IEEE Macquarie University Student Branch/MTT-S Chapter
IEEE NSW AP/MTT Joint Chapter

IEEE Distinguished Lecturer Professor Per-Simon Kildal

Date : **Friday, 21 March 2014**
Time : **4:00 pm to 5:00 pm**
Location : **Building E3A, Room 244 (Seminar Room)**
Macquarie University NSW 2109
Coffee/Tea: Building E6A, Level 3 (Tea Room) at 3:30 pm (Before Lecture)

Further Information:
Contact Professor Karu Esselle (karu.esselle@mq.edu.au)

Gap Waveguides and PMC Packaging: Octave Bandwidth mm- and submm-Wave Applications of Soft & Hard Surfaces, EBGs and AMCs

The gap waveguide is a new quasi-TEM transmission line appearing in the air gap between two parallel metal plates, one of which is provided with a texture or a substrate with metal traces and patches. The waves follows strips, ridges or grooves in the texture, and are prohibited from propagating in other directions within a stopband realized by periodicities in the texture, thereby avoiding the need for conducting contact between the two metal plates. Such conducting contact is needed in normal cylindrical waveguides, and is known to be difficult and expensive to realize, in particular above 30 GHz. The waveguide has been demonstrated to have low losses and octave bandwidth. It can be potentially be applied to realize high-frequency circuits up to THz, and has demonstrated that it also can be used for packaging of passive and active circuits realized by other transmission line technologies.

The lecture will explain how the gap waveguides have evolved from research on artificial surfaces, such as the soft and hard surfaces defined in 1988, and the later high-impedance surfaces (artificial magnetic conductors) and electromagnetic bandgap (EBG) surfaces. The ideal counterparts of such surfaces can be called canonical surfaces, and Kildal states the need for the boundary conditions of the canonical surfaces to be built into commercial electromagnetics software to enable fast initial feasibility studies and designs.

The lecture will then give the basic theory of the gap waveguides and explain how they work, describe how to design the stopband of normal parallel-plate modes using different periodic metal elements, such as pins (nails), patches with via holes (mushrooms), and helices (springs), introduce the three different realizations of it referred to as ridge, strip and groove gap waveguides, and show examples of antennas and components such as OMT, couplers and filters realized in this technology. Examples of packaging applications will also be shown, using a lid of springs at low frequencies and a lid of nails at high frequencies, as well as a systematic advantageous approach to packaging referred to as PMC packaging, in which the circuit design is done inside a PEC/PMC package, and thereafter the PMC is realized.

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Professor Per-Simon Kildal's Biography

Per-Simon Kildal (M'82-SM'84-F'95) has M.S.E.E., Ph.D., and Doc¬tor Technicae degrees from the Norwegian Institute of Technology (NTH) in Trondheim. He was with SINTEF research institute in Trondheim from 1979 till 1989, and since then he has been a Professor at Chalmers Uni¬versity of Technology, Gothenburg, Sweden, where he has educated 17 persons to a PhD in antennas.

Kildal has done several services to the IEEE Antennas and Propagation Society: elected member of the administration committee 1995-97, distinguished lecturer 1991-94, associate editor of the transactions 1995-98, and associate editor of a special issue in the transactions 2005. He has authored or coauthored more than 100 journal articles or letters in IEEE or IET journal, concerning antenna theory, analysis, design and measurement. He gives short courses and organizes special sessions at conferences, and he has given invited lectures in plenary sessions at several conferences. His textbook Founda¬tions of Antennas - A Unified Approach has been well received. SINTEF awarded his work in 1984. He has received two best paper awards in IEEE Transaction on Antennas and Propagation. He holds several granted patents and patents pending.

Kildal has done the electrical design of two very large antennas, including development of the numerical methods and software: the 40m x 120m cylindrical parabolic reflector antenna of the European Incoherent Scatter Scientific Association (EISCAT), and the Gregorian dual-reflector feed of the 300m diameter radio telescope in Arecibo, the latter on a contract for Cornell University. He has invented several feeds for reflector antennas, such as the dipole-disk feed used for 10 years in the commercial satcom ship terminal of the Norwegian company NERA, the hat feed used for 10 years in commercial radio links, and the decade bandwidth log-periodic Eleven feed developed for use in radio telescopes for VLBI2010 and Square Kilometer Array (SKA).

Kildal and his co-workers have pioneered the reverberation chamber to an accurate tool for Over-The-Air (OTA) testing of small antennas and wireless devices, being commercialized in the company Bluetest AB (www.bluetest.se). Bluetest was founded in 2000, and experiences now a rapid growth in the market.

Kildal introduced the concept of soft and hard surfaces in 1988, representing a generalization of the corrugated surface, and having similarities with the later electromagnetic bandgap surface. The soft and hard surfaces are today considered as metamaterials. On this background he invented in 2008 a new quasi-TEM so-called gap waveguide that appears in the air gap between two parallel conducting plates. The gap waveguide has been demonstrated to have decade bandwidth, low loss, and application for packaging of electronic high-frequency circuits. It is expected to find application up to THz.

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