DEPARTMENT OF PHYSICAL FOUNDATIONS OF ENGINEERING

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DEPARTMENT OF PHYSICAL FOUNDATIONS OF ENGINEERING

MAIN RESEARCH FIELDS

- Galvanomagnetic effects studies

Keywords: transducers, circuits

- Fault analysis in medium-voltage power networks

Keywords: circuits, networks

- Numerical simulation of electromagnetic field

Keywords: electric & magnetic field, 2D-FEM.

- Technical applications of magnetic liquids

Keywords: magnetic field, forces, geometry improvement, nonlinear materials.

- The analysis of two port networks as a gyrator

Keywords: gyrator, two port networks.

- Studies and investigation in solar energy

Keywords: solar energy, photovoltaic cells, numerical simulation.

- Optical features of ferofluids

Keywords: ferofluids, electromagnetic radiation, magnetic particles, heat pumps.

- Preparation of metallic oxides systems materials by several methods and structural, electric, magnetic properties study of these materials

Keywords: polycrystalline, crystalline structure, silicon solar panel, magnetic properties.

- Master equations and digital industrial radiography

Keywords: Black-Sholes equation, Fokker-Planck equations, stock market

- Heat, mass and momentum transfer processes, solidification of the materials

Keywords: heat, mass, momentum transfer processes, numerical simulation

- Quantum information and the coherent states formalism

Keywords: quantum mechanics, theory of information, quantum information

Researches in *GALVANOMAGNETIC EFECTS STUDIES*

FIELD DESCRIPTION

The domain refers to the analysis of electrical field in Hall plates and the behavior of Hall generator as a non-reciproc circuit component. Also the study refers to the determination of parameters of the Hall generator as function of the direction of the magnetic induction.

ACTIVITIES AND RESULTS

We have developed computing methods of the electric field in the Hall plates. The problem of the non-reciprocity of the Hall generator was completely elucidated by the introduction of the Hall generator non-reciprocity. As a consequence, was established a most general formulation of the condition of non-reciprocity. There were made devices as wattmeters Hall, ampermeters Hall, tesllameters Hall, and others.

RESEARCH TEAM

- Prof. doc. dr. eng. Constantin ŞORA, head of the team
- Prof. dr. eng. Ioan VETREŞ
- Prof. dr. eng. Ştefan HĂRĂGUŞ
- Assist. eng. Ildiko TATAI

RESEARCH OFFERS

Consulting on the achievement of the Hall generator and for the calculation of the electric field in the Hall plates

Researches in *FAULT ANALYSIS IN MEDIUM-VOLTAGE POWER NETWORK*

FIELD DESCRIPTION

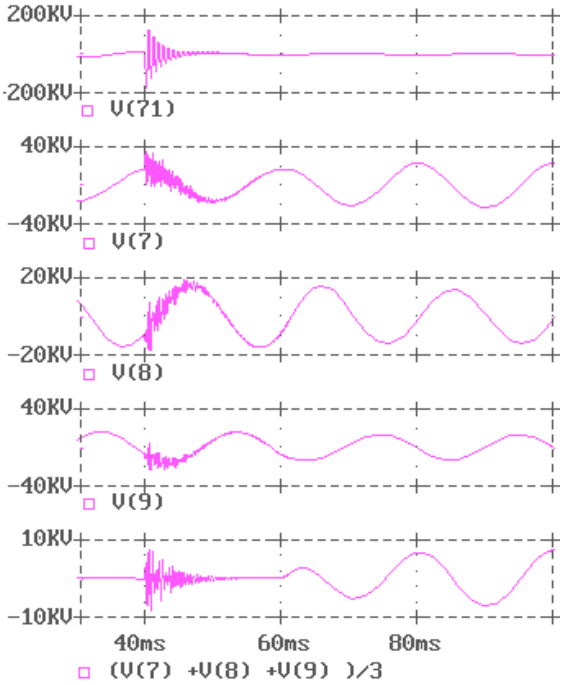
Proper detection of line-to-ground faults in medium-voltage power network depends on the neutral-grounding system in use in the considered network. Intensive research was made, both analytical and by numerical simulation, in order to obtain the correct value of the fault currents and other quantities needed for the protection.

