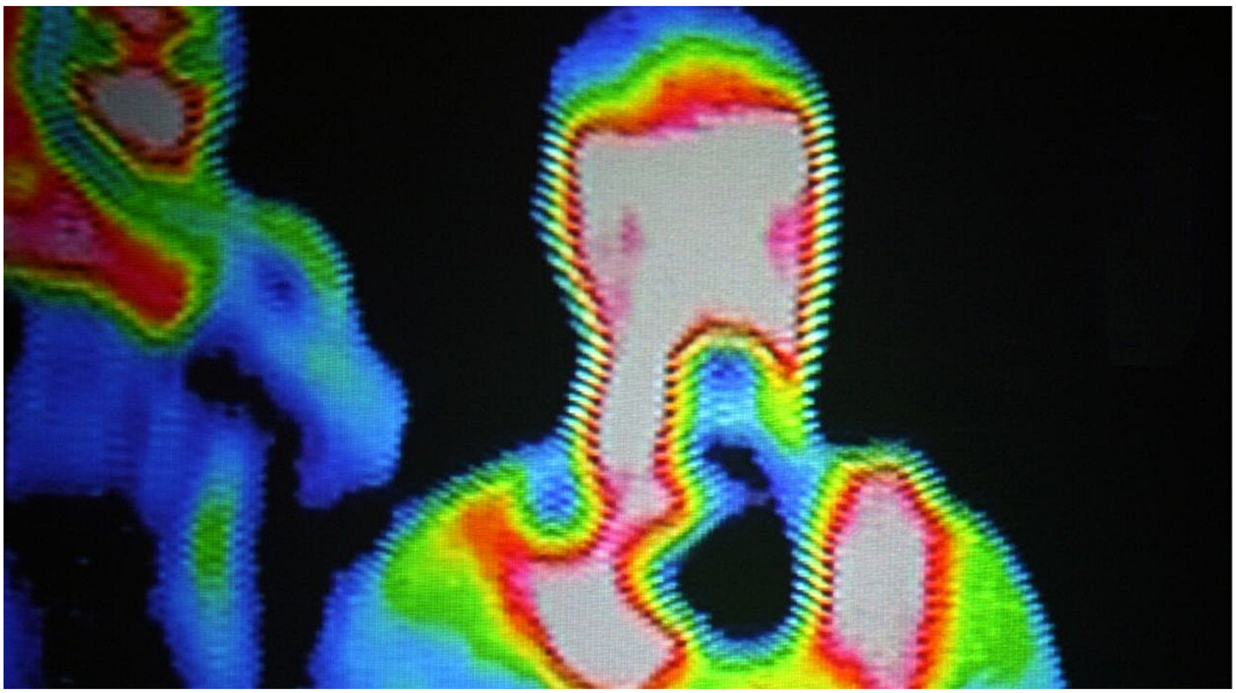

Credit: University of Houston

A new method to measure the continuous spectrum of light, developed in the lab of University of Houston professor of electrical and computer engineering Jiming Bao, is set to improve thermal imaging and infrared thermography, techniques used to measure and visualize temperature distributions without direct contact with the subject being photographed.

Because they are highly sensitive, thermal cameras and infrared thermometers measure temperature accurately from a distance , making them versatile and valuable tools in many fields from the military to medical diagnostics. They detect infrared radiation, invisible to the human eye, and convert it into visible images. Different colors on the image represent varying temperatures, allowing users to see heat patterns and differences.

Applications include:

- Medical diagnostics: Identifying inflammation and poor blood flow
- Building inspections: Detecting heat loss, insulation issues and water leaks
- Military, security and surveillance: Spotting people or animals in low visibility conditions
- Mechanical inspections: Finding overheating machinery or electrical faults

Both techniques rely on the principle of blackbody radiation—a theoretical perfect emitter—where objects emit infrared radiation based on their temperature. By capturing this radiation, the tools provide valuable insights into the thermal properties and behaviors of various objects and environments.

Thermal cameras and infrared thermometers cannot provide accurate readings because they rely on emissivity, a measure of how effectively a real object emits thermal radiation, and that varies with temperature—to determine temperature. Multi-spectral techniques address this by measuring infrared intensity at multiple wavelengths, but their accuracy depends on their emissivity models.

"We designed a technique using a near-infrared spectrometer to measure the continuous spectrum and fit it using the ideal blackbody radiation formula," reports Bao, in the journal *Device*. "This technique includes a simple calibration step to eliminate temperature- and wavelength-dependent emissivity."

Bao demonstrates his technique by measuring the temperature of a heating stage with errors less than 2°C and measuring the surface temperature gradient of a catalyst powder under laser heating. Using the near-infrared spectrometer, thermal radiation from a hot target is collected with an optical fiber and recorded by a computer. The collected spectrum is normalized using a system calibration response and fitted to determine the temperature.

"This technique overcomes challenges faced by conventional thermal cameras and infrared thermometers due to the unknown emissivity of targets and reveals much higher surface temperatures of photothermal catalysts than those measured by a buried thermocouple under strong light illumination," said Bao.

More information: Non-contact Thermometer for Measuring Surface Temperature of Photothermal Catalysts Using Near-infrared Blackbody Radiation Spectrum, *Device* (2024). DOI: 10.1016/j.device.2024.100467 . www.cell.com/device/fulltext/S2666-9986(24)00342-9

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