Einladung des Instituts für Grundlagen und Theorie der Elektrotechnik
zum **Gastvortrag** am **20.06.2018** um **10:30 Uhr**
im Hörsaal i4, Inffeldgasse 25D/EG, 8010 Graz

Effective Medium Theories Backward in Time: from the 21st to the 19th Century:

Non-Asymptotic and Nonlocal Approximations, Interface Boundaries, Random Matrices

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Joint work with Vadim Markel (University of Pennsylvania)

Most effective medium theories for periodic electromagnetic structures are asymptotic – i.e. valid in the limit of the lattice cell size vanishingly small relative to some characteristic scale. (For wave problems, this scale is the free-space wavelength; in statics, it is the scale of variation of the applied field and/or the size of the material sample.) It is now understood, however, that in this asymptotic limit all nontrivial effects – including, notably, magnetic response of intrinsically nonmagnetic structures – vanish.

We have developed non-asymptotic and nonlocal theories applicable to an arbitrary size and composition of the lattice cell. Interface boundaries play a critical role in the analysis and are an integral part of the methodology. Numerical examples demonstrate that nonlocal models can improve the accuracy of homogenization by an order of magnitude.

Effective medium theories of classical physics (Clausius-Mossotti, Lorenz-Lorentz, Maxwell Garnett) rely on simplification assumptions that work well for relatively simple mixtures but require extensions and enhancements in more complicated cases. While our perspective is very different from that of the 19th century physics, we show that classical theories fit nicely into the proposed framework.

The material of the talk has interesting connections with the mathematical theories of Trefftz approximations and random matrices. Nanotube Application and Manufacturing (ANAM) Initiative.

Biography:

Igor Tsukerman is Professor of Electrical and Computer Engineering at the University of Akron, Ohio, USA, where he has been a faculty member since 1995. His research is focused on the simulation of nanoscale systems, applied electromagnetics and photonics. He teaches a variety of undergraduate and graduate courses (Programming for Engineers, Signals & Systems, Circuits, Electromagnetic Fields, Digital Signal Processing, Random Signal Analysis, Simulation of Nanoscale Systems, and others). Tsukerman has over 200 refereed publications. He has authored the monograph Computational Methods for Nanoscale Applications: Particles, Plasmons and Waves (Springer 2008) and co-edited another book, Plasmonics and Plasmonic Metamaterials (World Scientific 2011). Currently he is acting as Editor-in-Chief of a five-volume reference set on electromagnetic analysis and simulation, to be published by World Scientific in 2018. He is also working on the 2nd edition of Computational Methods for Nanoscale Applications.

Before coming to the University of Akron, Tsukerman worked at the Department of Electrical & Computer Engineering, the University of Toronto (1990–1995). Tsukerman's academic degrees are from St. Petersburg Polytechnic in Russia: a combined B.Sc. / M.Sc. degree (with honors) in Control Systems (1982) and a Ph.D. in Electrical Engineering (1988).