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Method for Improving Accuracy of Temperature Measurement

Dual-wire thermocouples with simulations eliminate conduction error for highly accurate turbine temperature measurement.

Researchers at Purdue University have developed an improved temperature measurement method that eliminates conduction errors within thermocouple probes. The conduction error arises from the temperature difference between the thermocouple junction, the measurement location, and the probe support. In current systems, conduction effects can account for up to 5 K of error. This is a major limitation within industries using gas turbines, where it is essential that temperature measurements be within tenths of a degree Kelvin to determine the propulsion system efficiency accurately. The newly developed technology consists of two-wire thermocouple probes with different thermocouple diameters. The two thermocouple readings combined with conjugate heat transfer simulations correct the temperature readings and deliver the actual temperature free of conduction error.

Advantages

- Unprecedented accuracy in temperature measurements

- Easily implemented into two-wire thermocouple probes

Applications

- Temperature measurements

- Gas Turbines

- Aerospace

- Power generation

Technology Validation:

Technology ID
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Category
Biotechnology & Life Sciences/Biomarker Discovery & Diagnostics
Aerospace & National Security/Hypersonics & Propulsion Systems
Aerospace & National Security/Thermal Management & Combustion Optimization

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This technology has been validated experimentally and using high-fidelity aero-heat transfer computational simulations. Prototypes have also been built.

Related Publications:

Nares Alcala, RF, Bhatnagar, L, & Paniagua, G. "Development of a Conduction-Free Total Temperature Probe Based on the Two-Wire Thermocouple Concept." Proceedings of the ASME Turbo Expo 2023: Turbomachinery Technical Conference and Exposition. Volume 4: Controls, Diagnostics, and Instrumentation. Boston, Massachusetts, USA. June 26â€“30, 2023. V004T05A016. ASME. https://doi.org/10.1115/GT2023-102306

SÃ¡nchez de la Rosa, D, & Paniagua, G. "Enhancing Total Temperature Measurement Accuracy: Calibration Procedures and Novel Two-Wire Probes." Proceedings of the ASME Turbo Expo 2024: Turbomachinery Technical Conference and Exposition. Volume 4: Controls, Diagnostics, and Instrumentation. London, United Kingdom. June 24â€“28, 2024. V004T05A029. ASME. https://doi.org/10.1115/GT2024-126636

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Provisional-Patent, 2022-10-27, United States

Utility Patent, 2023-10-26, United States

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