Multiresolution Algorithm Development for Long Wavelength Video Based Fire Detection for Volume Sensor

John Brozena
The Calverton School

Christian P. Minor
Nova Research Inc.
Alexandria VA 22308

Susan L. Rose-Pehrsson
Naval Research Laboratory
Chemistry Division
Washington DC, 20375-5342

Volume Sensor

- Program for Damage Control and Identification
- For detecting fires, pipe ruptures, floods
- Uses microphones for acoustic analysis
- Uses Video systems for fire detection
- LWVD is NRL's algorithm for video based fire detection

Cameras Used

- The Long Wavelength Video Detection (LWVD) uses bullet style surveillance cameras
- These cameras include a filter that only allows light greater than a certain wavelength through

Methods

- The intensity of the pixels is converted to a standard, ‘luminosity’
- LWVD checks the background luminosity, and compares it to the current luminosity
- If the current luminosity is greater than the threshold plus the background, and this remains

Types of Fires

Flaming Fires

Flaming fires increase Luminosity greatly, and are easily caught by the LWVD algorithm.

Fires in Adjacent Compartments

These fires create “hot spots” on the wall from reflections. Many of these went undetected by LWVD.

Types of Fires cont'd

Smoldering Fires

Smoldering fires rarely make big flames. They normally make lots of smoke, affecting the luminosity values.

Bright Nuisances

These are events like welding or torch cutting steel. These tend to look like fires to the algorithms, and many set off false alarms.