A digital protection blok tip BHT – 10 a.

ACTIVITIES AND RESULTS

Analysis of single and double fault groundings in medium voltage power networks. Design and realization of digital relays to detect such faults in medium voltage power networks with not grounded neutral, respectively grounded via a compensation reactor. The possibility of the detection of nonsimmetries in low voltage power network was

also investigated, and a digital protective device to detect such regimes has been designed.
Simple ground faults have been simulated using PSPICE medium, in transient regimes. The results have been used to design the protection blocks. The Qfield FEM-2D program has been used to analyze the step voltage values for a ground fault in an electrical overhead line.
The results were published in technical journals, and the protective devices were implemented in the National Power System in the frame of three Grants namely MENER and CEEX. The quality of electrical energy and the compatibility of Romanian quality of electrical energy with the E.U. standards was also investigated.



Time variation of the voltages at broken conductor in resonant network

RESEARCH TEAM

- Prof. dr. eng. Dumitru TOADER
- Prof. dr. eng. Ştefan HĂRĂGUŞ
- Lect.dr.eng. Constantin BLAJ
- Lect.dr.eng. Marian GRECONICI
- Assist. drd.. eng. Daniela VESA

RESEARCH OFFERS

Research for specifically medium voltage power network, technical advice and the digital protective devices, are offered. Virtual systems for flexible modelization of different faults in medium voltage networks.

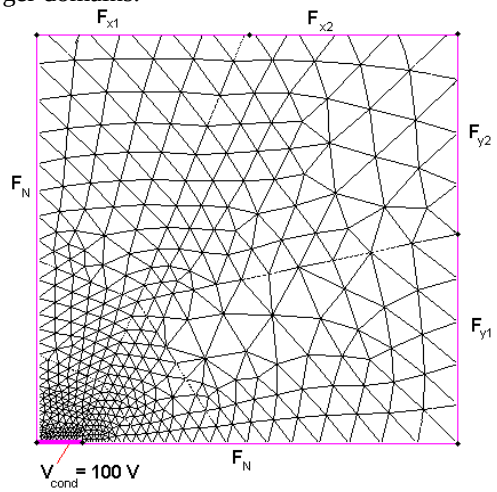
Researches in *NUMERICAL SIMULATION OF ELECTROMAGNETIC FIELDS*

FIELD DESCRIPTION

The use of numerical methods for solving electromagnetic and thermal fields in technical devices: galvanomagnetic devices, electromagnets and permanent magnet systems, magnetoelastic and high DC currents transducers, electrical machines, induction heating equipments.

ACTIVITIES AND RESULTS

Optimal design of special purposes electromagnets, high sensitivity relays with permanent magnets. Analysis of the electromagnetic and thermal field in induction heating equipments.
There is proposed a method of magnetic field analysis with FEM in iron plates packages, where very thin air gap are involved. The method uses an equivalent geometry that avoids the very small finite elements of the real air gap regions. Also, the method can be used in other situations where very thin domains are involved in connection with much larger domains.



Modelization on the quarter of the domain.

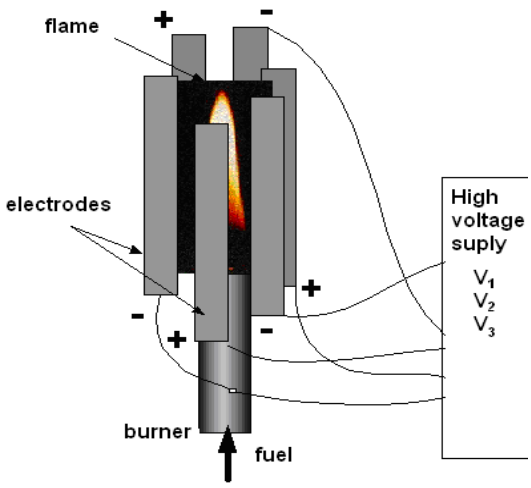
The electric field was calculated in the area of the flame of a burner, in order to improve the burning conditions of the combustible. For experiment was made a model of an adjustable burner, including the power supply for the electrodes.

