Institute of the Theory of Electrical Engineering and Electrical Measurements

REPORT 1997

Department of Electrical Engineering
Warsaw University of Technology

WARSAW UNIVERSITY OF TECHNOLOGY

Institute of the Theory of Electrical Engineering and Electrical Measurements

ANNUAL REPORT OF SCIENTIFIC ACTIVITY IN 1997

WARSAW, 1997

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I. SCIENTIFIC ACTIVITY OF THE INSTITUTE

1. OPTIMIZATION AND INVERSE PROBLEMS IN ELECTROMAGNETC FIELD THEORY
- S. Bolkowski, J. Sikora, S. Wincenciak, J. Starzynski, J. Korytkowski, M. Stodolski

Problem of analysis of electromagnetic fields: problem oriented language for field analysis; nonstandard elements for finite element method; neural network technique for mesh generation; pre- and postprocessing for data and results (visual presentation including animation); electric thermal coupled fields and eddy current problems (3D). Synthesis: efficient techniques for sensitivity analysis; optimization algorithms for nonlinear problems; identification of source functions and boundary conditions (application for computerized electrocardiography); optimal shape design; material derivative approach for optimal shape design; material structure identification.

2.ARTIFICIAL NEURAL NETWORK APPLICATION TO ELECTRICAL IMPEDANCE TOMOGRAPHY
- J. Sikora

Artificial Neural Network (ANN) application to inverse problem solution in particular for electrical impedance tomography, where the time of the solution is a very crutial point, algorithms of learning adjusted to impedance tomography, applications in different branches of engineering.

3. MATHEMATICAL MODELS DESCRIBING THE INTERACTION OF THE COUPLED FIELDS ON CONTINUOS MEDIA
- S. Krzeminski

Constitutive modeling of the interaction of the electromagnetic fields and moving electrodynamic media, methods of homogenization of nonuniform structures, analysis of the interaction of the electromagnetic fields and mobile non-Newtonian, electrically conducting fluids moving in the channels of the peristaltic walls, problems of magneto- and electrodynamic flows.

4. SYNTHESIS AND OPTIMIZATION OF POWER ELECTRONIC CIRCUITS
- K. Mikolajuk, Z. Filipowicz, A. Tobola

Synthesis of passive switching circuits: theory of LC switching one-ports and two-ports, creation of new thyristor and transistor switching structures, prticularly DC-DC converters, power electronic harmonic compensators, optimization of harmonic reduction in electrical power system, global optimization methods, computer simulation of the phenomena in the power electronic circuits.

5. RESEARCH IN THE AREA OF NEURAL NETWORKS
- S. Osowski, A. Cichocki, S. Filipowicz, M. Stodolski, K. Siwek, I. Sabała, A. Majkowski, Do Dingh Nghia, Tran Hoai Linh

Study of the properties and applications of neural networks (n.n.); development of new learning rules; methods of learning using global optimization algorithms, simulated annealing and genetic algorithms - applications in the field of electrical engineering; feedforward and recurrent dynamic n.n.; optimization using n.n., adaptive signal processing using n.n.; identification and estimation of signals for signal procesing systems using n.n.; application of n.n. in synthesis and design of electrical circuits, location of faults - application of feedforward and Kohonen networks, data compression, predictive properties of neural networks - application to load prediction of power electroenergetic system, neural fuzzy systems - study of learning rules and application in identification and prediction; blind separation and deconvolution of signals - development of new effective learning rules and its applications, PCA neural networks - learning algorithms and applications.

6. STUDY OF SINGULAR MULTIVARIABLE AND PARAMETER DISTRIBUTED SYSTEMS - DIRECT AND INVERSE PROBLEMS
- Z. Trzaska

Effective algorithms and computational procedures for analysis, synthesis, identification and design of singular dynamical multivariable systems; analysis and design of manipulators; studies of systems with distributed parameters; criogenic systems, fault diagnostic systems, geometrical approaches to dynamical system problems, electrical car drives; fundamentals and applications of the Fibonacci hyperbolic trigonometry and Fibonacci polynomials;

direct and inverse problem solutions for 2-D and N-D systems.

