*** ABSTRACT ONLY ***

Second International Conference on Fire Research and Engineering (ICFRE2)

10-15 August 1997

National Institute of Standards and Technology
Gaithersburg, Maryland USA

Organized by

National Institute of Standards and Technology
Gaithersburg, MD, USA

Society of Fire Protection Engineers
Boston, MA, USA

EXPERIMENTAL AND NUMERICAL EVALUATION OF A NEAR INFRARED FIRE DETECTOR

Y. Zhu, A. Lloyd, Y. R. Sivathanu and J. P. Gore
Thermal Sciences and Propulsion Center
School of Mechanical Engineering
Purdue University
West Lafayette, IN 47907-1003

Abstract

An experimental and numerical evaluation of a near infrared fire detector for indirect view monitoring is presented. The near infrared fire detector measures the spectral radiation intensities incident on it at two wavelengths (900 nm and 1000 nm). These intensities are used to calculate a time series of apparent source temperatures. The fire detection algorithm utilizes the probability density function and the power spectral density of the apparent source temperatures to infer the presence of a fire.

The experimental evaluation of the near infrared fire detector was completed using five standard test fires consisting of three open (heptane, plastic and wood) and two smoldering (cotton and wood) fires. The direct radiation from the test fires to the infrared detector was blocked using partitions. Only radiation that is reflected from the enclosure wall was incident on the fire detector. In all instances, the standard test fires were detected successfully by the near infrared fire detector, even though the fires were not within its direct view. In addition, there were no instances of false alarms present during these tests. Therefore, the near infrared fire detector can be used to monitor multiple rooms.

Numerical evaluation of the near infrared fire detector was conducted using the discrete probability function (DPF) method. The angular distribution of spectral radiation intensities emanating from a standard heptane pool fire was measured and used as an input to the simulations. The simulations were performed for axisymmetric and rectangular enclosures. A source of photons (to simulate the fire) was placed at one end of these enclosures. The near infrared fire detector was placed at various locations within the enclosure. The spectral radiation intensities incident on the fire detector were calculated using a photon tracing algorithm in conjunction with the DPF method. The effect of multiple reflections off the walls of the enclosure results in a preferential absorption of the shorter wavelength photons. Therefore, the apparent source temperatures estimated by the near infrared fire detector were higher than those obtained from direct viewing. Despite the higher values for the estimated source temperatures, the near infrared fire detector could successfully discriminate the fires from background radiation.

Acknowledgment

This work is sponsored by the US Department of Commerce, National Institute of Standards and Technology under Grant No. 60NANB5D0113 with Dr. William Grosshandler serving as Scientific Officer.