# NISTIR 6242

# ANNUAL CONFERENCE ON FIRE RESEARCH
## Book of Abstracts
## November 2-5, 1998

Kellie Ann Beall, Editor

Building and Fire Research Laboratory
Gaithersburg, Maryland 20899

**United States Department of Commerce**
**Technology Administration**
National Institute of Standards and Technology

# NISTIR 6242

# ANNUAL CONFERENCE ON FIRE RESEARCH
## Book of Abstracts
## November 2-5, 1998

Kellie Ann Beall, Editor

October, 1998
Building and Fire Research Laboratory
National Institute of Standards and Technology
Gaithersburg, MD 20899


**U.S. Department of Commerce**
William M. Daley, *Secretary*
**Technology Administration**
Gary Bachula, *Acting Under Secretary for Technology*
National Institute of Standards and Technology
Raymond G. Kammer, *Director*

**Development of Multi-signature Fire Detection Systems**

Dr. Daniel T. Gottuk
Hughes Associates, Inc.
3610 Commerce Drive, Suite 817
Baltimore, MD 21227 USA

and

Dr. Frederick W. Williams
Naval Research Laboratory, Code 6180
4555 Overlook Avenue, SW
Washington, DC 20375 USA

The U.S. Navy is working toward enhanced automation of ship functions and damage control systems. A key element to this objective is the improvement of current fire detection systems. As in many applications, it is desired to increase detection sensitivity and, more importantly, increase the reliability of the detection system through improved nuisance alarm immunity. Improved reliability is needed such that fire detection systems can fully control fire suppression systems. The use of multi-sensor/multi-criteria based detection technology continues to offer the most promising means to achieve both improved sensitivity to real fires and reduced susceptibility to nuisance alarm sources. An early warning fire detection system can be developed by properly processing the output from sensors that measure multiple signatures of a developing fire.

Although work has been done in the area of multi-signature detection, in many cases few sensor types have been examined (e.g., standard photoelectric smoke detectors and temperature or CO and $CO_2$ for gas signatures), and only singular standard test sources have been used. The current Navy program is aimed at developing a broad database of signatures from real fire and nuisance alarm sources. Besides using standardized single component fire tests for comparison purposes, particular attention is given to evaluate composite fuels that are more realistic to actual fire sources. For example, furniture materials of cushion foam and upholstery, mattresses with bedding (i.e., sheets, blankets, etc.), or mixed trash (e.g., plastic, cardboard, paper, etc.) are combined as single fuel sources. Nuisance alarm sources include cooking events (e.g., deep fat frying, toasting, baking, burning popcorn in a microwave), cigarette smoking, welding, acetylene torch cutting, and combustion engine exhaust. Both flaming and smoldering combustion modes are investigated. Although this work is focussed on shipboard applications, the nature of ship operations make this work relevant to many industrial and commercial applications as well.

Tests are being conducted in a 6.5 m x 4.1 m x 3.6 m high compartment with no ventilation active. Fire and nuisance alarm sources are positioned 1.5 m below the ceiling and all sensors are positioned 4 m away from the source. A wide range of signatures are evaluated, including twelve gas species, temperature, light obscuration, light scattering, measuring ionization chamber, and multiple ionization and photoelectric detector signals. Detection criteria will be developed primarily in Phase 2 of the program during 1999. The results of this study will identify key signatures and preliminary signal processing methods based on an analysis of the state-of-the-art work presented in the literature.