## DEPARTMENT OF PHYSICAL FOUNDATIONS OF ENGINEERING

### MAIN RESEARCH FIELDS

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<td>We have developed computing methods of the electric field in the Hall plates.</td>
<td>transducers, circuits</td>
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<td><strong>Fault analysis in medium-voltage power networks and the new protections conception</strong></td>
<td>We have calculated the internal parameters of a conductor of overhead power lines using an analytical computer model, numerical methods, respectively.</td>
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<td><strong>Numerical simulation of electromagnetic field</strong></td>
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<td><strong>Technical applications of magnetic liquids</strong></td>
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<td><strong>The analysis of two port networks as a gyrator</strong></td>
<td>Also, we have calculated the internal parameters of a conductor of overhead power lines using an analytical computer model, numerical methods, respectively.</td>
<td>gyrator, two port networks.</td>
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<td><strong>The analysis and processing of biological signals</strong></td>
<td>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</td>
<td>biological signals, wavelet analysis, biomagnetic field, ECG, MCG.</td>
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<td><strong>Preparation of metallic oxides systems materials by several methods and structural, electric, magnetic properties study of these materials</strong></td>
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<td><strong>Master equations and digital industrial radiography</strong></td>
<td>We have developed computing methods of the electric field in the Hall plates.</td>
<td>Black-Sholes equation, Fokker-Planck equations, stock market</td>
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<td><strong>Heat, mass and momentum transfer processes, solidification of the materials</strong></td>
<td>Also, we have calculated the internal parameters of a conductor of overhead power lines using an analytical computer model, numerical methods, respectively.</td>
<td>heat, mass, momentum transfer processes, numerical simulation</td>
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<td><strong>Quantum information and the coherent states formalism</strong></td>
<td>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</td>
<td>quantum mechanics, theory of information, quantum information</td>
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**Researches in GALVANOMAGNETIC EFFECTS 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 ŞORĂ, head of the team
- Prof. dr. eng. Ioan VETREŞȘ
- Prof. dr. eng. Ştefan HĂRĂGUŞȘ
- Assist. dr. 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.

**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 nonsymmetries 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 phase voltages and zero sequence current at for the phase-to-ground when the network is in resonant regime

The analytical model used to calculate the parameters of the conductors of overhead lines is based on Biot-Savart-Laplace’s relation. The numerical model uses finite element method implemented in the software package OPERA. An example of discretization of the field in a conductor with three layers, is shown in the figure below.

Meshing of a heart of steel used in the phase conductor overhead lines

RESEARCH TEAM
- Prof. dr. eng. Dumitru TOADER
- Prof. dr. eng. Ștefan HÂRĂGUȘ
- Prof. dr. eng. Dumițru RADU
- Lect.dr.eng. Constantin BLAJ
- Lect.dr.eng. Marian GRECONICI
- Assist. drd. eng. Daniela VESA
- drd. eng. Iulia CATA

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. Also calculation of internal parameters of a conductor of overhead lines using an analytical computer model, numerical methods that, since its construction (number of layers, the heart of steel, etc.).

Researches in NUMERICAL SIMULATION OF ELECTROMAGNETIC FIELDS

FIELD DESCRIPTION
The use of numerical methods based on the finite element method (FEM) for solving electromagnetic and thermal fields in technical devices: electrical machines, galvanomagnetic devices, electromagnets and permanent magnet systems, magnetoelastic and high DC currents transducers, induction heating equipments. The 2D and 3D FEM program OPERA 13 of Vector Field was used in the analyzed examples.

ACTIVITIES AND RESULTS
Numerical simulation and optimization of the wind generators with permanent magnets has been analyzed. Referring to some quantities of high importance in the design process, there have been analyzed how they change when some parameters of the generators (geometry) change.

The analyzed PM wind generator

There have been analyzed the magnetic field, the flux density distribution, the radial component of
the flux density in the air gap, the cogging torque and the back EMF.