7. THE ELECTRIZATION OF CONDUCTING ENVIRONMENTS IN ELECTRIC AND MAGNETIC FIELD AS SOURCE OF STATIC CHARGES
- H. Rawa

Mathematical modeling and analysis of the process of displacement of free charges towards the surface of the object under electrization in the electric and magnetic field, development of the theory and computer simulation of the phenomena.

8. SIMULATION OF POWER SYSTEM LOADED BY THE HIGH POWER NONLINEAR LOAD
- W. Brociek

Modeling of the elements of power system, interaction of the system and nonlinear load of quickly changing parameters (arc furnaces, traction substations), electromagnetic compatibility of the high power nonlinear load and power system in dynamic conditions, analysis of higher harmonics using simulation languages including PCNAP and PCSPICE, quality of the delivered energy under nonsinusoidal conditions.

9. SYNTHESIS AND IDENTIFICATION OF PARAMETERS OF THE CURRENT CIRCUIT OF THE THE IMPULSE PLASMA GENERATOR
- T. Karwat

Analytic and experimental investigation leading to the identification of the electrical parameters of the plasma generator, mathematical description of the plasma chamber, quality of the titanium nitride coating of the cutting instruments in the process of thermal - chemical treatment performed in the plasma chamber and its connection with the electrical parameters of the plasma.

10. RESEARCH IN THE AREA OF DYNAMIC SYSTEMS SIMULATION AND OPTICAL CHARACTER RECOGNITION
- M. Stabrowski,

Development of dynamic systems simulation languages, computer imple-

mentation of simulation languages in integrated environment; Image processing, computer implementation of typewritten characters recognition of polish national characters, context based methods.

11. RESEARCH IN THE AREA OF PERMALLOY AND AMORPHOUS THIN FILMS
- W. Kwiatkowski, J.Konopa, E. Misiuk

Optimization of manufacturing of thin films, design of optimal layout of thin films for measurement applications, application of thin sensors for measurement of magnetic and mechanical quantities. Studies of the new approach of applicatiojn of the thermobimetals in the meaurement techniques.

12. RESEARCH IN THE AREA OF METHODS OF METROLOGY AND EXPERIMENTATION TECHNIQUES
- J. Jaworski, T. Swiderski, J. Oledzki

Mathematical modelling of physical objects and phenomena, fundamentals of the design and execution of measurement-type and identification-type experiments, design and exploitation of the measuring devices and measuring systems , design and execution of advanced experiments, mathematical methods of the measurement of data processing. Parameter identification concept of measurement, system theory and techniques of experimentation and measurement.

13. RESEARCH IN THE AREA OF OPTIMIZATION OF TEMPERATURE TRANSDUCERS
- J. Czajewski, M. Poninski, B. Zyla

Development of new generation of temperature transducers based on wide range of sensors: metal resistors, semiconductor resistors termo- couples, junction elements, microcomputer's method of linearization, simulation and hardware implementation.

14. RESEARCH IN THE AREA OF METHODS AND SYSTEMS FOR TESTING MAGNETIC MATERIALS AND SYSTEMS FOR MEASURING IMPEDANCE WITHIN THE ACOUSTIC FREQUENCY RANGE
- J. Olędzki

Parameter identification approach to magnetic material testing, adaptive techniques in testing magnetic materials, e.g. adaptive control of demagnetization, of measurement process, adaptive digital synthesis of magnetizing current waveform. Methods of identification of two- and three-terminal networks in the harmonic current circuits when model accuracy in a frequency range is specified, computer parameter identification supplemented with an automatic selection of a model structure of adequate accuracy.