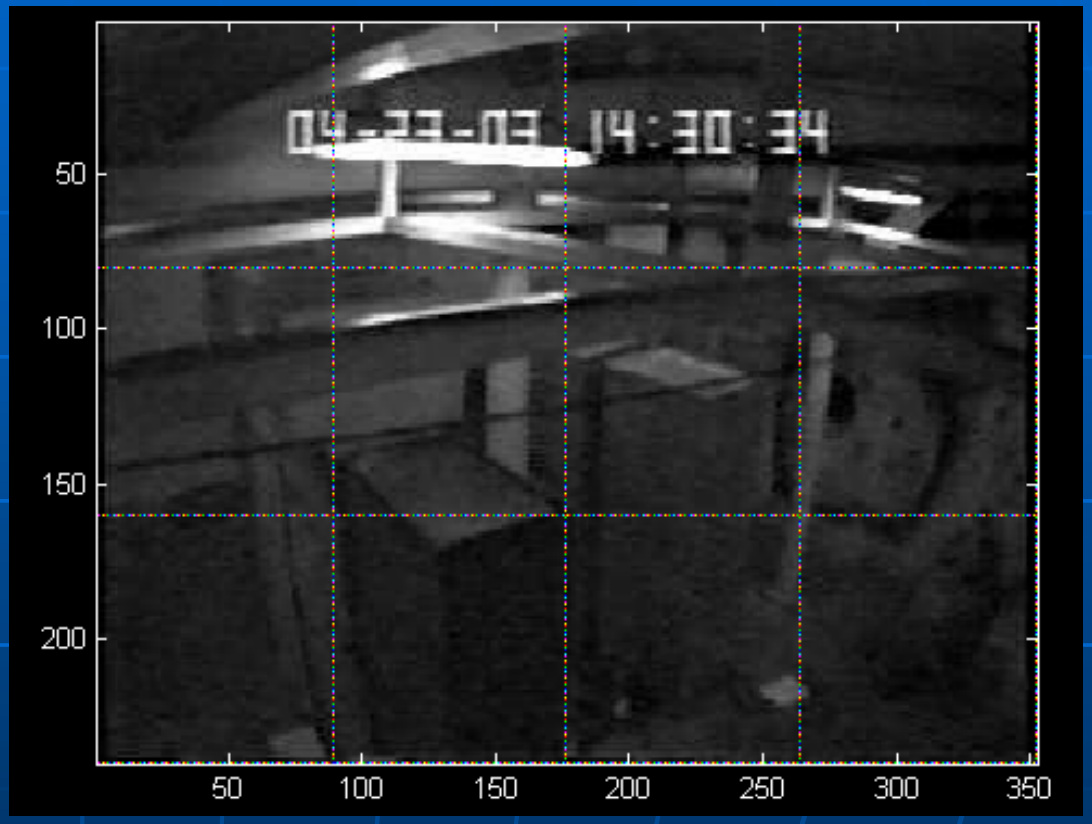
Problems

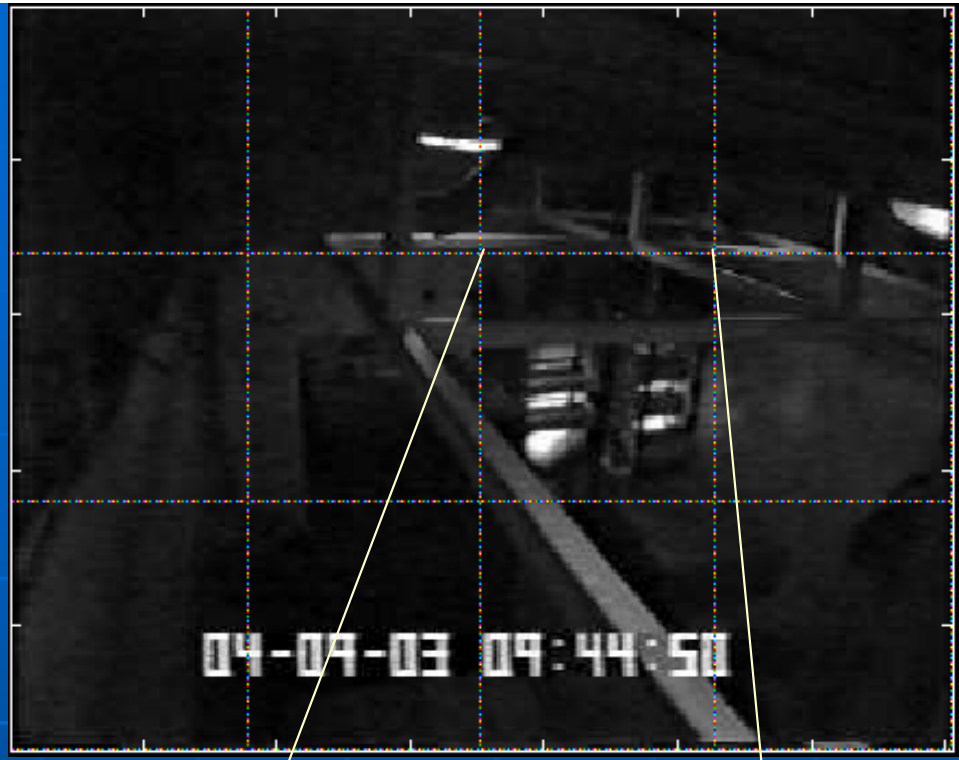
- Problems that the original fire detection algorithms faced was that if the fire was out of view and was only reflecting off of the walls, it did not increase the luminosity enough to sound the alarm.

A fire is occurring, but the luminosity increase is too little for LWVD to alarm.

FireGrid

- FireGrid is the program I developed in Matlab that breaks the video screen into a 12 block grid, achieving better sensitivity for smaller fires and adjacent compartment fires.