RESEARCH TEAM

- Prof. doc. dr. eng. Constantin ŞORA
- Prof. dr. eng. Ioan VETREŞ
- Prof. dr. eng. Dumitru RADU
- Prof. dr. eng. Ştefan HĂRĂGUŞ
- Prof. dr. eng. Ioan BERE
- Assoc. prof. dr. eng. Dumitru IRIMIA
- Assoc. prof. dr. eng. Mariana TITIHĂZAN
- Lect. dr. eng. Constantin BLAJ
- Lect. dr. eng. Marian GRECONICI
- Assist. eng. Daniela VESA
- Prep. eng. Ildiko TATAY

RESEARCH OFFERS

Optimal design of electromagnetic devices using numerical methods. 2D-FEM numerical analysis of electromagnetic and thermal field in inductive heating processes. Dielectrics in high frequency electromagnetic fields.



The electrodes position to adjust the flame in a electrostatic field.

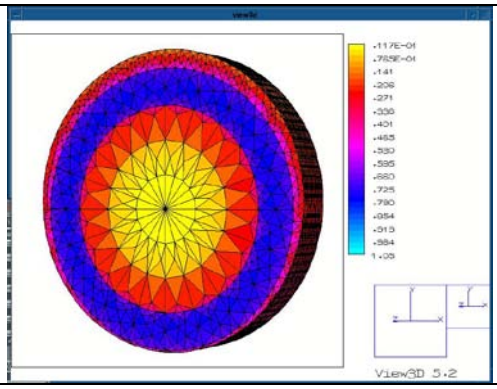
Researches in *TEHNICAL APPLICATIONS OF MAGNETIC LIQUIDS*

FIELD DESCRIPTION

The magnetic liquids have found a large interest in technical applications such as: magneto gravimetric separation, magnetic bearings and seals, pressure and flow transducers, inclinometers, accelerometers. Most of these applications are based on the magnetic field forces, depending on the magnetic properties of magnetic liquid and the geometry of the devices. The research of our group is concerned to find the adequate magnetic liquid and the geometry of the devices, in order to improve their performances.

ACTIVITIES AND RESULTS

The analytical and numerical evaluation of the magnetic force that acts on the shaft of cylindrical bearings represents the main research of the group. There has been investigated the cylindrical bearing with permanent magnetized shaft and magnetic liquid, and the cylindrical bearing with alternating poles (sandwich type structure). An approximate analytical expression of the magnetic force that acts on the shaft has been established, analyzing the influence of the geometrical design of the bearing and the magnetic properties of the liquid. The analytical results have been compared with the numerical results using a 3D-FEM program.



The magnetic field in a bearing with magnetic liquid

RESEARCH TEAM

- Lect. dr. eng. Marian GRECONICI
- Lect. dr. eng. Constantin BLAJ

RESEARCH OFFERS

Magnetic field computation for magnetofluidic devices. The evaluation of the forces and energy distribution in magnetic liquids. Geometry design improvement of ferrofluidic devices, based on field calculation.

Researches in *STUDIES AND INVESTIGATIONS IN SOLAR ENERGY*

FIELD DESCRIPTION

Energetic and exegetic efficiency of solar systems as a relation between controllable variables (flow, caption surface) as well as between uncontrollable variables (climatic and insulation magnitudes)

ACTIVITIES AND RESULTS

Solar systems producing electric energy, thermal energy, hot sanitary water and ventilation;
In the Physics Department:
Innovations for devices used in the intensity of the solar radiation measurement, installations for bitumen fluidization, solar collectors with self-focalization; experimental studies and numerical simulation of the thermal phenomena in solar collectors.