15. MAGNETIC FIELD MEASUREMENTS AND THEIR APPLICATIONS
- S. Tumanski, M.Stabrowski

Sensors of magnetic fields, magnetic fields measurements, construction of magnetometers, measurements of power frequency magnetic and electric fields, nondestructive testing of electric steel sheets. Computer controlled measurement system of magnetic fields. Computer aided processing of measurement data.

16. RESEARCH IN THE AREA OF APPLICATION ON MIS STRUCTURES AS NONELECTRICAL QUANTITIES TRANSDUCERS
- B. Moeschke, A. Siedlecki

Analysis of the relation between physical quantities, particularly mechanical and semiconductor materials, application of semiconductors, monocristalic and policristalic structures and p-n structures as nonelectric quantities transducers, application of MIS-structures as nonelectric quantities measurement transducers, experiments with selected structure, designing nonelectric quantities transducer with MIS structure and joint-structure.

17. RESEARCH IN THE AREA OF ELECTROMAGNETIC FLOW MEASUREMENTS IN OPEN CHANNELS
- A. Michalski, A. Kalicki

Study of the features of electromagnetic method, development of new generation of electromagnetic flow meter dedicated for industrial open channels, optimization of primary transducer (coil, electrodes) based on the finite element idea and generalized Newton algorithm, designing small measurements systems based on one chip microcomputers.

18.RESEARCH IN THE AREA OF HIGH RESOLUTION SPECTRAL ANALYSIS, CODING AND ESTIMATION
- Z. Staroszczyk, R. Rak, D. Sawicki, A. Majkowski

Interpolating FFT methods for distorted signals measurements, power systems measurement and identyfications, parametric spectral estimation of noisy signals, transfer function measurements, digital filters applications to high resolution spectral analysis, vector quantization of FFT spectrum, two dimensional spectrum/signal presentation.

II. PUBLICATIONS

The results of the scietific activity of the Institute of the Theory of Electrical Engineering and Electrical Measurements, Warsaw University of Technology have been published in 29 journal papers (both international and national) and 70 contributions of the proceedings of the national and international conferences. Below there is a list of papers published in 1997 as well as list of books written by members of the scientific staff of the Institute.

1. THE PAPERS IN SCIENTIFIC JOURNALS: (alphabetical order)

- **International journals**

1. S. Amari, T.-P. Chen, and A. Cichocki, Stability analysis of adaptive blind source separation, Neural Networks (in print).
2. A. Cichocki, R.E. Bogner, L. Moszczynski and K. Pope, Modified Herault-Jutten algorithms for blind separation of sources, Digital Signal Processing, Vol.7, No.2, April 1997, pp.80 - 93.
3. J. Karhunen, A. Cichocki, W. Kasprzak and P. Pajunen On neural blind separation with noise suppression and redundancy reduction, Int. Journal of Neural Systems, 1997 (in print).
4. F.-L. Luo, R. Unbehauen and A. Cichocki, A minor component analysis algorithm, Neural Networks, Vol.10, No.2, March 1997, pp.291-297.
5. M.Stabrowski, Efficient Algorithm for Solving of Stiff Ordinary Diferential Equations, Simulation Practice and Theory, vol 5, 1997, pp. 333-344

