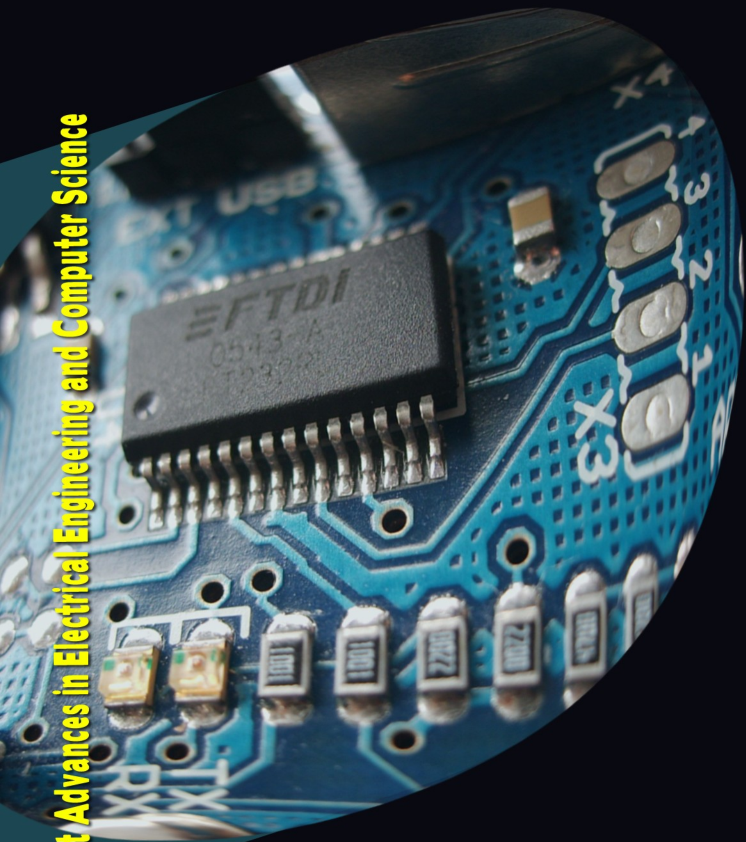
Recent Advances in Electrical Engineering and Computer Science



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Proceedings of the 2014 International Conference on Circuits, Systems and Signal Processing (CSSP '14)

Proceedings of the 2014 International Conference on Communications and Computers (CC '14)

Edited by

Yuri B. Senichenkov
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Saint Petersburg State Polytechnic University
Saint Petersburg, Russia
September 23-25, 2014

Co-organized by:
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Recent Advances in Electrical Engineering Series | 39

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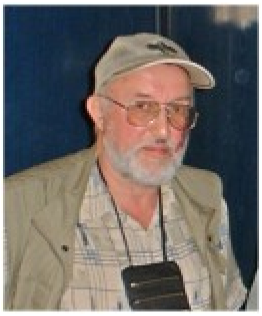
Plenary Lecture 1

Stiff Models and Gradient Methods with the Exponential Relaxation



Professor Igor G. Chernorutskiy
Saint Petersburg State Polytechnical University
Russia
E-mail: igcher@spbstu.ru

Abstract: 1. For a class of matrix gradient methods a new concept of the relaxation function is suggested. This concept allows to evaluate the effectiveness of each gradient optimization procedure, and to synthesize new methods for special classes of ill conditioned (stiff) non-convex optimization problems. According to the suggested formula , it is possible to build relevant search procedures for any given relaxation function.
2. The theorem about the relaxation conditions of each matrix gradient method is proven. Based on the concept of the relaxation functions it is given the geometric interpretation of relaxation properties of gradient methods. According to this interpretation it is possible to build a relaxation area, and to evaluate the speed of the objective function values decreasing.
3. The analysis of classical matrix gradient schemes such as simple gradient method, Newton's methods, Marquardt method is given. It is shown that the relaxation function and its geometric interpretation gives almost full information about the properties and capabilities of relevant gradient optimization methods.
4. A new class of matrix gradient methods with the exponential relaxation function (ERF) is suggested. It is shown that ERF-method summarizes the classical gradient methods including Newton methods, and Marquardt method. In contrast to these methods, ERF-methods have the relaxation functions, entirely located in the relaxation area, which significantly increases the computational efficiency of gradient methods.
5. The ERF-methods convergence for a wide class of non-convex objective functions is established.

