

# **From Maxwell's Equations to Modern Antenna Marvels: From Tiniest Capsule Antennas to Largest Space Antennas**

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An important fact from physics, namely, “accelerated charges radiate” along with the outcomes of Maxwell’s equations, namely, “existence of EM waves traveling at the speed of light” forever have changed how we live, enjoy life and protect ourselves. Antennas are perhaps one of the most celebrated devices that have allowed controlled generation and reception of the EM waves. Antennas come in a variety of sizes, shapes and functionalities. In this talk two classes of antennas will be highlighted: (a) Miniaturized sized antennas in bio-telemetry applications and (b) Large reflector antennas for space applications.

About quarter of century ago, the research community was advertising the concept of “global connectivity with anyone, at any time, in any place and with any amount of data”. This is now a reality. The next big concept is “bio-telemetry connecting patients to their doctors and hospitals at anytime, any location and with any amount of monitoring and diagnostics data”. History has shown that it typically takes about quarter of century to bring any out-to-the-box idea into the mainstream. We are in the midst of this new paradigm to becoming a reality. Advances over the past decade has enabled the use of smart capsules (electronic digestible pills) in biomedical applications helping in the treatment and diagnosis of various diseases (GI tract diseases, etc.). One of the paramount components in effective implementation of these devices is the development of unique ingestible capsule antenna designs for smart pill systems suitable for medical monitoring and diagnostic applications. This talk will provide an overview of advances in this area.

Reflector antennas confine the electromagnetic energy over a distributed aperture into a focal plane or radiate the electromagnetic waves for communication or energy transfer. Reflector antennas are key components in diverse applications, such as radio astronomy, communications, remote sensing, radar, defense and medical devices. The second part of the presentation will start with a dramatic story of the use of parabolic reflectors in the ancient legend of Archimedes using them to focus the Sun’s heat to burn attacking ships to modern giant spaceborne mesh and membrane reflector antennas for satellite communications, remote sensing and radio astronomy applications and the mutli-band shaped reflector antenna system for detecting the cosmic microwave background from the big bang and the early universe. Novel out-of-the-box concepts will also be highlighted.