

## Distinguished Lectures on Microelectronics and Power Electronics

**Date and Time:** 7<sup>th</sup> January 2010 (Thursday), 11:30AM

**Venue:** Auditorium II in Library, University of Macau

**Prof. Adrian Ioinovici**

Professor, HIT Israel, IEEE Fellow,  
Visiting Professor, City University of Hong Kong

### SWITCHED CAPACITOR CONVERTERS

**Abstract:** Converters formed by only switches and capacitors, with no magnetic elements, can be used in portable electronic equipment due to their small size, low weight and high power density. The talk will present the controlled transfer of energy through a switched-capacitor circuit, the derivation of its dc voltage gain and efficiency formulas. Step-down and step-up dc-dc converters will be presented, as well as a SC inverter. The use of a SC converter for controlling a quasi-resonant converter will be shown. Then, switched-capacitor and switched-inductor structures will be presented for obtaining converters with large dc voltage ratio.

### ZCS FULL-BRIDGE CONVERTER WITHOUT VOLTAGE OVER-STRESS ON THE SWITCHES

**Abstract:** A new current-driven soft-switched full-bridge converter, in which all main switches are zero-current-switched (ZCS), and the switches in a switched-capacitor snubber are zero-voltage-switched (ZVS) is presented. For each value of the supply and load, the snubber capacitor is adaptively charged at the minimum necessary value for assuring soft-switching; thus, less resonant energy is circulated. There is no extra voltage stress on the switches. The current through the switches is limited to the input current. A dc analysis led to the derivation of the voltage conversion ratio. The resonant elements of the snubber circuit are optimally designed by trading-off the soft-switching range and the duty-cycle loss over a wide supply and load variation. A 530V/15kV, 5kW prototype has been built and evaluated.

### SOFT-SWITCHING CONVERTERS WITH $V_{in}/n$ VOLTAGE STRESS ON PRIMARY SWITCHES AND MULTIPLE RECTIFIER

**Abstract:** By using a special structure formed by n cells, each one containing two switches, and each one being connected across a large capacitor, a transformer with n windings and n flying capacitors, and a rectifier formed by n parallel inductor-diode branches, a dc-dc converter is obtained. Its advantages are:  $V_{in}/n$  voltage stress on each primary-side switch, ZVS of all the transistors, an output current capacity multiplied n times. As a result, the new converter serves for applications with very large input voltage, allowing for use of low-rated MOSFETs, and for large powers. A prototype with  $V_{in} = 15$  kV and  $P=2$  kW will be discussed.

**The lectures are open to the public.**

**For enquiry:**

Analog and Mixed-Signal VLSI Laboratory

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[http://www.fst.umac.mo/en/lab/ans\\_vlsi/index.html](http://www.fst.umac.mo/en/lab/ans_vlsi/index.html)

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**Adrian Ioinovici** (M'84-SM'85-F'04) received the degree in electrical engineering in 1974 and the Doctor-Engineer degree in 1981, both in Iasi, Romania.

In 1982, he joined the Holon Institute of Technology, Israel, where he is currently a (full) professor in the Electrical and Electronics Engineering Department. During 1990-1995 he was on leave from HIT, serving as a Reader and then a Professor in the Electrical Engineering Department, Hong Kong Polytechnic University. His research interests are in simulation of power electronics circuits, switched-capacitor-based converters and inverters, soft-switching DC power supplies, and three-level converters. He is the author of the book *Computer-Aided Analysis of Active Circuits* (New York: Marcel Dekker, 1990) and of the chapter "Power Electronics" in the Encyclopedia of Physical Science and Technology (Acad. Press, 2001). He has published more than 150 papers in circuit theory and power electronics.

Prof. Ioinovici has been Chairman of the Technical Committee on Power Systems and Power Electronics of the IEEE Circuits and Systems Society for repetitive terms (1995/96; 1999/2000; 2003/2004). He has served as an Associate Editor of the IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS - I and of the Journal of Circuits, Systems, and Computers for repetitive terms. He has been an Overseas Advisor of the IEICE Transactions, Japan. He was chairman of the Israeli chapter of the IEEE CAS Society between 1985-1990. and served as General Chairman of the Conferences ISCAS'86, ISCAS'88 (Herzlya, Israel), SPEC'94 (Hong Kong), organized and chaired special sessions in Power Electronics at ISCAS'91, ISCAS'92, ISCAS'95, ISCAS'2000, and was a member of the Technical Program Committee at the Conferences ISCAS'91-ISCAS'95, ISCAS'06, PESC'92-PESC'95, track chairman at ISCAS'96, ISCAS'99-ISCAS'2005, technical program committee member for IASTED International Conf. on Circuits, Signals and Systems (2004-2009), power electronics technical track chairman for IEEE Conf. Industrial Electronics and Applications (ICIEA'09) May 2009, Xian, China, and IEEE International Power Electronics and Motion Control Conf. (IPEMC 2009), Wuhan, China, co-chairman of the Special Session's Committee at ISCAS'97, co-chairman of the Tutorial Committee at ISCAS'06, and designed co-chair, Special Session Committee at ISCAS'10, Paris. He was a Guest Editor of special issues of IEEE Transactions on CAS (Aug. 1997 and Aug. 2003) and a special issue on Power Electronics of Journal of Circuits, System and Computers (Aug. 2003). He was a Fellow Committee member of the IEEE CAS Society (2005-2006), a member of the IEEE DLP (distinguished lecturer program) for 2001-2004. He serves as a referee for Natural Sciences and Engineering Research Council of Canada (NSERC).

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