proceedings

Abstract

Accelerating Discoveries Through Effortless Fusing of High Quality Thermal and Visual Imagery †

Peter De Ieso [1], Matthew Hasty [2] and Hideyuki Uemura [3], Jerry Beeney[4]

[1] FLIR Systems Australia Pty Ltd, Mulgrave Victoria 3170, Australia
[2]Teledyne FLIR, LLC, Niceville, FL 32578, USA
[3]FLIR Systems Japan K.K., Shinagawa-ku, Tokyo, 141-0021, Japan
[4]Teledyne FLIR LLC, Hudson, NH 06051, USA

Correspondence: peter.deieso@teledyne.com + 61 (03) 9550 2800

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1. Introduction

Historically, researchers and engineers have faced the challenge of choosing between recording and analyzing visible-light or thermal data during testing. While visible-light imaging provides structural and contextual information, thermal data reveals heat signatures and thermal patterns. Attempting to capture both sets of data and manually align them spatially—or even more challenging, synchronize them temporally—has proven to be both inconsistent and time-consuming, often yielding more questions than answers.

2. Discussion

The FLIR Multispectral Imaging Xperience (MIX) heralds a transformative leap in multispectral imaging by effortlessly fusing high-quality thermal and visual imagery into a single, synchronized dataset. This innovative system eliminates the historical trade-off between capturing heat signatures and revealing structural details by integrating advanced dual-sensor technology into one seamless package. The result is a streamlined, real-time solution that removes the burden of manual alignment and post-processing, ensuring that every captured frame reflects both precise thermal nuances and vivid visible context. In doing so, effortless fusing of high quality thermal and visual imagery not only raises the standard for data interpretation but also paves the way for accelerated discoveries across a multitude of research and industrial domains.

At the heart of the system is an integrated imaging architecture capable of recording events at speeds up to 1,004 frames per second. This high-speed performance is critical for capturing transient thermal events—from dynamic material stress testing and rapid chemical reactions to high-speed ballistics and airbag deployment analysis—without sacrificing spatial accuracy. The simultaneous capture of thermal and visible data [Figure 1] allows researchers to unlock deeper insights into processes that evolve quickly over time, thereby reducing analysis time and enhancing the precision of quantitative measurements.

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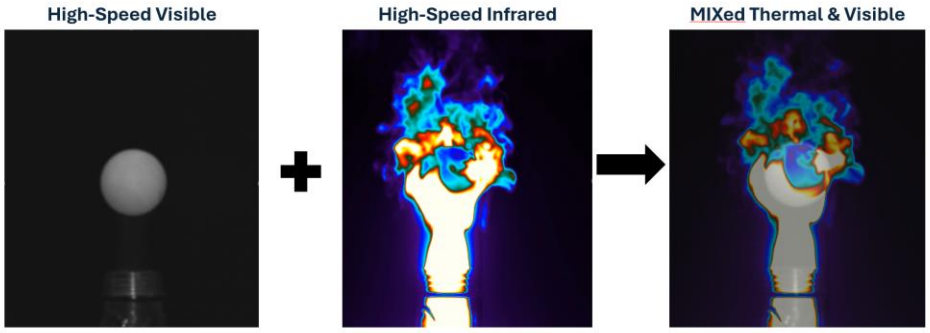

Figure 1. Simultaneous capture and fusing of visible and infrared data

The system is meticulously designed to address a broad spectrum of advanced applications through differentiated kit configurations. The X-Series Starter Kit, for example, is tailored for high-speed research environments, combining FLIR X69xx thermal cameras with high-speed visible cameras, precision optics, and custom mounting hardware to support demanding applications such as aerospace testing and industrial diagnostics. Meanwhile, the A-Series Starter Kit offers a versatile solution for sectors like electronics design, renewable energy, and battery testing, where integration with FLIR A67xx thermal cameras ensures the capture of both robust thermal data and fine visual detail. For researchers seeking post-processing flexibility, the FLIR MIX Toolkit provides an add-on option that seamlessly synchronizes thermal and visual footage in real time, consolidating every frame into one comprehensive dataset.

Coupled with FLIR Research Studio software, Toolkit delivers an end-to-end solution that enhances user workflows from capture through analysis. This unified control platform automates the synchronization process, offering intuitive data management and real-time analysis capabilities that dramatically reduce the time between data acquisition and actionable insights. [Figure 2] With its pixel-accurate overlays and time-matched imagery, the system enables researchers to focus on interpreting results and accelerating discovery without being hindered by the complexities of traditional imaging systems.

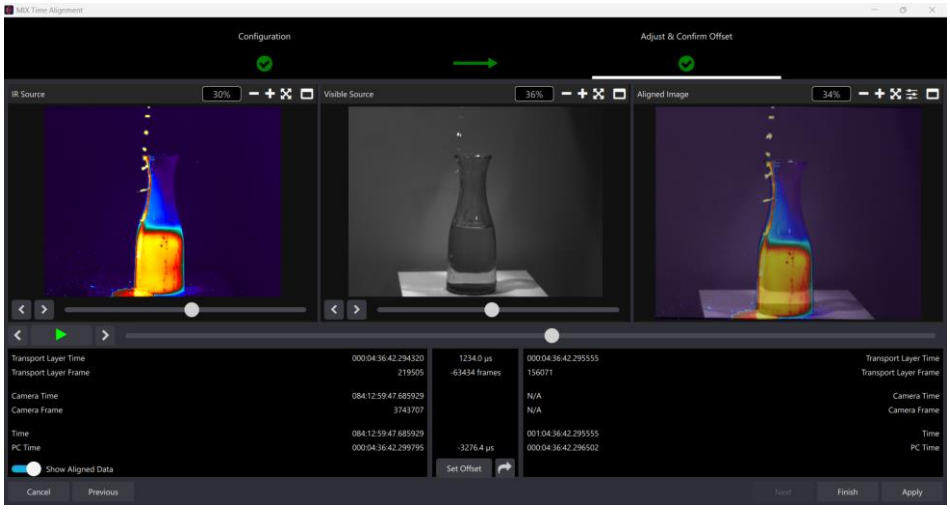

Figure 2. Temporal synchronization of visible and infrared data

By converging high-speed thermal capture with high-resolution visible imaging, the solution not only provides a complete picture of fast-moving thermal phenomena but also elevates the quality and reliability of multispectral data. This breakthrough technology empowers scientists, engineers, and innovators to interrogate and understand intricate thermal environments with unprecedented clarity and speed. The comprehensive, real-time merged datasets facilitate a more nuanced understanding of dynamic

processes, driving forward breakthroughs in fields as diverse as defense, materials science, and renewable energy research.

3. Conclusion

FLIR MIX™ represents a paradigm shift in infrared and multispectral imaging, offering a quantitatively superior alternative to legacy imaging workflows. By synchronizing thermal and visual data at rates up to 1,004 frames per second with pixel-level spatial accuracy, the system can reduce post-processing time by up to 50% compared to conventional dual-camera setups requiring manual alignment. Benchmark studies have demonstrated that MIX-enabled workflows improvements in measurement precision during transient event analysis, such as high-speed impact and thermal stress testing.

Compared to traditional infrared-only systems or manual dual infrared and visual camera configurations, FLIR MIX delivers a unified dataset that dramatically enhances interpretability and reproducibility. This integrated approach not only enables researchers to capture both structural and thermal data simultaneously but also supports cross-domain applications—from defense and aerospace to battery diagnostics and energy systems—where synchronized high-fidelity data are critical for modeling fast-evolving phenomena.

Supplementary Materials: Supporting information can be downloaded at: www.flir.com/MIX