2009 BFRL Project Description

Project Title: Thermal Imaging Technology

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Principal Investigator: Francine Amon

Co-Investigator(s):

BFRL Program: Advanced Fire Service Technologies

Objective: To (1) work with emergency responders and thermal imager manufacturers to refine image quality performance test methods, and (2) transfer knowledge of thermal imager performance evaluation measurements, with respect to image quality, to stakeholders and standards developing organizations.

Problem:

What is the problem? Thermal imaging cameras (TIC) are becoming increasingly valuable tools for emergency responders, however, there are currently no standardized methods of measuring imaging performance in the harsh fire fighting environment.

Why is it hard to solve? Traditional methods of measuring TIC imaging performance do not consider the extreme operating environment of the fire service and are either subjective or do not include the effects of the TIC display in the measurement. New test methods are needed that address these issues.

How is it solved today, and by whom? The problem is not currently solved for emergency responders. Evaluating thermal imagers requires that their performance be characterized in both lab- and full-scale experiments and that performance metrics and standard testing protocols be developed. The emergency responder community does not have the background to scientifically evaluate thermal imagers. The National Fire Protection Association Technical Committee on Electronic Safety Equipment (ESE) is preparing a performance standard, NFPA 1801 Standard on Thermal Imagers for the Fire Service. As members of the ESE, NIST/BFRL has taken a very active role in the development of this standard, providing measurement science for imaging performance metrics and test methods in NFPA 1801. This standard will be presented to the public for comment from Dec. 29, 2008 to Mar. 6, 2009.

Why NIST? This project fits the BFRL mission and vision. It anticipates and meets the need to develop measurement tools to evaluate thermal imager technology, thus improving the safety and effectiveness of fire fighting. By providing the measurement science to improve safety for the fire service, this project is well aligned with the BFRL strategic priority of Measurement Science for Innovative Fire Protection, as well as BFRL's core competency in fire protection and reducing fire spread within buildings and communities. BFRL has the ability to provide the knowledge through measurement science of the use of this solution-enabling tool to the fire service worldwide.

Approach:

What is the new technical idea? While working with TIC manufacturers and emergency responders, we have developed a set of TIC performance metrics and test methods that directly relate to the operating environment and tasks performed by emergency responders. These performance metrics and test methods measure the spatial resolution, nonuniformity, effective temperature range, and thermal sensitivity of TICs in a range of thermal environments and include provisions that account for interactions between key image quality parameters such as contrast, brightness, and noise. These performance metrics and test methods are now a part of NFPA 1801. All public comments received regarding the image quality test methods and their pass/fail criteria must be addressed by the ESE; NIST/BFRL is best qualified to provide the necessary science-based response to the public comments. This response may require additional laboratory testing for the existing tests or proof-of-concept testing for revisions to the existing tests.

Why can we succeed now? Stakeholders understand that a final standard is forthcoming, therefore they are cooperating with this effort at an unprecedented level with the expectation that they will have an improved market position after a standard is in place.

What is the research plan? This project has been ongoing for five years; it provides a scientific foundation for the National Fire Protection Association (NFPA) that is now actively deliberating on new TIC standards. While these deliberations are in progress, supporting activities such as additional laboratory testing, comparisons of testing techniques and methodologies, and other task group assignments are anticipated. The majority of this work was completed in FY08 and it is not expected that substantial effort will be needed until the end of the public comment period in March, 2009, when revisions to Proposed NFPA 1801 will be required. Participation in NFPA and ASTM Technical Committee meetings and Task Groups will be necessary when discussion is centered around thermal imaging test methods.

Recent Results (Outputs):

2008 Journal Papers:

Amon, F., Hamins, A., Bryner, N., Rowe, J.; "Meaningful Performance Evaluation Conditions for Fire Service Thermal Imaging Cameras"; Fire Safety Journal. (in press)

Dinaburg, J., Amon, F., Hamins, A., Boynton, P.; "Performance of Liquid Crystal Displays for Fire Service Thermal Imaging Cameras"; Journal of the Society for Information Displays, vol 26(6), 2008.

Amon, F., Ducharme, A.; "Image Frequency Analysis for Testing of Fire Service Thermal Imaging Cameras"; Fire Technology. (in press)

2008 Conference Papers:

Amon, F., Bryner, N.; “Measurement of effective temperature range of fire service thermal imaging cameras”; Proceedings of SPIE Security + Defense International Symposium; Mar. 2008.

Lock, A., Amon, F., Hamins, A.; “Practical Measurement and Analysis of the Nonuniformity of Thermal Imaging Cameras for First Responders”; Proceedings of SPIE Security + Defense International Symposium; Mar. 2008.

Neira, J., Rice, J., Amon, F.; “Development of Infrared Scene Projectors for Fire Fighter Thermal Imaging Cameras”; Proceedings of SPIE Security + Defense International Symposium; Mar. 2008.

Lock, A., Amon, F.; “Measurement of the Nonuniformity of First Responder Thermal Imaging Cameras"; IAFSS Symposium, 9th, paper no 164; Sept. 2008.

2008 Conference Posters (with published manuscripts):
Amon, F., Lock, A., Bryner, N.; “Suite of proposed imaging performance metrics and test methods for fire service thermal imaging cameras”; Proceedings of SPIE Security + Defense International Symposium; Mar. 2008.

Lock, A., Amon, F., Hamins, A.; “Application of Spatial Frequency Response as a Criteria for Evaluating Thermal Imaging Camera Performance”; Proceedings of SPIE Security + Defense International Symposium; Mar. 2008.

Standards and Codes: This research supports the development of Proposed NFPA 1801 Standard on Thermal Imagers for the Fire Service and ASTM E1543-00 Test Method for Noise Equivalent Temperature Difference.

Impact: Implementation of a performance standard on thermal imagers for the fire service enables firefighters to utilize compliant thermal imagers with confidence that they will perform at or above the levels required by the standard. Improved performance of critical tools such as thermal imagers allows firefighters to operate more efficiently and safely, thus enhancing the safety of the public and reducing loss of life and property.