DAYS OF THE SCIENCE of the Technical University of Sofia, SOZOPOL 2025

ДНИ НА НАУКАТА на Технически университет – София, СОЗОПОЛ 2025

ДНИ НАУКИ Технического университета – София, СОЗОПОЛЬ 2025

35th INTERNATIONAL SCIENTIFIC SYMPOSIUM

XXXV МЕЖДУНАРОДЕН НАУЧЕН СИМПОЗИУМ

XXXV МЕЖДУНАРОДНЫЙ НАУЧНЫЙ СИМПОЗИУМ

METROLOGY AND METROLOGY ASSURANCE 2025

МЕТРОЛОГИЯ И МЕТРОЛОГИЧНО ОСИГУРЯВАНЕ 2025

МЕТРОЛОГИЯ И МЕТРОЛОГИЧЕСКОЕ ОБЕСПЕЧЕНИЕ 2025

PROGRAMME

ПРОГРАМА

ПРОГРАММА

September 7 – 11, 2025, Sozopol, Bulgaria

7 – 11 Септември 2025 г., Созопол, България

7 – 11 Сентября 2025 г., Созополь, Болгария

ORGANISED BY

Technical University of Sofia

- ***Department of Information and Measurement Technology***
- ***Department of Precision Engineering and Measuring Instruments***

Institute of Electrical and Electronics Engineers, Bulgaria Section

WITH THE ATTENDANCE OF

Bulgarian Institute of Metrology

Union of Metrologists in Bulgaria

Federation of Scientific and Technical Unions in Bulgaria

Kozloduy Nuclear Power Plant

WITH THE SUPPORT OF

RESEARCH AND DEVELOPMENT SECTOR BY THE TU-SOFIA

SOFTTRADE **NIK 47 Ltd** **R&DL "CMME"**

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- ***Катедра "Прецизна техника и уредостроене"***

Институт на инженерите по електротехника и електроника, Българска секция

С УЧАСТИЕТО НА

Български институт по метрология

Съюз на метролозите в България

Федерация на научно-техническите съюзи в България

"АЕЦ Козлодуй" ЕАД

С ПОМОЩТА НА

III. ТУ-СОФИЯ – НАУЧНО-ИЗСЛЕДОВАТЕЛСКИ СЕКТОР СОФТТРЕЙД НИК 47 ЕООД НПЛ „КИМ"

СИМПОЗИУМ ОРГАНИЗУЕТСЯ

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- ***Кафедрой Информационно-измерительной техники***
- ***Кафедрой Прецизионной техники и приборостроения***

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Союза метрологов Болгарии

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"АЭС Козлодуй" ОАО

ПРИ ПОДДЕРЖКЕ

ТУ-СОФИЯ - НАУЧНО-ИССЛЕДОВАТЕЛЬСКИЙ СЕКТОР

СОФТТРЕЙД **НИК 47 ООО** **НПЛ „КИМ"**

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Prof. Ilia Zhelezarov, PhD	TU-Gabrovo, Bulgaria

PROGRAMME / ПРОГРАМА / ПРОГРАММА

REGISTRATION / РЕГИСТРАЦИЯ	Hotel Lobby or On-line	7.09.2025	10:00 – 13:00 14:00 – 17:00
OPENING / ОТКРИВАНЕ / ОТКРЫТИЕ	Hall/Зала/Зал 1	8.09.2025	10:00 – 10:30
PAPERS AND SCIENCE NOTES ДОКЛАДИ И НАУЧНИ СЪОБЩЕНИЯ ДОКЛАДЫ И НАУЧНЫЕ СООБЩЕНИЯ	Hall/Зала/Зал 1	8.09.2025	10:30 – 11:15 11:30 – 12:30 13:30 – 14:30 14:45 – 16:00 16:15 – 17:15 17:30 – 18:45
		9.09.2025	09:00 – 10:15 10:30 – 12:30 13:00 – 14:15 14:30 – 15:30 15:45 – 16:45 17:00 – 18:00
		10.09.2025	09:00 – 10:15 10:30 – 11:30
ROUND TABLE “DIGITALIZATION IN METROLOGY” КРЪГЛА МАСА “ДИГИТАЛИЗАЦИЯ В МЕТРОЛОГИЯТА” КРУГЛЫЙ СТОЛ “ЦИФРОВИЗАЦИЯ В МЕТРОЛОГИИ”	Hall/Зала/Зал 2	9.09.2025	10:00 – 12:30
WELCOME / ДОБРЕ ДОШЛИ / ДОБРО ПОЖАЛОВАТЬ		8.09.2025	19:30
COCKTAIL / КОКТЕЙЛ / КОКТЕЙЛЬ		9.09.2025	19:30
CLOSING / ЗАКРИВАНЕ / ЗАКРЫТИЕ	Hall/Зала/Зал 1	10.09.2025	12:00
DEPARTURE / ОТПЪТУВАНЕ / ОТЪЕЗД		11.09.2025	

