

Capture Radiometrically Accurate Thermal Infrared Data of Hypersonic Models In-Flight

Visualize and assess temperature gradients, stagnation regions, shock interactions, boundary layers, turbulent structures and more with a new stop-motion IR imaging solution from Telops!

Stop Motion HD MWIR Camera for Hypervelocity Research

Infrared (IR) assessment of hypervelocity targets and models in-flight has long been understood as a complex challenge due to the time scales involved and the physics of IR detectors. Despite widespread adoption of ultra-high-speed visible spectrum systems and advanced techniques like Schlieren imaging in aeroballistic ranges, the lack of dedicated IR solutions has caused hesitancy in deployment of scientific IR cameras. To address these challenges and provide a dedicated solution for the hypersonics community Telops has developed a new stop-motion variant of our M3 Super HD MWIR Camera (1920x1536 Pixels, 1.5 μ m-5.4 μ m) complete with a custom calibration allowing for radiometrically accurate data with exposure times as low as 100ns.

Why Stop-Motion?

The necessity for an IR stop-motion solution arises from the need to limit motion blur of hypervelocity targets to improve image quality and increase the accuracy of the radiometric assessment. Unlike ultra-high-speed visible spectrum systems maximum IR camera frame rates are limited to at most tens of thousands of Hz. Without multiple cameras or a large-scale range and an advanced tracking system, this makes collecting multiple frames of a single target in-flight experimentally challenging. Instead, we

must focus on collecting a single high-quality, high-definition image captured at just the right moment. The ideal solution for a fixed operation IR camera targeting hypersonic models in flight is an ultra-sensitive high definition FPA with electronics capable of repeatably and accurately collecting ultra short exposures.

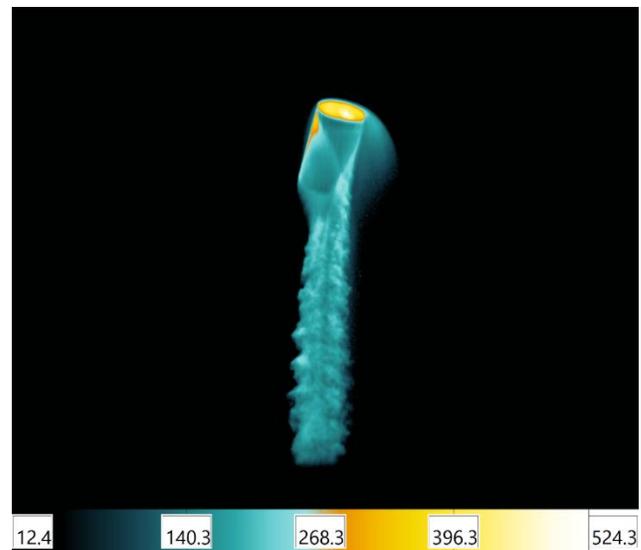


Figure 1: A Delrin Cylinder in flight at Mach 9. Telops Stop-motion variant M3 Shd MWIR camera freezes hypersonic projectiles in flight allowing for MWIR assessment of full temperature gradient information, location of stagnation regions, identification of shock interactions, and visualization of turbulent structures. These actionable data points provide a complementary IR tool to support results from widely used high-speed visible spectrum and Schlieren systems. Image courtesy of Dr. Bryan Schmidt and the HOPLITE Lab at Case Western Reserve University.



Telops M3Shd Stop-Motion Variant Hypersonics Solution		
Model & Resolution	(1.5µm-5.4µm)	1920x1536
Exposure times	100ns, 300ns, 500ns, 800ns, 1000ns.	
Accuracy	< 10 K at 1,000°C scene	
Residual Non-uniformity	< 5 K (1σ) at 1,000°C scene	
Trigger	Precision Trigger Standard : Accepts TTL & LVTTTL	
Availability	Now available as a dedicated solution. Standard option for capable systems arriving in 2026. Customization always available.	

Table 1: Operational detector and noise specifications for Telops M3Shd Stop-motion Variant hypersonics solution. Available now as a custom solution and arriving as a standard option for additional models in late 2026.

Calibrating Ultra Short Exposures

Though several existing IR cameras may be able to access ultra short exposures below 1µs, this is not the only challenge. When pushed to these extremes, the ability to collect sufficient thermal signal from the target at a given exposure and to calibrate the system for repeatable, low non-uniformity images is a far more critical. After testing several potential detectors, we identified unique traits consistent with Telops MWIR HD and Super HD line which made them ideal for this purpose with achievable modifications. Subsequently, a research and development effort was undertaken to design and implement these modifications and develop a new custom calibration for these systems. Despite the extremely challenging radiometric realities, we must contend with when attempting to optically freeze hypervelocity targets in-flight, this specialized calibration applied to these uniquely positioned ultra-sensitive high-definition arrays results in an exceptional new tool capable of acquiring crisp, radiometrically accurate, and scientifically valuable thermal infrared information.

Conclusion

Telops is proud to offer this new solution to the hypersonics community and we wish to foster an extended dialogue with researchers deploying these technologies. We are experienced with these sensitive, unique, and challenging collections, and are ready to help solve the complex imaging problems they create. Please reach out to our dedicated field engineering team via email FAE@telops.com to begin a conversation. Local national representatives are available to assist contacts and organizations in Canada, Europe, and the United States of America.

For additional information please request our recent paper: Dupont, F., Zambon, V., Côté, A., Carrock, J., Sauté, B., Dumont, A., & Gagnon, J. P. (2025, May). Infrared imaging at hypersonic speeds: assessing sub-microsecond exposure. In *Image Sensing Technologies: Materials, Devices, Systems, and Applications XII* (Vol. 13454, p. 1345402). SPIE.

Telops Inc.

Represented by

Infrared Imaging LLC

Email: sales@infraredimaging.com

Website: infraredimaging.com