6. M.Stabrowski, The Pivoted Block Solver for Large Banded Linear Equation Systems, Comunications in Numerical Methods in Engineering, vol. 13, 1997, pp. 407-415
7. Trzaska Z., State-Space-Descriptor Models and Asymptotic Behavior of Continuous-Time Positive Control Systems, International J. Computers and Mathematics with Applications, Vol.34, No. 12, 1997, pp. 1-10
8. Trzaska Z.,On factorial Fibonacci numbers, Math. Gazette., vol 81, No. 490, March 1997, pp. 82-85
9. Trzaska Z., Two-variable polynomials and continued fractions, Comm. Analyt. Th. Cont. Frac., Vol. 6, 1997, pp. 45-62
10. Trzaska Z., On 2-D Polynomials and Discrete-Continuous Systems, Jour. Appl. Math. and Computer Science, Vol.7, No.4, 1997, pp. 131-146
11. Trzaska Z., Simplest approach for solving linear differentail equations of the second order, Math. Gazette., Vol.82, No.495, July 1998, pp. 43-52
12. Trzaska Z., Foundation of Distributed Artificial Intelligence, ed. G.M.P. O'Hare and N.R. Jennings, (rev.), IEEE Concurency, Vol.5, No.4, 1997, p.82
13. S. Tumański, T. Winek, Measurements of the local values of electrical steel parameters, Journal of Magn. & Magn.Mat., v.174, s.185-191, 1997
14. S. Tumański, M. Stabrowski, The magnetovision method as a tool for investigations of electrical steel quality, Measurement Science and Technology, (in print)
15. S. Tumański, B. Fryśkowski, Investigation of the magnetic anisotropy of electrical steel, Studies in Applied Electromagnetic (in print)
16. S. Tumański, The investigations of electrical steel non-uniformity, Journal de Physique (in print)
17. S. Tumański, M. Stabrowski, 2D analysis of magnetic field strngth in GO SiFe steel sheets, Journal de Physique (in print)
18. S. Tumański, B. Fryśkowski, New method of thexture and anisotropy analysis in GO SiFe steel, Journal de Physique (in print)

- **National journals**

1. Chwaleba, J. Czerski, A. Michalski, Z. Staroszczyk, Z. Stefaniak, System respirometryczny do pomiaru zużycia O2 i wydatkowania CO2 przez rośliny i małe zwierzęta, Biuletyn informacyjny Aparatura Badawcza i Dydaktyczna COBRABiD, No 2, 1997
2. A. Michalski, A.Chwaleba, A.Kalicki Problemy praktycznej realizacji strumieniomierzy elektromagnetycznych i ich zastosowania w stacjach monitoringu wód powierzchniowych, Biuletyn Naukowy WAT Elektronika, Nr 2, 1997, pp. 93 - 110
3. A. Michalski, A.Chwaleba, A.Kalicki, H.Lipski Uniwersalny zestaw kontrolno pomiarowy do wspomagania procesów galwanotechnicznych Biuletyn informacyjny Aparatura Badawcza i Dydaktyczna COBRABiD No 1, 1997, pp. 7 - 20
4. Michalski A. Wincenciak S., Projektowanie przetwornika pierwotnego do pomiaru strumienia objętości cieczy metodą elektromagnetyczną, Biuletyn WAT, Elektronika, No 2, 1997, s.59-92.
5. K. Mikołajuk, Periodically switched Passive 1- and 2-ports. Bulletin of Polish Academy of Sciences Technical Sciences vol.45, No.3, 1997, pp.427-432.
6. Osowski S, Cichocki A., Ladder network design through optimization, Bull. of Polish Academy of Sciences., 1997, vol. 45, pp. 403 - 415
7. R. Sikora, J. Sikora, B. Pańczyk, Crack identyfication by eddy current tomography, Archives of Electrical Engineering, Vol. XLVI, No 1, pp.35-48, 1997.
8. Starzyński J., Wincenciak S., Diffpack Aided Design of 3D Eddy Currents Simulator, Archives of Electrical Engineering, Vol.XLVI, No 3, 1997, pp. 79-89.
9. Trzaska Z., New Approach to Continuous-Discrete Systems, Bull. Acad. Polon. Scie., Ser. Sci. Techn., Vol.45, No.3, 1997, pp. 433-442
10. Trzaska Z., Podstawy rozlożonej sztucznej inteligencji, edf. G.M.P. O'Hare and N.R. Jennings, (rev.), Przeglad Elektrot. Vol. LXXIII, No.11, 1997, pp. 299-300
11. S. Tumański - Nieniszczące badania blach elektrotechnicznych przy wykorzystaniu czujników magnetorezystancyjnych, Zeszyty Naukowe Pol

