

The Joy of Understanding Ray Techniques and Uniform Theories in EM Scattering: I Observed the Keller's Cone at a Hotel!

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Abstract

It is with utmost gratitude that I present this invited paper at this 2011 General Assembly session dedicated to the memory and professional life of Prof. Kouyoumjian. Bob, as we always called him, was a beloved educator and researcher in our profession and touched the technical life of almost everyone who dealt with the high frequency diffraction techniques. The lasting endurance of any scientific/engineering contributions is its sustained utilization and impact. Prof. Kouyoumjian's pioneering work alongside Prof. Pathak on the extension of the Keller's Geometrical Theory of Diffraction (GTD) through the construction of the Uniform Theory of Diffraction (UTD) was indeed such a contribution. His work on UTD has secured his position as one of our most celebrated researchers in our community.

Introduction

I had the fortune and privilege to closely interact with Prof. Kouyoumjian at the dawn of the development of UTD. We have had many fruitful, deep and exciting discussions on the merits of several profoundly elegant uniform theories: among them UTD (Uniform Theory of Diffraction, Kouyoumjian and Pathak), UAT (Uniform Asymptotic Theory, Lewis, Beersma and Ahluwalia; Lee and Deschamps) and STD (Spectral Theory of Diffraction, Mittra and Rahmat-Samii). All of them were originated based on a cleverly developed Ansatz. At the same time the Physical theory of Diffraction (PTD) was also developed by Prof. Ufimtsev in the Soviet Union. I recall wonderfully constructive debates and discussions about all these theories. When in 2000 Prof. Collin and I organized the millennium session at the IEEE AP-S symposium in Utah, I invited Prof. Kouyoumjian to present a historical insight into the development of UTD.

In this presentation I would like to re-visit Keller's diffraction theory and various uniform theories. Additionally, I would like to share an interesting recent experience on the observation of Keller's cone. There are of course some laser/razor-blade demonstrations of Keller's cone. I will describe my own personal encounter with the Keller's cone! In a recent trip to Orlando, Florida, as part of my IEEE AP-S Distinguished Lectureship Tour, I witnessed an amazing event. I witnessed Keller's cone! I thought it would be interesting to share this wonderful experience with the participants of this memorial session.

On Oct. 14, 2007, in my hotel in Orlando, I saw a circle of light on the front door in the early morning. I was very intrigued with the observation and thought this might be the intersection of the Keller's cone with the front door. The next question was: where does the Keller's cone come from? I noticed that through a small opening of the curtain from an opposite direction to the door, rays of light were coming into the room. Subsequently, I noted that the edge of the TV stand, which was made from some kind of shiny material, was illuminated by the sun rays. By observing the angle of the incident ray with respect to the edge and noticing that the edge of the stand was in perpendicular direction with respect to the door, it became clear how the circle was formed. Fortunately, my cell phone had a camera and I was able to document this observation. I will share my observation in this talk.