



# 20th International Zurich Symposium on Electromagnetic Compatibility

## TU-3 on Monday, January 12

Title Tutorial	Numerical Inversion of Laplace Transform: Its Theory and Application in Transient Analysis of Electromagnetic Pulses
Organizer's name	Qingsheng Zeng, qingsheng.zeng@crc.ca
Organizer's affiliation	Communications Research Centre Canada

**Abstract:** The advancement of electromagnetic engineering has been driving the need to develop efficient time domain techniques for transient analysis of transmission, propagation and reception of electromagnetic pulses. This workshop addresses one method based on numerical inversion of Laplace transform, which overcomes the restrictions in previous approaches on the relative dielectric constant and the incidence angle, leads to good accuracy in both late and early time, and has a simple algorithm, short calculation time, small required memory size and readily controlled error. The emphasis in this workshop is placed on how to extend and apply this method to transient analysis of reflection and transmission of pulses. The related theoretical work and combination with Prony's method are described for the extension and application purposes. Correctness and effectiveness of this work are validated through the comparisons between our results and the published results. Furthermore, the results that cannot be generated with the previous approaches are also provided. In closing, the extended method is summarized with a discussion of its advantages and limitations.

### Tutorial Outline:

1. Introduction
2. Theory on Numerical Inversion of Laplace Transform
3. Combination with Prony's Method
4. Pulse Transient Analysis
  - Reflection from a Conductive Interface
  - Transmission through a Lossy Dielectric Slab
  - Transmission in Plasma and Waveguides
5. Parameter Estimation of Pulse Distortion
6. Conclusions

### Primary Audience:

Scientists and engineers in industrial and research agencies, faculty members, research fellows and graduate students in educational institutions.

**Novelty:** To our knowledge, this would be the first workshop that systematically treats the theory of numerical inversion of Laplace transform and its application in transient analysis of electromagnetic pulses. This workshop will highlight how to overcome the restriction that numerical inversion of Laplace transform has high demands on image functions, and will deliver the results for pulse propagation both in non-dispersive and in dispersive media, some of which cannot be achieved with the previous approaches.

**Biographies of Speaker:**

**Qingsheng Zeng** received his B. Eng. from Taiyuan University of Technology, Taiyuan, China, in 1984, his M. Eng. from Xidian University, Xian, China, in 1987, and his M. Sc. from INRS – Telecommunications, University of Quebec, Montreal, Canada, in 2002, all in electrical engineering. He is a Ph.D. candidate in the School of Information Technology and Engineering (SITE), University of Ottawa.

During 1987-1992, he worked at the Second Institute, the Chinese Ministry of Electronic Industry, as an engineer, and at Taiyuan University of Technology, as a lecturer. From 1993 to 1995, he was a visiting scholar at the Institute of High Frequency Technology, Ruhr University, Bochum, Germany. He joined Communications Research Centre Canada (CRC) as a research engineer in 2001. Since then, he has been engaged in research at CRC and also in projects related to the international activities of Industry Canada. He has undertaken research and teaching in several fields, including antennas, electromagnetics, optoelectronics, wireless and speech communications, authored and co-authored more than 30 technical publications in these fields, and serves as a reviewer for several scientific conferences and journals, including *IEEE Transactions on Antennas and Propagation*, *IEEE Transactions on Electromagnetic Compatibility*, *IEEE Microwave and Wireless Components Letters (MWCL)*, *IEEE Antennas and Wireless Propagation Letters (AWPL)*, *IEEE Antennas and Propagation Magazine*, and *International Journal of Microwave and Optical Technology (IJMOT)*. He is a member of the International Program Committee (IPC) of the IASTED (International Association of Science and Technology for Development) International Conference on Antennas, Radar and Wave Propagation (ARP), and has organized and chaired the Special Session “Progress in Time Domain Electromagnetics and Ultra Wideband (UWB) Technology” for the IASTED ARP 2007 held in Montreal, Canada, May 30 - June 1, 2007.

Currently, he has been focusing on modeling propagation of electromagnetic pulses, analyses of electromagnetic compatibility/interference (EMC/EMI), UWB antenna analysis and design, as well as the establishment of a link between information theory and electromagnetism.