

## Distinguished Lecture on

A Power Wave Theory of Antennas

by

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### Abstract

While developing ultra-wideband antennas over the past two decades, we became frustrated by our inability to describe antenna performance in the time domain with a parameter as simple as gain in the frequency domain. To address this, we developed a theory of antenna radiation and scattering that fully extends into the time domain most of standard antenna terms, including gain, realized gain, effective length, antenna pattern, beamwidth, scattering cross section, and radar cross section. Power wave theory applies to linear reciprocal antennas of all feed impedances and feed types, including waveguide feeds. It also applies to antennas embedded in any lossless medium. The approach is analogous to that used to describe circuits with generalized scattering parameters, with different reference impedances at each port. We identify receiving and transmitting impulse responses, and prove that they always have a simple relationship to each other. We also identify a scattering impulse response that can be applied to either an antenna or an arbitrary scatterer. From these functions, we build a Generalized Antenna Scattering Matrix (GASM), which provides a complete description of antenna response in the far field, in either the time or frequency domain. The GASM forms the basis of a network graph, which helps with calculations with a source or load of arbitrary impedance. This approach unifies the time and frequency domain descriptions of antenna performance.

### Biography

**Everett Farr** received the Ph.D. in electrical engineering in 1985 from the University of Illinois at Urbana-Champaign. In 1991 he formed Farr Research, which later became Farr Fields, where he has investigated a variety of ultra-wideband antennas. These included many variations of Impulse Radiating Antennas (IRAs), consisting of a parabolic reflector and a wideband feed. He also developed a time domain antenna measurement system. Many of these antennas and systems are available as commercial products.

Dr. Farr is Chairman of USNC-URSI Commission E, and Chairman of the IEEE AP/MTT/EMC/NPSS joint chapter in Albuquerque. He is a co-recipient of the 2006 IEEE John Kraus Award, with citation reading, "For the development of novel and innovative ultra-wideband antenna concepts that have enabled a new area of electromagnetics." He is also a Summa Foundation EMP Fellow. He received the Best Applied Paper Award at the 1990 Nuclear Electromagnetics Conference, for his work on the Balanced Transmission-line Wave sensor; and again at the 2002 AMEREM Conference, for his work on IRAs.

**Date** : 26 August, 2014 (Tuesday)  
**Time** : 11:00 am - 12:00 noon  
**Venue** : Room 15-202, meeting room of State Key Laboratory of Millimeter Waves,  
15/F, Academic 3, City University of Hong Kong

\*\*\* ALL ARE WELCOME \*\*\*

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