2. CONFERENCE PROCEEDINGS REPORTS,

- **International conferences**

1. A. Cichocki, B. Orsier, A. Back and S. Amari, On-line adaptive algorithms in nonstatiionary environments using modified conjugate gradient approach, Proc. of IEEE Workshop on NNSP, Sept. 1997
2. A. Cichocki, Blind separation and extraction of source signals - recent results and open problems, invited paper, Proc. of the 4-th Annual Conference of the Institute of Systems, Control and Information Engineers, ISCIIE, May 21-23, Osaka 1997, pp. 43-48.
3. Do Dingh Nghia, Osowski S., Shape recognition using FFT preprocepping and neural network, Intern. Symp. on Theoretical Electrical Engineering, ISTET'97, Palermo, 1997
4. M. Enakizono, T. Todaka, Y. Tsuchida, M. Akita, R. Sikora, M. Komorowski, J. Sikora, T. Chady, Non-Destructive Testing by Differential Type of Rotational Magnetic Sensor, The International Symposium on Non-Linear Electromagnetic Systems ISEM97, Braunschweig, Germany, May 12-14 1997, paper TPA2-27.
5. J.Jaworski, J.Borzymiński Measurement Traceability and Uncertainty from the view point of uniformity of measurements, International Conference on Theoretical and Practical Aspects of Metrology - 97, Mińsk (Białoruś), 1997, pp. 28 - 31
6. Korytkowski J., Starzyński J., Wincenciak S., The New Method of Handling Open Boundaries and Disconnected Regions in FEM Model of Eddy Currents, XI Conference on the Computation of Electromagnetic Fields COMPUMAG/RIO, November 2-6, 1997, Rio De Janerio, Brazil, pp. 797-798.
7. A. Krawczyk, A. Kwiatkowska, J. Sikora, Optimal Design of Two - Layer Capacitor by Means of Material Derivative, 5th Polish - Japanese Joint Seminar on Electromagnetics in Science and Technology, Gdańsk'97, May 19-21, 1997.
8. A. Krawczyk, A. Kwiatkowska, J. Sikora, Optimal Design by Means of Material Derivative, ISEF'97, Gdańsk, Sept. 25-27, 1997, pp 311-314.

9. Krzemiński S., Śmiałek M., Włodarczyk M., Finite element approximation of MHD flows - Stream - velocity magnetic potential approach, Int. Conf. ISTET, Palermo, 1997, pp. 415 - 418
10. Krzemiński S., Śmiałek M., Włodarczyk M., Analysis of magnetohydrodynamic pressure in conducting fluids, XI Conference on the Computation of Electromagnetic Fields COMPUMAG/RIO, 1997, Rio De Janerio, Brazil, pp. 1021 - 1024
11. A.Michalski A.Kalicki The Electromagnetic flow meter for open channels as a distributed measurement system Flucome'97, Fifth Triennial International Symposium on Fluid Control, Measurement and Visualization, HAYAMA, Japan 1997
12. A.Michalski, J.Starzyński, S.Wincenciak, Optimal design of the coils of the electromagnetic flow meter Compumag 1997, Conference on the XI Conference on the Computation of Electromagnetic Fields COMPUMAG/RIO, November 2-6, 1997, Rio De Janerio, Brazil, pp. 179-180.
13. Mikołajczak-Ratajewicz E., Sikora J., Starzyński J., Neural Network Approach to Inverse Problems Solution, Nonlinear Boundary Conditions Identification, Proceedings of ISEM97, Braunschweig, 1997.
14. K. Mikołajuk, M. Dzieciątko, Simulated Annealind in Otimization of Harmonic Compensators Location. ISTET 97, Palermo - Italy, 9-11.6.1997, pp.180-183.
15. Osowski S., Majkowski A., Cichocki A., Robust PCA neural networks for random noise reduction of the data, 1977 Int. Conf. on Acoustic, Speech and Signal Procepping, Munich, 1997
16. Osowski S., Łobos T., Location of remote harmonics in a power system using SVD, 15 IMACS World Congress, Berlin, 1997
17. Osowski S., Cichocki A., Tran Hoai L., Signal flow graphs in application to recurrent neural networks learning, 1997 ECCTD, Budapest, 1997
18. Osowski S., Dębowski W., Global optimization of electrical networks - comparative study, 1997 ECCTD, Budapest, 1997
19. Rak R.J.: Wavelet Transform Vector Quantization of Images, 13th International Conference on Signal Processing DSP'97, Santorini, Greece, 1997.