RESEARCH TEAM

- Lect. dr. Ioan LUMINOSU
- Assist. dr. Viorel CHIRITOIU
- Lect. dr. Ioan DAMIAN
- Lect. dr. Ioan ZAHARIE
- As. dr. Marius COSTACHE
- Lect. dr. Romeo NEGREA
- As. Dr. Bogdan CARUNTU

RESEARCH OFFERS

The setting, through numerical simulation, of the parameters which influence the maximizing of the photovoltaic cells efficiency.

Researches in *OPTICAL FEATURES OF FEROFLUIDS*

FIELD DESCRIPTION

Transmission and absorption of electromagnetic radiation by the ferofluids in the presence or absence of the magnetic field;
The distribution of magnetite particles after the dimension criteria;
The reology of colloidal solutions.

ACTIVITIES AND RESULTS

Heat pumps, measurement devices, magneto fluid sealing, optical transmission of the information through light signals modulation.

RESEARCH TEAM

- Lect. dr. Ioan LUMINOSU
- Prof. dr. Dusan POPOV
- Lect. dr. Ioan ZAHARIE

RESEARCH OFFERS

The invention called Solar Installation for heating through auto pumping.

Researches in *PREPARATION OF METALLIC OXIDES SYSTEMS MATERIALS BY SEVERAL METHODES AND STRUCTURAL, ELECTRIC, MAGNETIC PROPERTIES STUDY OF THESE MATERIALS*

FIELD DESCRIPTION

Preparation of polycrystalline. Transition elements oxides containing samples by using the coprecipitates thermal decomposition, ceramic and melting methods.

Crystalline structure, dielectric and magnetic properties in low or radio frequency fields, magnetic loops in the static and dynamic regime study.

The modeling of silicon solar cell, from solar panel.

ACTIVITIES AND RESULTS

a) Elaboration of ternary oxidic samples α(Fe2O3-Cr2O3-Al2O3) with different composition at the constant content of 50% and 70% mol, αFe2O3, by thermal decomposition of hydroxide coprecipitates. The investigation of these samples by X-ray diffraction and IR absorption spectra in order to correlate structure and physical properties with composition of polycrystalline samples.

Investigation on the physicochemical properties of different proveniences dolomites, as eaw dolomites and after thermal decomposition up oxides.

b) Experimental study on obtaining and on the visible and IR transmission of selective layers, SnO2 and Si, for solar radiation.

The modeling of the typical silicon solar cell, from solar panel.

RESEARCH TEAM

- Prof. dr. Minerva CRISTEA
- Prof. dr. Alicja RATUSZNA
- Lect. dr. Ioan DAMIAN
- Lect. dr. Ioan ZAHARIE
- Lect. dr. Ioan LUMINOSU
- Cercet.1 dr. Lidia TAUBERT
- Assist. dr. Marius COSTACHE
- Asist. drd. Viorel CHIRITOIU

RESEARCH OFFERS

a) This study is a part from a larger program of study of physical properties in the ternary sesquioxides system, because there is a lack of data and some data are contradictory, concerning binary and ternary systems of these Me2O3 oxides. This system presents interesting thermal, electric and magnetic properties.

Our results allow explaining some aspects of these properties.

b) The properties of obtained SnO2 and Si thin layers recommends like selective layer for insulators.

The modeling of Si solar cell yield to a numerically simulation of photovoltaic panels in different naturally insulation conditions and optimization of photovoltaic energy systems.

Researches in *MASTER EQUATIONS AND DIGITAL INDUSTRIAL RADIOGRAPHY*

FIELD DESCRIPTION

Nowadays, there is a boom in using master equation for a better understanding of market's price evolution. One tries to find reasonable solution for Black – Sholes equation, for instance. I have proposed to use the Fokker – Planck equation instead of the above one. The Fokker – Planck equation, or forward Kolmogorov equation, intends to find out the probability to have, in future, a price of a stock, if we know the price now. I solved the Fokker – Planck equation for two cases of stocks' price evolution. This field is a part of what is called today Econophysics.

Using the non-destructive methods to find the defects in materials became a usual procedure. In the last time, the radiographic methods with X and gamma rays using semiconductor detection instead of film radiography started to be of extensively use.