Brief Biography of the Speaker: Dr. Chernorutskiy currently is a Professor of Saint-Petersburg State Polytechnical University (SPbSPU). Degrees (SPbSPU): Professor, 1990; Doctor of Technical Science, 1987; Associate Professor, 1982; Ph.D., 1978; M.S., 1970.
Professor Chernorutskiy is the Chair of Information & Control Systems Division of Computer Science and Engineering School (CSES).
Research Interests
Applied Software Engineering, Optimization Tools, Real - Time Systems Modeling and Simulation, Parameter Estimation, and Adaptive Optimization, Decision Support Systems, Artificial Intelligence and Expert Systems.

Plenary Lecture 2

Enhancing Efficiency and Performance of Electric Power Systems by Using Smart Grid Technology

Professor Nikolay V. Korovkin
Chef of Theoretical Electrical Engineering Department
Saint Petersburg State Polytechnical University
Russia
E-mail: nikolay.korovkin@gmail.com

Abstract: A new approach for optimization of power system states with Smart grid utilities will be proposed.
The development of electric power systems (EPS) goes to the construction of power plants, connection of new consumers to networks, introduction into service of new power transmission lines. The complication of electric power system structure and configuration results in reduction of their flexibility and has an adverse effect on the main indices of EPS performance: power distribution losses, power quality and power supply security. Actual conditions of operation and development of large EPS call for new control techniques to be introduced, that is why the elaboration of methods to control the power system operation and to optimize its states with respect to various criteria is now the trend of scientific researches of current concern.

Brief Biography of the Speaker: Education (degrees, dates, universities):
1978, Leningrad Polytechnic Institute, research engineer
1984, Leningrad State University, candidate of science (Phd)
1997, Saint Petersburg Polytechnic university, doctor of science
Career/Employment (employers, positions and dates):
1978, Leningrad State University, assistance professor
1984, Leningrad State University, docent
1997, Saint Petersburg Polytechnical university, professor
2010, Saint Petersburg Polytechnical university, head of Theoretical Electrical Engineering department

Plenary Lecture 3

Modeling of Mechanism of State and Private Partnership Development of the Social Infrastructure in the Regions

Professor, Doctor of Science, Vice Rector Vladimir V. Gluhov
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Polytechnicheskaja str., 29, 195251, St. Petersburg
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E-mail: vicerector.me@spbstu.ru

Abstract: 1. There are identified and analyzed the problems of development of social infrastructure in the regions of Russia. It is developed the mechanism and proposed the forms of cooperation for their solution on the basis of private and state partnership.
2. It is developed institutional framework for interaction between city administrations and business communities, aimed at creating an environment for effective development of the social infrastructure in the regions.
3. It is developed the game theory approach for modeling the interaction of city administrations and businesses considering the possible development of the institutional environment.
4. It is described a class of cooperative games simulating the interaction of businesses and city administration.
5. It is proposed a mechanism for solving the problems of social infrastructure development based on the analysis of game interaction models of city administrations and businesses.

Brief Biography of the Speaker: Vice-Rector for administrative and economic activity of St. Petersburg State Polytechnic University, Professor of Russian-German Center of Management and Marketing “Progress”, laureate of state prize “President of Russian Federation Prize in Higher Education”, laureate of St. Petersburg governor prize for excellence in higher education, laureate of V.V. Novozhilov prize (the Russian Academy of Sciences).
Member of following Academies:
• International Academy of Technological Cybernetics
• International Academy of Informational Support
• Baltic Academy of Informational Support
• International Academy of Ecology and Security Sciences
• Academy of Humanities
• International Academy of Higher School Science
• Academy of Municipal Sciences
The scholarly works of Vladimir V. Gloukhov develop the “effective management” research area.

Vladimir V. Gloukhov developed the full system of optimization mathematical models for iron and steel enterprises, which found their places in engineering practice and were described in “Mathematical methods and models in manufacturing planning and management” scientific work. These models formed a basis of new school of thought and applied research area – optimization models of iron and steel production.

Vladimir V. Gloukhov has also developed some methods of economic analysis of newest technological processes (in the fields of powder metallurgy, laser processing, ferrous and non-ferrous industry), which have later been implemented in many production enterprises of Russia. The theory of economic analysis of newest technological processes allowed to form the “economics and management of innovation technologies” educational direction.