![Magnetic field lines distribution](image)

The radial component of the flux density in the air gap

![Cogging Torque](image)

The dependence cogging torque versus mechanical angle for different magnets widths

![EMF induced](image)

The back EMF induced for different rotor speeds

The FEM analysis of the electrical generators used in wind energy conversion systems, in the design process avoids some errors that could be encountered and allows optimizing some performances of the generators by some corrections on the preliminary design. Such adjustments in the generators design could have considerable economical benefits.

**RESEARCH TEAM**
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- Prof. dr. eng. Ștefan HĂRĂGUȘ
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- Assoc. prof. dr. eng. Dumitru IRIMIA
- Assoc. prof. dr. eng. Mariana TITIHÂZAN
- Lect. dr. eng. Constantin BLAJ
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- Assist. eng. Daniela VESA
- Assist. dr. 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.

**TECHNICAL 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.

**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.

**FIELD DESCRIPTION**
An accurate ECG signal, unaffected by low-frequency and high-frequency interferences, is seldom encountered in practice. Usually an electrocardiogram is affected by noise and the artifactual data is due to the movement, perspiration or breathing of the patient, electrode contact, power-line interferences, etc. This noise influences the baseline of the ECG signal, introducing a wandering which can make the inspection difficult and even mask some significant features.

**ACTIVITIES AND RESULTS**
A method to reduce the baseline wandering of an electrocardiogram signal has been developed. The method is based on stationary wavelet approximation of the whole signal. The main advantage of this method, compared with others, is the fact that it is a nonsupervised method, allowing the process to be used in an automatic analysis of electrocardiograms. Also, a denoising algorithm particularly suited to ECG signals processing has been developed. The main stage of this algorithm consists in a MAP filtering in the wavelet domain. Its effectiveness relies on the qualities of the wavelet transform and of the statistical filter used. Tests made on ECG signals, in realistic conditions, showed very promising results. The noise is almost completely removed, while the useful waveforms are preserved.

**RESEARCH TEAM**
- PhD. Stud. eng. Beatrice ARVINTI
- Lect. dr. Marius COSTACHE
- PhD.eng. Alexandru ISAR
- As. PhD.eng. Corina NAFORNITA
- PhD.eng. Dumitru TOADER

**RESEARCH OFFERS**
The processing of biologic signals, the removal of baseline wander and denoising of ECGs using the Stationary Wavelet Transform.

**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
- Prof. dr. Dusan POPOV
- Lect. dr. Ioan DAMIAN
- Lect. dr. Ioan ZAHARIE
- Lect. Dr. Nicolina POP
- Asist. drd. Viorel CHIRITOIU

**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
- Lect. Dr. Nicolina POP
- As. Dr. Bogdan CARUNTU

**RESEARCH OFFERS**

The invention called Solar Installation for heating through auto pumping.

**Researches in PREPARATION OF METALLIC OXIDES SYSTEMS MATERIALS BY SEVERAL METHODS 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 \(\alpha(\text{Fe}2\text{O}3-\text{Cr}2\text{O}3-\text{Al}2\text{O}3)\) with different composition at the constant content of 50% and 70% mol, \(\alpha\text{Fe}2\text{O}3\), 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
- Lect. dr. Marius COSTACHE
- Asist. dr. 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
- Lect. dr. Marius COSTACHE
- Assist. drd. Robert MARIA
- Assist. drd. Daniel POPA

**RESEARCH OFFERS**

Regarding master equations, a new field is to describe the stock market using Fokker-Planck equations.
Researches in REACTIVE COLLISION BETWEEN ELECTRONS AND MOLECULAR CATIONS WITH APPLICATIONS IN PLASMA PHYSICS AND ASTROPHYSICS

FIELD DESCRIPTION

Dissociative recombination (DR) of molecular cations with electrons is a major elementary process in the kinetics and in the energy balance of astrophysical ionized media (supernovae, interstellar molecular clouds, planetary ionospheres), fusion plasmas in the divertor region, hypersonic entry plasmas and in many other cold media of technological interest.