ACTIVITIES AND RESULTS

Regarding this subject I have proposed, to International Atomic Energy Agency, a research project, which have been approved and it will be extended on three years.

RESEARCH TEAM

- Assoc.Prof.dr. Vasile DOROBANTU
- Prof. dr. Nicolae ROBU
- Lect. dr. Simona PRETORIAN
- Assist. drd. Viorel CHIRITOIU
- Assist. dr. Marius COSTACHE
- Assist. drd. Daniel POPA

RESEARCH OFFERS

Regarding master equations, a new field is to describe the stock market using Fokker-Planck equations.

Researches in *HEAT, MASS AND MOMENTUM TRANSFER PROCESSES, SOLIDIFICATION OF THE MATERIALS*

FIELD DESCRIPTION

The solidification of the crystals (nano-crystals) and of the polycrystals (multi-crystalline Silicon) takes place within various heat, mass and momentum fields. The numerical models of the transfer processes is a very active domain of the research and can provide a deep knowledge of the phenomena associated with the solidification matter. The numerical soft Fluent™ is a commercial soft-ware, and I am using it for numerical modeling of the heat, mass and momentum fields in various solidification furnaces.

ACTIVITIES AND RESULTS

A time dependent 3D numerical model of the solidification process of large size photovoltaic Si ingots is realized. The difficulty of the model is related to the relative movement of various parts of the furnace that we solve by using a dynamic layering mesh approach. This permitted to calculate the thermal gradient, solidification rate and hydrodynamics of the silicon, which are important in order to control and optimize the grain structure of the ingot. The comparison between the numerical predictions and the experimental measurements shows a reasonable agreement. The effect of some geometrical modifications of the equipment on the thermal field is studied in order to improve the solidification process and the structure of the ingot.

RESEARCH TEAM

- Assoc. Prof. dr. Floricica BARVINSCHI
- Prof. dr. Thierry DUFFAR

RESEARCH OFFERS

The numerical simulations of heat, mass and momentum transfer can offer a deep knowledge of the phenomena associated with the solidification matter.

Researches in *QUANTUM INFORMATION AND THE COHERENT STATES FORMALISM*

FIELD DESCRIPTION

The quantum mechanics and the theory of information are two very prolific scientific fields founded in XX century. The synergetic result of their interaction is the theory of quantum information. In our researches we examine the connection between the information and the quantum states, particularly the coherent states. In this way, the coherent states formalism becomes an useful instrument to characterize the quantum information. On the other hand, a quantum system is connected by the corresponding density matrix. Their trace is the quantum partition function, which contains maximal information about the properties of the systems.

ACTIVITIES AND RESULTS

Since 1978, theoretical investigation were made on the description of the multielectronical systems (particularly, diatomic molecules) by means of the density matrix approach. This approach was applied, also, to the harmonic or anharmonic oscillators, especially the pseudoharmonical and Morse oscillators. Some results were used for the elaboration of the doctoral thesis and other scientific works in the physics journals.

RESEARCH TEAM

- Prof. dr. Duşan POPOV
- Lect. dr. Ioan ZAHARIE
- Assoc. Prof. dr. Mihai V. PUTZ
- Drd. Deian POPOV

RESEARCH CONTRACTS

1. D. Toader, CEEX 100/2005 Subcontract 12271/12.10.2005, *New methods, ecological technologies and realization solutions in accordance with the E.U. standards, to improve the electrical energy quality*, CEEX Program
2. D. Toader, GRANT 46GR/2007, Tema 13, Cod CNCSIS 377, *Virtual system for numerical simulation of the complex electric circuits with implementation in medium voltage electrical networks.*
3. D. Popov, Grant 76GR/2007, Tema 29, Cod CNCSIS A647, *Contribuţii la utilizarea formalismului stărilor coerente în fizica informaţiei cuantice.*
4. V. Dorobantu, 14201RO, International contract *Development of optimal source digital detector configurations for testing different materials and defects*.
5. I. Zaharie, CEEX 247/2006, *Cercetari privind cresterea eficientei celulelor fotovoltaice nanostructurate*.

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