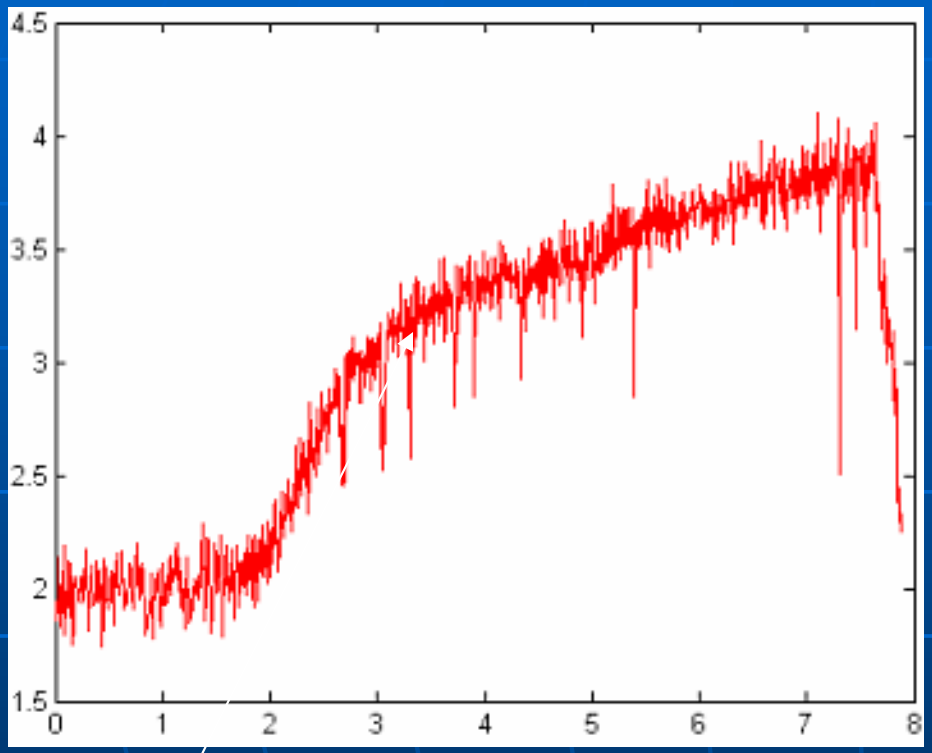




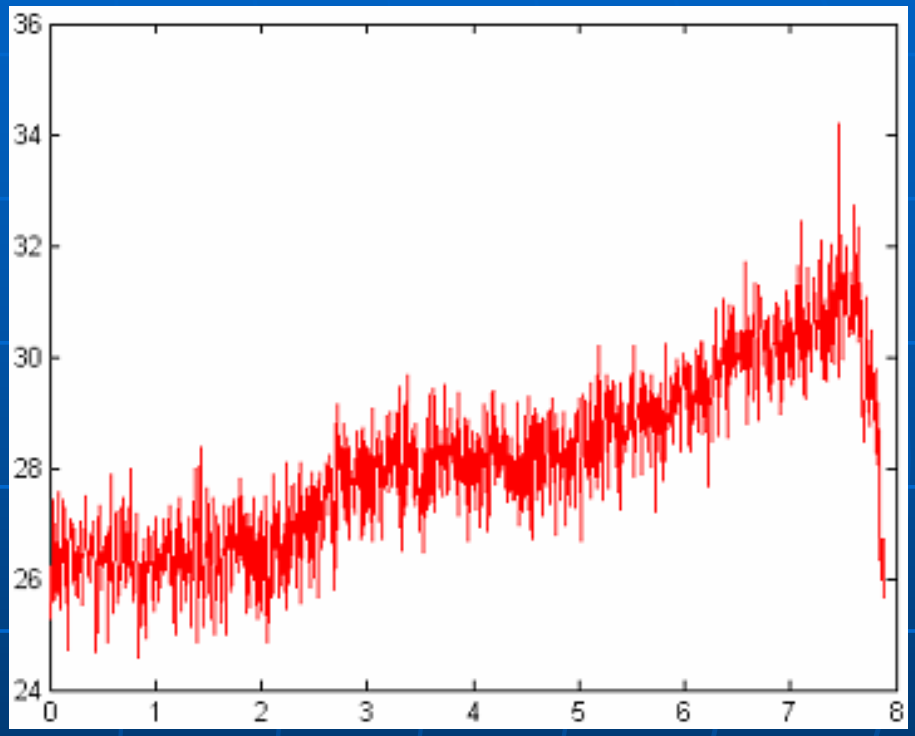
By making the grid smaller, small changes in the luminosity become much more apparent.

Luminosity Plot Comparisons

Luminosity Change Over Time, of the Grid Where the Fire Took Place



Luminosity Change Over Time for the entire Video Screen.



FireGrid alarmed here, whereas LWVD didn't alarm at all.