7 September / Септември / Сентября 2025 (Sunday / Неделя / Воскесение)	
10:00 – 13:00	**Registration / Регистрация**
14:00 – 17:00	**Registration / Регистрация**

8 September / Септември / Сентября 2025 (Monday / Понеделник / Понедельник)	
10:00 –10:30	**Opening / Откриване / Открытие**
10:30 – 11:15	**Plenary Session / Пленарно заседание / Пленарное заседание**
11:15 – 11:30	**Coffee break / Кафе пауза / Кофе перерыв**
11:30 – 12:30	**Section / Секция I** General Aspects of Metrology. Measurement Methods. Unity and Accuracy of Measurements Общи аспекти на метрологията. Методи на измерване. Единство и точност на измерванията Общие аспекты метрологии. Методы измерения. Единство и точность измерений
12:30 – 13:30	**Free time / Свободно време / Свободное время**
13:30 – 14:30	**Section / Секция I:** CONTINUES / ПРОДЪЛЖЕНИЕ / ПРОДОЛЖЕНИЕ
14:30 – 14:45	**Coffee break / Кафе пауза / Кофе перерыв**
14:45 – 16:00	**Section / Секция III** Measurement and Information Systems and Technologies Измервания и информационни системи и технологии Измерительные и информационные системы и технологии
16:00 – 16:15	**Coffee break / Кафе пауза / Кофе перерыв**
16:15 – 17:15	**Section / Секция III:** CONTINUES / ПРОДЪЛЖЕНИЕ / ПРОДОЛЖЕНИЕ
17:15– 18:45	**Section / Секция VI** Measurements in the Electrical Power Engineering Измервания в електроенергетиката Измерения в электроэнергетике
19:30	**Welcome / Добре дошли / Добро пожаловать**

9 September / Септември / Сентября 2025 (Tuesday / Вторник / Вторник)

10:00 – 12:30	**Round Table / Кръгла маса / Круглый стол** Digitalization in Metrology Дигитализация в метрологията Цифровизация в метрологии in Parallel in Hall 2 / паралелно в зала 2 / параллельно в зале 2

9 September / Септември / Сентября 2025 (Tuesday / Вторник / Вторник)	
09:00 – 10:15	**Section / Секция II** Sensors, Transducers and Devices for Measurement of Physical Quantities Сензори, преобразуватели и уреди за измерване на физични величини Сенсоры, преобразователи и приборы для измерения физических величин
10:15 – 10:30	**Coffee break / Кафе пауза / Кофе перерыв**
10:30 – 12:30	**Section / Секция XI** Quality Management and Control, Standardization, Certification, Accreditation Управление и Контрол На Качеството, Стандартизация, Сертификация, Акредитация Управление и Контроль Качества, Стандартизация, Сертификация, Акредитация
12:30 – 13:00	**Free time / Свободно време / Свободное время**
13:00 – 14:15	**Section / Секция IV** Measurements in the Industry Измервания в индустрията Измерения в промышленности
14:15 – 14:30	**Coffee break / Кафе пауза / Кофе перерыв**
14:30 – 15:30	**Section / Секция VIII** Metrology Practice Метрологична Практика Метрологическая Практика
15:30 – 15:45	**Coffee break / Кафе пауза / Кофе перерыв**
15:45 – 16:45	**Section / Секция VIII:** CONTINUES / ПРОДЪЛЖЕНИЕ / ПРОДОЛЖЕНИЕ
16:45 – 17:00	**Coffee break / Кафе пауза / Кофе перерыв**
17:00 – 18:00	**Section / Секция IX** Ionizing Radiation Measurements Измерване на Йонизиращи Лъчения Измерение Ионизирующих Излучений
19:30	**Cocktail / Коктейл / Коктейль**

10 September / Септември / Сентября 2025 (Wednesday / Сряда / Среда)	
09:00 – 10:15	**Section / Секция VII** Measurements in the Ecology, Biotechnology, Medicine, and Sport Измерване в екологията, биотехнологиите, медицината и спорта Измерения в экологии, в биотехнологиях, в медицине и в спорте

10:15 – 10:30	**Coffee break / Кафе пауза / Кофе перерыв**
10:45 – 11:30	**Section / Секция VII:** CONTINUES / ПРОДЪЛЖЕНИЕ / ПРОДОЛЖЕНИЕ
12:00 – 12:30	**Closing Session / Закриваща сесия / Заключительное заседание**

