52. IWK

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COMPUTER SCIENCE MEETS AUTOMATION

VOLUME I

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Preface

Dear Participants,

Confronted with the ever-increasing complexity of technical processes and the growing demands on their efficiency, security and flexibility, the scientific world needs to establish new methods of engineering design and new methods of systems operation. The factors likely to affect the design of the smart systems of the future will doubtless include the following:

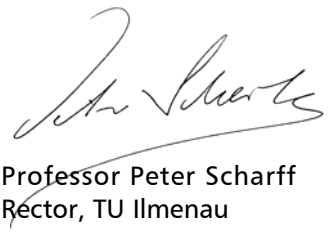
- As computational costs decrease, it will be possible to apply more complex algorithms, even in real time. These algorithms will take into account system nonlinearities or provide online optimisation of the system's performance.
- New fields of application will be addressed. Interest is now being expressed, beyond that in "classical" technical systems and processes, in environmental systems or medical and bioengineering applications.
- The boundaries between software and hardware design are being eroded. New design methods will include co-design of software and hardware and even of sensor and actuator components.
- Automation will not only replace human operators but will assist, support and supervise humans so that their work is safe and even more effective.
- Networked systems or swarms will be crucial, requiring improvement of the communication within them and study of how their behaviour can be made globally consistent.
- The issues of security and safety, not only during the operation of systems but also in the course of their design, will continue to increase in importance.

The title "Computer Science meets Automation", borne by the 52nd International Scientific Colloquium (IWK) at the Technische Universität Ilmenau, Germany, expresses the desire of scientists and engineers to rise to these challenges, cooperating closely on innovative methods in the two disciplines of computer science and automation.

The IWK has a long tradition going back as far as 1953. In the years before 1989, a major function of the colloquium was to bring together scientists from both sides of the Iron Curtain. Naturally, bonds were also deepened between the countries from the East. Today, the objective of the colloquium is still to bring researchers together. They come from the eastern and western member states of the European Union, and, indeed, from all over the world. All who wish to share their ideas on the points where "Computer Science meets Automation" are addressed by this colloquium at the Technische Universität Ilmenau.

All the University's Faculties have joined forces to ensure that nothing is left out. Control engineering, information science, cybernetics, communication technology and systems engineering – for all of these and their applications (ranging from biological systems to heavy engineering), the issues are being covered.

Together with all the organizers I should like to thank you for your contributions to the conference, ensuring, as they do, a most interesting colloquium programme of an interdisciplinary nature.
I am looking forward to an inspiring colloquium. It promises to be a fine platform for you to present your research, to address new concepts and to meet colleagues in Ilmenau.



Professor Peter Scharff
Rector, TU Ilmenau

Professor Christoph Ament
Head of Organisation

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J. Naumenko

The computing of sinusoidal magnetic fields in presence of the surface with bounded conductivity

ADVANCES IN CONTROL THEORY AND CONTROL ENGINEERING

There exist a number of technical problems in that necessary to provide a control of electro technical systems that include conducting plates and cases. The most common example of such systems is MAGLEV. The main aim of this work is the creation of the methods for computing of integral parameters of there systems such a force or electromagnetic field energy.

Let's consider the space $L_2(S)$ that consists of two-component complex square-integrable on S vector functions. We suppose that the multiconnected surface S and its boundary satisfy the Lipschitz's conditions. The space $L_2(S)$ can be decomposed to the sum: $L_2(S) = L_2^s(S) \oplus L_2^h(S) \oplus L_2^p(S)$. Here $L_2^p(S)$ consists of potential fields generalized by the Weyl [1], $L_2^s(S)$ consists of generalized solenoidal fields and $L_2^h(S)$ consists of generalized harmonic fields. Let's designate $L^S = L_2^s(S) \oplus L_2^h(S)$. We use the orthoprojector $\mathrm{P} = \mathrm{P}^{\mathrm{L}}\mathrm{P}^{\mathrm{S}}$ below where P^{S} wanishes normal to S field component and P^{L} is orthoprojector $L_2(S) \to L^S$.

The computing of sinusoidal magnetic fields in presence of the surface with bounded conductivity can be reduced to the following operator equation for eddy currents density on S:

$$\boldsymbol{\delta} = \lambda \mathrm{K} \boldsymbol{\delta} + \mathbf{f} .$$

Here $\mathrm{K} = \mathrm{P}\Gamma$, $\Gamma\boldsymbol{\xi} = \frac{1}{4\pi}\iint_S \frac{\boldsymbol{\xi}}{r} dS$, $\lambda = j\mu\gamma h\omega$ is some imaginary parameter, μ is the magnetic permeability of the medium, γ is the conductivity of the surface S, h is the thickness of the S, ω is the circle frequency of the exiting sources, $\mathbf{f} \in L^S$.

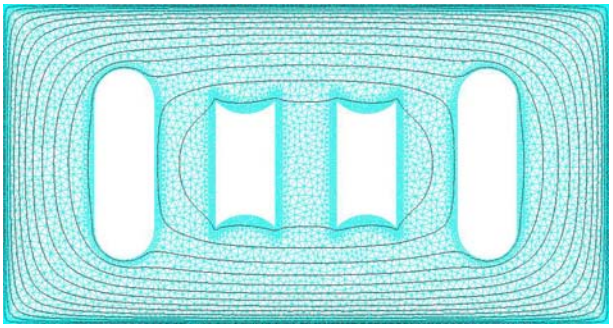

Fig. 1

We proof the existence, uniquiness and numerical stability of the described equation solution in the space L^S and also in the space $W_{2,L}^1 = L^S \cap W_2^1(S)$ by the theory of Riess – Fredholm. Here $W_2^1(S)$ is the two-component Sobolev space.

The software package was built on the basis of the described theory. Some practical problems of electrodynamics were computed by it. The example of package usage is shown on Fig.1. The exiting field is homogenous, the frequency is 500 Hz, the thickness is 1mm, the material of S is copper.

References:

[1] Weyl H. The method of orthogonal projection in potential theory // Duke Math. J. 1940. V. 7. P. 411 – 444.

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