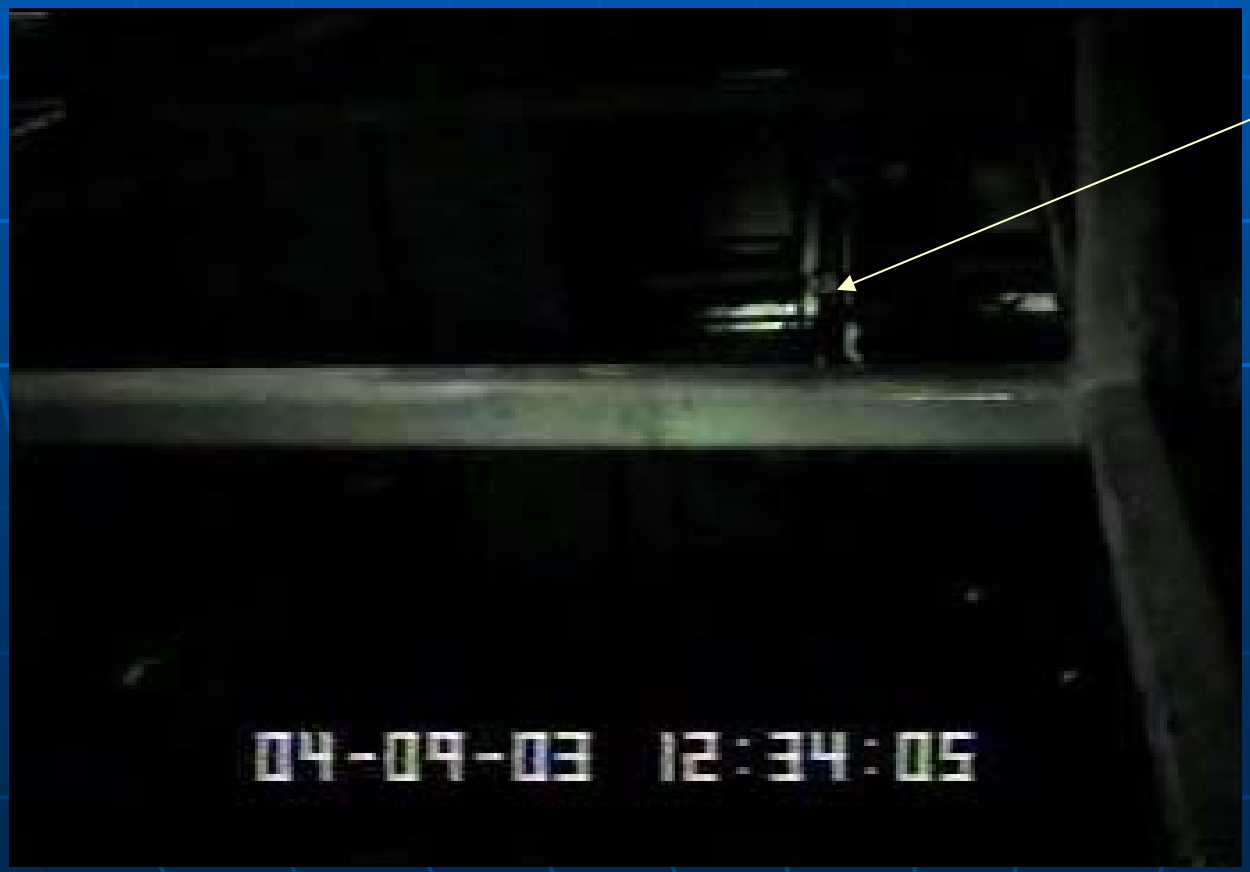
Notice over the same amount of time, the change in luminosity of FireGrid's block is much steeper, causing quicker alarm times, as opposed to checking the entire video's luminosity.

Future Developments

It will also be able to recognize and distinguish between nuisances, such as welding.

Future Developments cont'd

- The 4x3 grid that FireGrid uses is effective, but by making the grids even smaller, sensitivity would again jump. This would be especially effective for very small 'hot spots' on the walls caused by reflections from the fire.



This is a 'hot spot' that went undetected by both the LWVD system and FireGrid.

Summary

- Developed a Multiresolution Algorithm for Long Wavelength Fire Detection
- Improved sensitivity to small fires
- Improved sensitivity to adjacent compartment fires
- Faster response times

Acknowledgements

- Science Engineering Apprenticeship Program
- Naval Research Laboratory
- Christian Minor
- Dr. Susan Rose-Pehrsson
- Mark Hammond