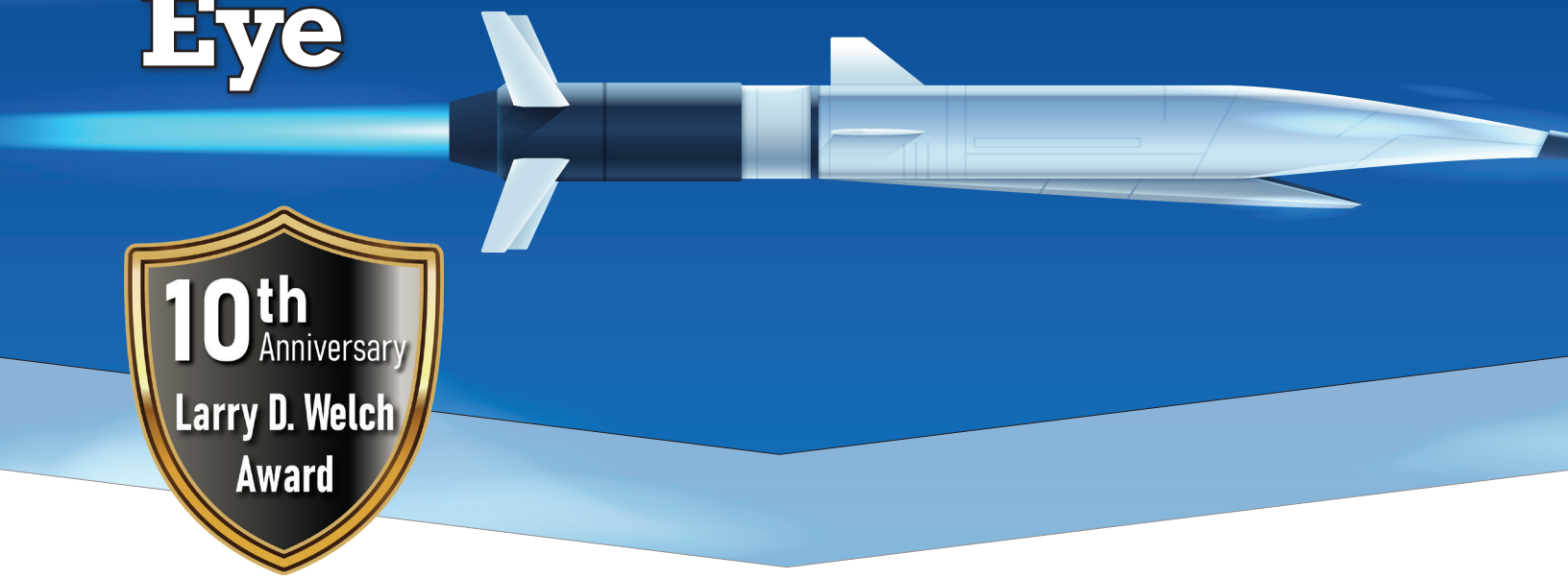
IDA | Research Summary

Hypersonic Reentry Visible to the Naked Eye



10th Anniversary Larry D. Welch Award

IDA's Welch Award annually recognizes the best external publication by IDA researchers. Last year marked the 10th anniversary of the award, named for retired U.S. Air Force General Larry D. Welch, who served as president of IDA from 1990 to 2003 and again from 2006 to 2009. This summary is the seventh in a series reflecting on the 10 winning publications since the award's inception in 2011. The Welch Award winner for best external publication in 2015 was "Visible Signatures of Hypersonic Reentry."

