NASA TECH BRIEF

Ames Research Center

High-Temperature-Radiation Analyzer

The problem:

To make simultaneous temperature and spectral measurements on surfaces which have temperatures as high as 3900°K and undergo temperature variations in time intervals of the order of milliseconds (for example, targets illuminated by short bursts of radiant energy).

The solution:

A six-channel radiometer with three ultraviolet (UV) detection channels to measure temperatures at 2-millisecond intervals, one infrared (IR) channel to measure total radiation, and two infrared channels to measure radiation in discrete spectral intervals at a rate of 40 intervals per second.

How it's done:

The radiation analyzer consists of an optical and an electrical system. The optical system is comprised of an 8-inch Cassegrain mirror arrangement to gather radiation emitted by the target and direct it to a six-sided pyramid reflector which illuminates each of six detectors; it includes the sighting, focusing, modulating, and filtering sections of the radiometer. The electrical system includes detection, preamplification, signal processing, logic circuitry, control, and power systems; the signal-processing circuitry provides a precise analog of the detected radiation.

The three UV channels use filters to cover a broad region of the spectrum in slightly overlapping ranges, and 1P28 photomultipliers operating at constant current are used to provide measurements of the target temperature; measurements in this region are not greatly influenced by target emissivity. One of the IR channels is made to respond to total radiation in the spectral range from 0.37 to 8.0 μm by use of a thermistor bolometer as a detector; to analyze the spectral intensity distribution of the energy emitted by the target, the other two IR channels, called the long- and short-wave spectral channels, are provided with a common set of narrow-band optical filters in a rotating wheel. One pulse of energy is received through each filter during a complete rotation of the wheel. The characteristics of each channel are summarized in the table.

Channel	Function	μm	Remarks
1	UV temperature	0.25	2660° to 3900°K
2	UV temperature	0.30	2170° to 3000°K
3	UV temperature	0.40	1500° to 2500°K
4	Total radiation	0.35—8.0	Thermistor
5	Short-λ spectral	0.5—1.78	10 intervals; PbS detector
6	Long-λ spectral	2.0—6.3	10 intervals; thermistor

The radiation analyzer is used to make measurements on a target which has been exposed to chopped pulses of energy from an arc source. A mechanical phase shifter in the radiation analyzer makes possible synchronization so that detection and measurement of the target emission in the UV and IR channels noted above occur immediately after the target has been exposed to arc radiation. An ultrahigh-temperature calibration standard provides high-emissivity

(continued overleaf)

References:

1. Barnes Engineering Company; Instruction Manual for Model R-8A6 Radiation Analyzer. BEC 2408 0371.
2. Barnes Engineering Company; Operating and Maintenance Instructions for Model 11-170, Ultra-high Temperature Radiation Reference Standard. BEC 2407 0271.

Notes:

1. A secondary calibration source, consisting of a tungsten ribbon lamp situated behind a frosted sapphire window is used as a separate unit; it serves as a target at known temperatures for rapidly checking the performance of the radiometer.
2. No additional documentation is available. Specific questions, however, may be directed to:

   Technology Utilization Officer
   Ames Research Center
   Moffett Field, California 94035
   Reference: B73-10017

Patent status:

NASA has decided not to apply for a patent.

Source: Richard P. Farwell of
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