The 'Rydberg resonances', induces prominent structures in the measured cross sections, and is elegantly modelled by an approach of the DR based on the Multichannel Quantum Defect Theory (MQDT). In terms of this theory, the temporary capture states are involved in the dynamics by allowing closed channels to act on equal footing with the open ones.

ACTIVITIES AND RESULTS

The application of the MQDT theory to the two-channel and three-channel cases was studied by our research using an analytical model in order to explain the enhancing role of the closed channels in the case of weak coupling between the entrance channel and the dissociative one. The resulting analytical formulas are used to make model predictions for $H_3^+$. The computational results obtained for cross section and rate coefficients was in reasonable agreement with experimental data.

RESEARCH TEAM

- Lect. dr. Nicolina POP
- Prof. dr. Ioan SCHNEIDER
- Prof. dr. Ousmanou MOTAPON
- Prof. dr. Christian JUNGEN

RESEARCH CONTRACTS

1. Greconici Marian, Research and development of energy efficient systems for power supply and drive of electric vehicles, partener in cadrul Proiectului Universitatii din Novi Sad, Serbia finatant de Secretariatul pentru Stiinta si Tehnologie al Provinciei Voivodina, Serbia.

2. Vasiu Radu, Toader Dumitru ş.a., Dezvoltarea si sustinerea de programe postdoctorale multidisciplinare in domeniul tehnice prioritare ale strategiei nationale de cercetare - dezvoltare - inovare 4D-POSTDOC, POSDRU/87/1.5/S/52603.

3. Ionel Ioana, Toader Dumitru, Greconici Marian, ş.a., Rețea națională de formare continuă a cadrelor didactice din învățământul preuniversitar profesional și tehnice – CONCORD, POSDRU/87/1.3/S/61397

PUBLICATIONS

BOOKS


PUBLISHED PAPERS

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6. V. Sajfert , J. Jacimovski, Jovan P. Šetrajcic, Ljiljana Maškovic, N. Bednar, Pop Nicolina,


8. Tatai Ildiko, *A Comparison of Two Gyration Realization as regarding the Energy Flow control from One Port to the Other*, The 6th IEEE International Symposium on Applied Computational Intelligence and Informatics (SACI 2011), 5 pg, ISSN 978-1-4244-9107-0;


13. Vesa Daniela, *Fem Modelling Of The Magnetic Field In The Air Gap Of Weiss Electromagnet*, Scientific Bulletin Of “Politehnica” University of Timișoara, Romania, Tom 56(70), Fascicola 2, pagina 89, 7 pg, ISSN 1224-6069;

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25. Pop Nicolina, Paulescu Marius, Pacurar Angel, A New Parametric Model For Solar Irradiance Components, 10-th International Conference on Environment and Electrical Engineering, 4 pg, ISSN 978-1-444-8781-3;


31. Vjekoslav Sajfert, Pop Nicolina, Miroljub Đurić, Chiriţoiu Viorel, Popov Duşan, About some properties of phonons in the nanorods, 1-st Central and Eastern European Conference on Thermal Analysis and Calorimetry, Craiova, 7-10 September, Book of papers, 1-st Central and Eastern European Conference on Thermal Analysis and Calorimetry, pa 311, ISSN 978-606-11-1893-9;


35. Paunescu V.D., Luminosu Ioan, Pop Nicolina, Maria Robert, Pacurar A., Study of magnetite particles in a ferrofluid by size criterion, 1-st Central and Eastern European Conference on Thermal Analysis and Calorimetry, Craiova, 7-10 September, pg 321, ISSN 978-606-11-1893-9;

37. Vesa Daniela, *The effective forces exerted by the macroscopic magnetic field in ferrofluid*, Zilele Academice Timișoara, Timișoara, 26-27 mai, CD, 6 pg;