Our Fascination with Reflector Antennas: URSI Commission B's last 100 Years Contributions

Yahya Rahmat-Samii
Distinguished Professor
Department of Electrical and Computer Engineering, University of California, Los Angeles, USA
email: rahmat@ee.ucla.edu

We are celebrating the 100 years birthday of URSI in this conference. Commission B was one of the first ones that were established among the ten commissions of URSI. Among many topics covered within Commission B, antennas have always been considered as one of the most paramount areas of research and development for a variety of applications ranging from space applications to wireless communications and more recently medical. Particularly reflector antennas have received considerable attention from the members of this commission from very early time and up to now. This invited presentation will highlight several milestone developments of reflector antennas and details why these antennas are still so popular among researchers, engineers, scientific communities, industry and defense organizations. This presentation will focus on the following topics and the interested readers are referred to the author's several review papers on this topic which contain many references:

A bit of history and WWII: It is conjectured that Archimedes used parabolic mirror reflectors to focus the Sun's heat on attacking Roman ships in order to set them on fire. Subsequently and at the close of the Renaissance optical mirrors of many conical shapes utilized in many astronomical discoveries including designs such as Gregorian, Cassegrain and other folded optics. Not until WWII era that reflector antennas were utilized in non-optical regimes and receiving much attention particularly for RADAR applications.

Radio Astronomy: It was discovered that many heavenly objects not only observable in visible light but also emit radiation at radio frequencies. Apart from observing energetic objects such as pulsars and quasars, radio telescopes are capable of observing other astronomical objects: galaxies, nebulae, black holes, and even radio emissions from planets. Jansky at Bell Labs in 1930 detected background radiation from the Milky Way Galaxy. Grote Reber, inspired by Jansky's work, built a 9.5-m radio telescope in 1937 in his backyard in Illinois, USA. Pioneered by Reber's construction, colossal reflector antennas have been constructed with amazing resolution and performance capabilities.

Communication Satellites, Earth Observation Systems and CubeSats: The era of global connectivity demanded the development of multi-beam, contour beam and reconfigurable reflector antenna systems. Enhanced performance requirements for earth observation systems pushed reflector antenna technology to apply all kinds of reflector antennas including sophisticated deployment designs. The recent interests in using CubeSats have also influenced the design and developments mesh reflector antennas. Representative examples will be highlighted.

Advanced Computational and Measurement Techniques: To accurately and reliably characterize, synthesized and predict the performance of complex and modern reflector antennas many advanced numerical techniques have been explored and customized. Among them are Physical Optics (PO), Geometrical Theory of Diffraction (GTD), Physical Theory of Diffraction (PTD), Method of Moments (MoM) and their hybridization. Modern measurement techniques including near field, compact range and microwave holography are routinely used to evaluate the RF performance of various size reflector antennas with high degree of reliability.

References

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