Distinguished Lecture on

Wireless Power Transfer via Wheels to Running Electric Vehicles

by

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Abstract

Electric vehicles (EVs) are strongly expected as a drastic green innovation to replace conventional gasoline engines. Unfortunately for the moment, EVs are not so widely used. This is because of their short cruising distance, long charging time, high cost, and heavy weight. These are all due to the bulky batteries onboard. Indeed chemical engineers are attempting to improve battery performance, we still need a breakthrough for this problem. As possible Maxwellian solutions, wireless feeder approaches have been recently taken for EVs exploiting magnetic coupling between two coils: one on the road and another onboard. Still however, the two coils must be put at exact places having a common axis to keep a high power-transfer efficiency. This implies mainly standing applications, not always optimal for powering while running. This lecture explores an emerging scheme stemming from a very different aspect. We focus on the steel belt usually built in a tire for vehicles. It can collect RF displacement current if another electrode is buried beneath the road by analogy to an overhead wire for railways or trolleys. Since the tire always surely touches on the road surface, it could be an ultimate wireless power transfer scheme. We call this scheme V-WPT or Via-Wheel Power Transfer. Being free from air gap (zero-gap coupling) unlike the twin coils, high dielectric constant of the tire permits high efficiency displacement current with much less electromagnetic field leakage to outside than trans-air-gap schemes. In a meaning, this is similar to electric railway, which is powered even during in motion. If EVs can employ such a feeding system, they have significant advantages of long cruising, no charging time, and lightweight. One may doubt such a scheme is really feasible. We answer yes by proposing its concept as well as possibly bringing a prototype demonstration featuring a spectacular scale model of running car to exhibit in the seminar room.

Biography

Takashi Ohira received the B.E. and D.E. degrees in communication engineering from Osaka University, Osaka, Japan, in 1978 and 1983. In 1983, he joined NTT Electrical Communication Laboratories, Yokosuka, Japan, where he was engaged in research on monolithic integration of microwave semiconductor devices and circuits. He developed GaAs MMIC transponder modules and microwave beamforming networks aboard multibeam communication satellites, Engineering Test Satellite VI (ETS-VI) and ETS-VIII, at NTT Wireless Systems Laboratories, Yokosuka, Japan. From 1999, he was engaged in research on microwave analog adaptive antennas (ESPAR antenna) and wave-engineered secret key generator devices at ATR Adaptive Communications Research Laboratories, Kyoto, Japan. Concurrently he was a Consulting Engineer for National Space Development Agency (NASDA) ETS-VIII Project in 1999, and an Invited Lecturer for Osaka University from 2000 to 2001. From 2005, he was Director of ATR Wave Engineering Laboratories, Kyoto, Japan. Currently, he is Professor of Toyohashi University of Technology. He is working on unified theory of Q factors in resonators and oscillators. He is also establishing an RF powering technology for running electric vehicles. He coauthored Monolithic Microwave Integrated Circuits (Tokyo: IEICE, 1997). Prof. Ohira was awarded the 1986 IEICE Shinohara Prize, the 1998 APMC Prize, the 2004 IEICE Electronics Society Prize, and the 2012 CEATEC Semi Grand Prix. He served as APMC International Steering Committee Chair, URSI Commission Chair, and IEICE Microwave Technical Committee Chair. He founded two regional chapters in IEEE MTT Society (Kansai Chapter in 2006 and Nagoya Chapter in 2010). He is an IEEE Fellow, and serves as IEEE Microwave Distinguished Lecturer.

Date : 25 August, 2014 (Monday)
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***** ALL ARE WELCOME *****

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