Plenary Lecture 4

On Complete Monotonicity of Some Functions of the Mittag-Leffler Type in Non-Debye Relaxation Processes

Professor Francesco Mainardi
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Abstract: In this talk we discuss some interesting examples of relaxation occurring in viscoelastic and dielectric materials, which are described by special completely monotone functions of the Mittag-Leffler type. This means that these response functions are represented by continuous distributions of elementary (i.e. exponential) relaxation processes via non-negative spectra of relaxation in frequency or time. In addition to the well known functions of Mittag-Leffler type in one and two parameters, we revisit two more general kinds of Mittag-Leffler functions in three parameters, that is the Prabhakar and the Kilbas-Saigo functions. For all these functions we prove the conditions on the parameters to ensure the complete monotonicity and compute the corresponding frequency spectra. For some study-cases we present numerical results with illustrative plots for the field variable and for the corresponding spectral distribution. We hope that our results can be adopted when the field variable is the response function associated with non-Debye relaxation processes found e.g. in dielectrics. In particular we have derived as noteworthy particular cases the classical models of non-Debye relaxation phenomena referred to as Cole-Cole, Davidson-Cole, Havriliak-Negami along with the so-called Kohlrausch-Williams-Watts (KWW) law based on the stretched exponential function.

Brief Biography of the Speaker: For a full biography, list of references on author's papers and books see:
Home Page: http://www.fracalmo.org/mainardi/index.htm
and http://scholar.google.com/citations?user=UYxWyEEAAAAJ&hl=en&oi=ao

Plenary Lecture 5

From Physical to Mathematical Circuits: Theoretical and Practical Issues

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Abstract: Electrical engineers typically talk about "circuits", without first defining what a circuit really is. If we mean circuits to be sets of elements containing insulating and conducting material, as well as magnetic material, nearly everything is a circuit.

If, instead, we mean circuits as "sets of elements in which some wires that connect components to each other are clearly distinguishable", they constitute a set (the set of all possible circuits) that is a bit more limited, and maybe clear enough.

When talking about circuits, typically electrical engineers think of this latter definition. In addition, they typically assume that Kirchhoff's equations are valid for all circuits.

This creates theoretical and practical issues that are normally underestimated. In particular:

• Kirchhoff's laws are not valid in general. In the speech examples of "circuits" (according to the above definition) for which they are not valid are reported;

• the very concept of "potential" of points of the circuits is vague if not totally wrong.

The speech will discuss this inconsistence thoroughly and proposes a solution to the issues the fol-lowing approach:

• Systems in which electric and magnetic phenomena occur are simply called electromagnetic systems; for them Maxwell's equations are valid, where Kirchhoff's laws not only are not valid, but even loose meaning

• Systems in which electric magnetic phenomena occur and have a circuital shape, i.e. are com-posted by lumped components connected to each other by means of insulated wires, are called physical circuits. For them Maxwell's equations are still valid; they are susceptible to be ab-stracted in such a way that, under given conditions, mathematical circuits can be inferred from them

• Mathematical circuits, or simply circuits, are abstracted structures, that constitute under given conditions, approximations of actual physical circuits, for which Kirchhoff's equations are valid, or better, are postulated to be valid. As such, Kirchhoff's equations are just the version of the continuity (charge conservation) equation and energy conservation for mathematical circuits. Instead of the Maxwell's equations, for circuits Kirchhoff's and constitutive equations are valid.

Once circuits (the short name of mathematical circuits) are defined, not all problems are solved.

In the speech, the author shows that to obtain circuits from physical circuits containing transmission lines, for which Kirchhoff's laws are valid, is not always possible; however, a special version of them, that will be called metacircuit, will be introduced.
Again, it will be discussed that in circuits with ideal transformers do not allow Kirchhoff's laws to be written in their more common form, and special treatment is needed.
Circuits are lumped component systems: i.e., systems composed by components that are connected to each other through interfaces. Therefore their behavior over time can be computer-simulated using object-oriented tools and languages. The final part of the speech will show that the modern si-mulation language Modelica has an approach that is one perfectly in line with the analysis of this speech, and even the graphical tricks used to evidence lumped components and connections are in total agreement with the Modelica approach.
This gives additional usefulness to the approach proposed in the speech, and in its companion paper.

Brief Biography of the Speaker: Born in 1960, he took his Ms Degree in Electrical Engineering from the University of Pisa, with honours, in 1985. For some years he has worked in an Italian private research centre. Since 1992 he has been working in Electric Power Systems first as a researcher, then as a professor.
He is full professor of Electric Power Systems since 2002, and teaches Electric and Hybrid Vehicles at the University of Pisa and on-board Electrical Systems at the Naval Academy of Livorno.
He is author or co-author of more than one hundred National and International scientific papers, mainly regarding power systems, electrochemical energy storage, and electric and hybrid vehicles.
He is the chairman of the School of Engineering of the University of Pisa, that coordinates teaching activities of around 250 researchers and professors.
He is the main author of the IEEE-Wiley book "Fundamentals of Electric Power Engineering – from Electromagnetics to Power Systems".