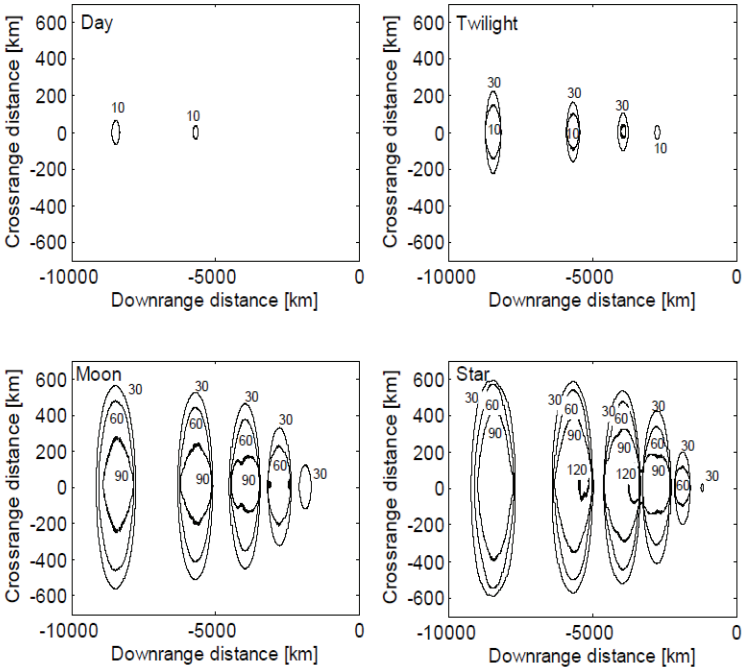
Is it possible to detect a hypersonic reentry vehicle before impact just by looking up at the sky? IDA researchers Jeremy A. Teichman and Leon R. Hirsch's Welch Award-winning publication began as a Department of Defense-tasked project to evaluate long-range hypersonic delivery concepts. Originally, IDA was to evaluate system detectability and early warning of hypersonic vehicles via techniques traditionally used for detection, like radar. For Teichman and Hirsch of the Science and Technology Division, the work soon brought to light the lack of evaluation of simpler, non-technological means of reentry detection, namely, the naked human eye.

Detectability of reentry vehicles has long been essential to awareness and avoidance. The *Journal of Spacecraft and Rockets* published "Visible Signatures of Hypersonic Reentry" in 2014, wherein Teichman and Hirsch set out to test whether or not radiated light produced by reentry vehicles could be visible by an unaided individual from the ground just by looking up. If so, how far away from its impact point could the vehicle be viewed, and for how long?

February 2022
NS D-32879

The goal was to measure human sight as a means of detection by quantifying "noticeability" and "visibility," two things which had historically been largely unquantified. The analysis included considerations of the observer's position relative to the object, the amount of visible light radiated from the object, the object's contrast against the sky, and the psychophysical conditions of an individual's attention. The authors' research ultimately determined that reentry vehicles are visible up to hundreds of kilometers away from their impact points between seconds and minutes before impact.

The project was not Teichman and Hirsch's first together. The two also worked in tandem on a 2006 project related to the flow of intelligence, surveillance, and reconnaissance information in support of tactical operations. Teichman was proud to receive the 2015 award and described it as "very gratifying to be recognized for the work and to know that IDA was proud of it too." Teichman also noted that the award encouraged him to more strongly pursue publishing-worthy work for a broader audience.



Duration of Noticeability: the reentry body aerodynamically skips across the atmosphere multiple times. Under daylight conditions, there is little opportunity to view the object at any point along the trajectory. Under dimmer conditions, the object is visible for extended periods of time (over 2 minutes) uprange.

Credited for unconventional thinking on the hypersonic reentry project, Teichman and Hirsch ushered in a broad-minded approach to this multidisciplinary investigation. The analysis was an exemplary model for critical thinking in IDA projects, especially those involving air and missile defense. Moreover, their innovative approach made it possible for human detection of reentry vehicles to be taken into greater consideration in traditional study of airspace surveillance and defense.

According to Hirsch, "the analysis was emblematic of the open-minded thinking IDA brings to problems." IDA continues to regularly apply subject matter expertise to insightful analysis of air and missile defense issues.

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