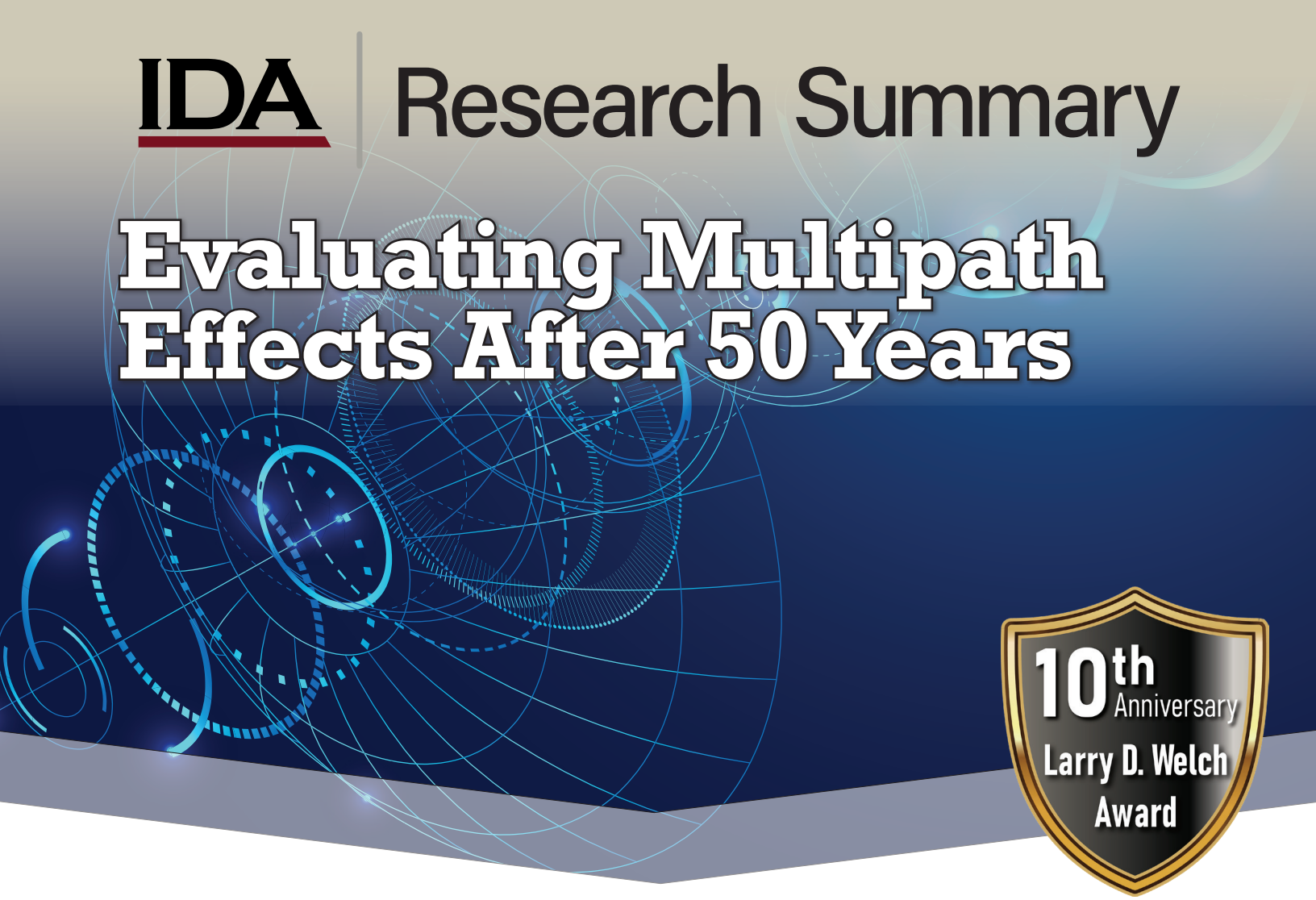
IDA | Research Summary

Evaluating Multipath Effects After 50 Years



IDA's Welch Award annually recognizes the best external publication by IDA researchers. This year marks 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 ninth 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 2013 was "Comparison of Predicted and Measured Multipath Impulse Responses."

IDA researchers Kent Haspert and Michael T. Tuley have worked together in the Science and Technology Divison of the Systems and Analyses Center since 1999. In 2013, the two joined forces for a project on multipath impulse responses. The study used classic, fundamental concepts to evaluate multipath effects. However, since the original concepts had been developed 50 years prior, technology had improved to support wide-bandwidth communications and radar systems.

