**“A Class of Printer Leaky Wave Antennas”**

## IEEE MTT/AP Orlando Chapter Meeting

**DATE/TIME: Friday, Sep. 12th ,2014 (5:00pm-6:00pm)**

**SPEAKER:** Prof. Yahia Antar, Royal Military College of Canada, Canada

**ABSTRACT:**

Leaky wave antennas form one type of traveling wave antennas in which an aperture is illuminated by the fields of a traveling wave.  Usually a leaky wave stems from a close guiding structure that supports traveling waves but has some means of continuous power leakage into the exterior region.  The illuminated aperture extends over several wavelengths and is limited by wave attenuation caused by power leakage.  In a typical leaky wave antenna structure, an incident mode travels inside a wave guiding structure with one of the sides allowing power leakage causing some perturbation to the propagating mode.  Therefore, assuming propagation in the zdirection, the mode longitudinal wave number bzs in a completely closed waveguide will be slightly changed to, say bz, and there appears, in addition an attenuation factor az.  Therefore, a leaky mode is one having a complex wave number kz = bz – jaz, where bz is less than the free space wave number k0 rendering the leaky mode to be a fast wave.  A leaky mode will radiate in a direction q given by q = sin-1(bz/k0).  Since bz is a function of frequency, it follows that the radiation beam can be steered by frequency scanning between broadside and end fire.  The beamwidth depends on the attenuation rate az.  As az is reduced, the illuminated aperture extends over larger area resulting in higher directivity and lower beamwidth.

The basic properties of leaky wave antennas were founded in the pioneering work of Tamir and Oliner back in the early 1960s and later in the work of Jackson and Oliner.  Recently, the need for high gain microstrip antennas has revived interest in leaky waves resulting in a great number of papers on printed leaky wave antennas also by Jackson and others. In here we discuss leaky waves and their supporting structures.  We describe a leaky wave mathematically as a complex plane wave.  The leaky mode supporting structure is treated as a perturbation of a closed waveguide.  A planar antenna configuration with a partially reflecting screen will be studied in detail as an example of a leaky wave antenna structure. Another example of such a structure is a multilayered planar antenna with the capability of gain enhancement.  Analysis of these two structures reveals the main properties of leaky wave antennas and provides some physical insight into their nature.  In addition, we present practical designs of one-dimensional and two-dimensional leaky wave antennas that radiate fan-shaped beams and conical or pencil beams respectively, along with some planar feeding schemes.

**BIOGRAPHY:**

Dr. Yahia Antar received the B.Sc. (Hons.) degree in 1966 from Alexandria University, and the M.Sc. and Ph.D. degrees from the University of Manitoba, in 1971 and 1975, respectively, all in electrical engineering.  
  
In 1977, he was awarded a Government of Canada Visiting Fellowship at the Communications Research Centre in Ottawa where he worked with the Space Technology Directorate on communications antennas for satellite systems. In May 1979, he joined the Division of Electrical Engineering, National Research Council of Canada, Ottawa, where he worked on polarization radar

applications in remote sensing of precipitation, radio wave propagation, electromagnetic scattering and radar cross section investigations. In November 1987, he joined the staff of the Department of Electrical and Computer Engineering at the Royal Military College of Canada in Kingston, where he has held the position of professor since 1990. He has authored or co-authored close to 200 journal papers, many chapters in books ,about 350 refereed conference papers, holds several patents, chaired several national and international conferences and given plenary talks at many conferences . He has supervised and co-supervised over 80 Ph.D. and M.Sc. theses at the Royal Military College and at Queen’s University, of which several have received the Governor General of Canada Gold Medal, the outstanding PhD thesis of the Division of Applied Science as well as many best paper awards in major international symposia. He served as the Chairman of the Canadian National Commission for Radio Science (CNC, URSI,1999-2008), Commission B National Chair (1993-1999),held adjunct appointment at the University of Manitoba, and, has a cross appointment at Queen's University in Kingston. He also serves, since November 2008, as Associate Director of the Defence and Security Research Institute (DSRI).

Dr. Antar is a Fellow of the IEEE (Institute of Electrical and Electronic Engineers), a Fellow of the Engineering Institute of Canada (FEIC), a Fellow of the Electromagnetic Academy, serves as an Associate Editor (Features) of the IEEE Antennas and Propagation Magazine, served as Associate Editor of the IEEE Transactions on Antennas and Propagation, IEEE AWPL, and was a member of the Editorial Board of the RFMiCAE Journal. He served on NSERC grants selection and strategic grants committees, Ontario Early Research Awards (ERA) panels, and on review panels for the National Science Foundation.

In May 2002, Dr. Antar was awarded a Tier 1 Canada Research Chair in Electromagnetic Engineering which has been renewed in 2009. In 2003 he was awarded the Royal Military College of Canada “Excellence in Research” Prize and in 2012 the Class of 1965 Teaching Excellence award. He was elected by the Council of the International Union of Radio Science (URSI) to the Board as Vice President in August 2008, and to the IEEE Antennas and Propagation Society Administration Committee in December 2009. On 31 January 2011, Dr Antar was appointed Member of the Canadian Defence Science Advisory Board (DSAB).

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