20. E. Ratajewicz-Mikołajczak, J. Starzyński, J. Sikora, Neural Network Approach to Inverse Problems Solution: Nonlinear Boundary Conditions Identification, The International Symposium on Non-Linear Electromagnetic Systems ISEM97, Braunschweig, Germany, 1997, paper TPB1-7.
21. E. Ratajewicz-Mikołajczak, G.H. Shirkoohi, J. Sikora, Two ANN Reconstruction Methods for Electrical Impedance Tomography, COMPUMAG 11th Conference on the Computation of Electromagnetic Fields, Rio de Janeiro, Brazil, 1997, Conference Proceedings, pp. 525-526.
22. J. Sikora, A. Kwiatkowska, A. Krawczyk, Optimal Design by Means of Shape Derivative, COMPUMAG 11th Conference on the Computation of Electromagnetic Fields, Rio de Janeiro, Brazil, Nov 2-6, 1997, Conference Proceedings, pp. 517-518.
23. R. Sikora, J. Sikora, A. Kamińska, Sensitivity Analysis for 2D Open-Boundary Regions, COMPUMAG 11th Conference on the Computation of Electromagnetic Fields, Rio de Janeiro, Brazil, Nov 2-6, 1997, Conference Proceedings, pp. 385-386.
24. R. Sikora, B. Pańczyk, J. Sikora, A. Kamińska, Non-Destructive Testing Using 2D Infinite Elements, The International Symposium on Non-Linear Electromagnetic Systems ISEM97, Braunschweig, Germany, 1997, paper MPB1-15.
25. Staroszczyk, K. Mikołajuk, Invasive methods for localisation of harmonic distortion sources in power systems, Materiały konferencyjne IV Int. Workshop on Power Definitions and Measurements under Nonsinusoidal Conditions, Milano, Italy, Sept. 1997, pp. 77-81
26. Starzyński J., Wincenciak S., On Effective Coupling of Optimization Algorithms to Solve Inverse Problems of Elektromagnetic, International Symposium on Electromagnetic Fields in Electrical Engineering ISEF'97, Gdańsk, September 25-27, 1997, pp. 322-325.
27. Trzaska Z., Studies of Transients in 2-D Systems, Proc. IFAC - Workshop MIM'97, Febr.3-5 1997, Wien, pp. 215-219
28. Trzaska Z., Combinatorial Ippue for Control Analysis of Distributed Parameter Systems, Proc.15th IMACS World Congres, Berlin, 1997, Vol.1, pp.64-69

29. Trzaska Z., On the Asymptotic Stability of Continuous-Time Positive Systems, Proc.15th IMACS World Congres, Berlin, 1997, Vol.6, pp. 575-561
30. Trzaska Z., Reactive and distortions powers- real or imaginary?, Proc. 7th European Conf. on Power Electronics and Applications, Trondheim, 8-10 Sept. 1997, Late papers volume, pp. 16-27
31. Trzaska Z., On dynamic properties of an electro-magneto-mechanical actuator, Proc. Summer School Theor. Appl. Electrot., Lvov, 1997, pp. 123-125
32. S. Tumański, B. Fryśkowski - Nondestructive investigation of electrical steel anisotropy, ISEM Conf. Proc., Paper no. MPB1-12, Braunschweig, 1997
33. S. Tumański, The investigations of electrical steel nonuniformity, Proc. SMM13, Paper no. Tpm, 6A-03, p.175, Grenoble, 1997
34. S. Tumański, M. Stabrowski - 2D analysis of magnetic field strength in GO SiFe steel sheets, Proc. SMM13, Paper no. Tpm, 6A-04, p.176, Grenoble, 1997,
35. S. Tumański, B. Fryśkowski - New method of texture and anisotropy analysis in GO SiFe steel, Proc. SMM13, Paper no. Wpm, 7A-02, p. 82, Grenoble, 1997
36. A. Wac-Włodarczyk, J. Sikora, T. Piasecki, Advanced Methods of Complex Electromagnetic Circuits Analysis by Means of PSPICE, 5th Polish - Japanese Joint Seminar on Electromagnetics in Science and Technology, Gdańsk'97, May 19-21, 1997.