Haspert and Tuley's article presented a modified version of the traditional approach to the evaluation of multipath effects and then compared the predicted multipath data with that collected from wideband instrumentation radar. The article was published in *IEEE Transactions on Aerospace and Electronic Systems* in 2011.

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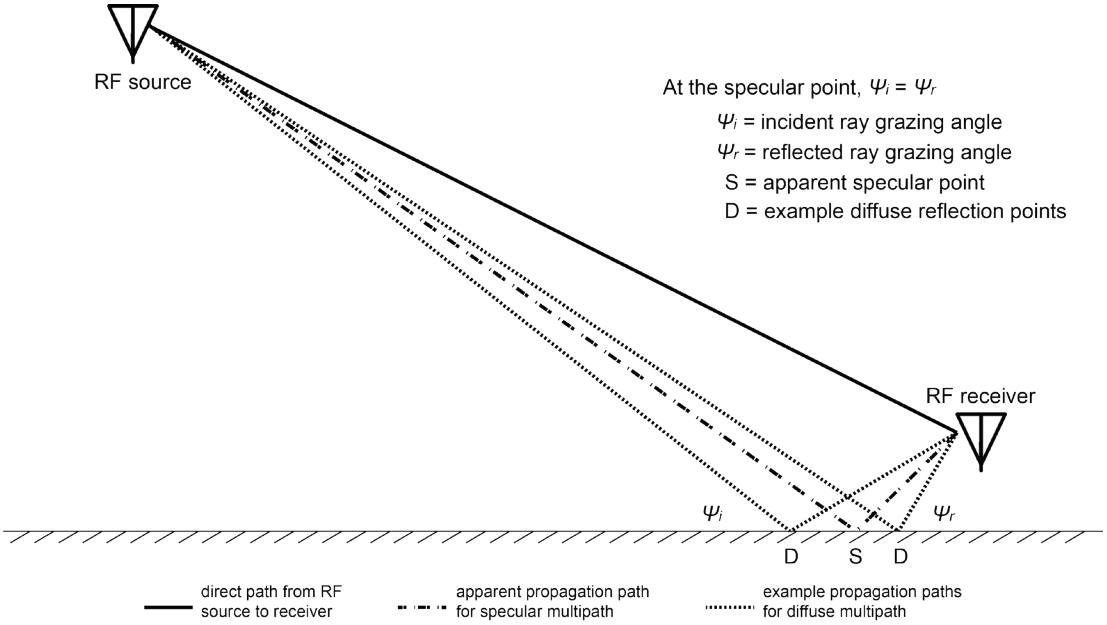
Much of Haspert and Tuley's work is classified, so being able to submit this paper for publication was a wonderful and rare opportunity. Haspert said the publication allowed the team, the Science and Technology Division, and IDA to gain some wider recognition.

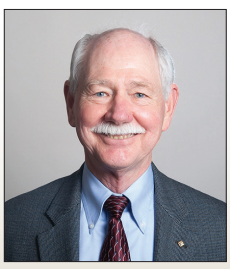
Haspert and Tuley found that multipath should be treated as a combination of both specular and diffuse effects. Multipath is electromagnetic propagation that combines a direct, line-of-sight transmission and one or more bounce paths. Its specular characteristic means it has a flat, mirror-like reflection, while its diffuseness means it also reflects in a scattered way, like a reflection off of a rough surface.

Both of these effects need to be considered to effectively evaluate radio or radar-signal transmissions. Haspert and Tuley demonstrated how these characteristics present themselves as well as an effective way to model them.



The test data used in this research were collected for conditions that strongly favored diffuse multipath. However, the experimental technique also supported the detection of any unexpected specular contributions. The demanding test conditions also revealed some real-world effects that had to be addressed. After these real-world effects were incorporated in the multipath model, Haspert and Tuley were able to predict the observed multipath relatively accurately.

The research presented in the Welch Award–winning article helped create a foundation for future multipath research at IDA, allowing for more in-depth analysis of how to address multipath effects in a classified system implementation.



Kent Haspert (khaspert@ida.org) and **Michael T. Tuley** (mtuley@ida.org) are members of the research staff in the Science and Technology Division of the Systems and Analyses Center. Haspert earned a doctorate in electrical engineering from the University of Maryland. Tuley holds a master's degree in electrical engineering from the Georgia Institute of Technology. Their award-winning article was based on work sponsored by IDA's Independent Research Program.