- **National conferences**

1. Brociek W., Badania symulacyjne rozpływu wyższych harmonicznych prądów generowanych przez piec łukowy, III Krajowa Konf. Elektrotechnika Prądów Niesinusoidalnych, Zielona Góra, 1997, pp. 15-21
2. Brociek W., Wilanowicz R., Wymagania cyfrowe pracy odbiornika nieliniowego o szybkozmiennym obciążeniu, XX SPETO, Ustroń, 1997, pp. 283-286
3. Do Dingh Nghia, Osowski S., Rozpoznawanie kształtów przy zastosowaniu sieci neuronowej i transformacji FFT, XX SPETO, Ustroń, 1997, pp. 511 - 516

4. J.Jaworski Niedokładność, błąd niepewność, XXIX Miedzyuczelniana Konferencja Metrologów, Lublin 1997, t. 1, pp. 197-216
5. J.Jaworski, Filozofia niepewności pomiaru, V Sympozjum Klubu POLSKIE FORUM ISO 9000: Metrologia w systemach jakości - 2, Mikołajki, 1997 pp. 25-64
6. A. Kamińska, J. Sikora, Dwuwymiarowe elementy nieskończone, II Konferencja Naukowo-Techniczna Zastosowania Komputerów w Elektrotechnice ZKwE'97, Poznań/Kiekrz, 7-9 Kwietnia 1997, pp. 77-80.
7. A. Kamińska, J. Sikora, B. Pańczyk, R. Sikora, Tomografia prądów wirowych o brzegu otwartym, SPETO'97, XX Seminarium z Podstaw Elektrotechniki i Teorii Obwodów, Gliwice-Ustroń, 21-24, Maj 1997.
8. Karwat T., Zdunek K., Tworzenie modeli pola magnetycznego w akceleratorze komory plazmowej na podstawie pomiarów, V Krajowe Symp. Pomiarów Magn., Kielce, 1997
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III. KBN GRANTS

1. Synthesis and optimal shape design of electrical equipment using hybrid methods of optimization and neural networks, - prof. dr S. Bolkowski

2. Conditions of electromagnetic compatibility of the high power nonlinear load and power system in dynamic conditions - dr W. Brociek

3. Identification of multidimensional dynamic systems – prof. dr hab. A. Cichocki

4. Algorithms of analysis of the interaction of the magnetic fields and the non-Newtonian fluid in open flow chanels - doc. dr hab. S. Krzemiński

5. Computer simulation of the interaction of magnetic field on fluid conductor with moving boundary, - doc. dr hab. S. Krzemiński

6. New generation of rail measurement carriage - dr A. Michalski

7. Practical aspects of neural networks approach to signal procepping - prof. dr hab. S. Osowski

8. Recognition and description of the mechanisms of electrization of technical objects and human beeings - prof. dr hab. H. Rawa

9. Computer measurement system for visualization of distributed magnetic fields - dr hab. S. Tumański

10. Identification of the sources in distributed parameter systems - prof. dr hab. Z. Trzaska

11. Methods of optimization and identification of objects in electromagnetic fields, dr hab. S. Wincenciak

IV. PHD DISSERTATIONS

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