11 September / Септември / Сентября 2025 (Thursday / Четвъртък / Четверг)
Departure / Отпътуване / Отъезд

SCIENTIFIC PROGRAMME
НАУЧНА ПРОГРАМА
НАУЧНАЯ ПРОГРАММА

8 September / Септември / Сентября 2025 (Monday / Понеделник / Понедельник)

OPENING / ОТКРИВАНЕ / ОТКРЫТИЕ

10:00 – 10:30 *Chairman: Prof. D. Diakov, PhD*
Secretary: Assoc. Prof. G. Milushev, PhD
N. Gurov, MEng

PLENARY SESSION / ПЛЕНАРНА СЕСИЯ / ПЛЕНАРНОЕ ЗАСЕДАНИЕ

10:30 – 11:15 *Chairman: Prof. D. Diakov, PhD*
Secretary: Assoc. Prof. G. Milushev, PhD
N. Gurov, MEng

P.1. EC 62	Nikolay Alexandrov DIGITALIZATION OF THE PHYSICAL QUANTITIES IN THE NEW MATRIX REPRESENTATION OF THE INTERNATIONAL SYSTEM OF UNITS (SI). REPRESENTATION OF THE PHYSICAL EQUATIONS IN THE MATRIX STRUCTURE
P.2. EC 66	George Milushev, Dimka Ivanova, Valentin Starev METROLOGY - VISION AND CHALLENGES AFTER 150TH ANNIVERSARY OF THE SIGNING OF THE METRE CONVENTION

Section / Секция I

GENERAL ASPECTS OF METROLOGY. MEASUREMENT METHODS. UNITY AND ACCURACY OF MEASUREMENTS

ОБЩИ АСПЕКТИ НА МЕТРОЛОГИЯТА. МЕТОДИ НА ИЗМЕРВАНЕ. ЕДИНСТВО И ТОЧНОСТ НА ИЗМЕРВАНИЯТА

ОБЩИЕ АСПЕКТЫ МЕТРОЛОГИИ. МЕТОДЫ ИЗМЕРЕНИЯ. ЕДИНСТВО И ТОЧНОСТЬ ИЗМЕРЕНИЙ

11:30 – 12:30 *Chairman: Prof. I. Zakharov, DSc*
13:30 – 14:30 *Secretary: Assist. Prof. I. Blagov, PhD*
N. Gurov, MEng

I.1. EC 7	Iryna Morozova, Olga Ivanets, Rimvidas Khrashchevskyi, Pavlo Kulakov, Rynat Salimov and Anton Plugovyi INCREASING THE RELIABILITY OF DIAGNOSIS AND CONTROL IN THE UNCERTAINTY OF PRIMARY INFORMATION
I.2. EC 11	Nikolay Koshevoy, Tatiana Rozhnova, Olena Kostenko, Maksym Tsekhovskyi, Oleksii Potylchak and Andrii Andriushko METHODOLOGY FOR DEVELOPING MEASURING TRANSDUCERS OF PHYSICAL QUANTITIES
I.3. EC 40	Rumyana Komarska MECHANICAL NEURAL NETWORKS

I.4. EC 41	Dobri Komarski, Dimitar Diakov, Velizar Vassilev and Hristiana Nikolova STUDY OF TRIPOD ELASTIC PARALLEL MECHANISM FOR MECHANICAL NEURAL NETWORK
1.5. EC 46	Radoslav Marinov COMPARISON OF GUM AND MONTE CARLO METHODS FOR EVALUATION THE MEASUREMENTS UNCERTAINTY OF DC VOLTAGE, DC MAGNETIC FLUX DENSITY AND DC RESISTANCE
I.6. EC 47	Igor Zakharov, Kiril Banev, Elena Nicolova, Dimitar Diakov, Olesia Botsiura and Oleg Novoselov PROCEDURE FOR REVISING THE INTERCALIBRATION INTERVAL OF MEASURING INSTRUMENTS
I.7. EC 61	Igor Zakharov and Olesia Botsiura MEASURING THE OBJECTS COORDINATES IN THREE-DIMENSIONAL SPACE USING THE RANGEFINDER METHOD
I.8. EC 63	Roald Taymanov and Kseniia Sapozhnikova WHAT KIND OF ROBOT DO YOU NEED: A FRIEND OR A SERVANT?

Section / Секция III

MEASUREMENT AND INFORMATION SYSTEMS AND TECHNOLOGIES

ИЗМЕРВАТЕЛНИ И ИНФОРМАЦИОННИ СИСТЕМИ И ТЕХНОЛОГИИ

ИЗМЕРИТЕЛЬНЫЕ И ИНФОРМАЦИОННЫЕ СИСТЕМЫ И ТЕХНОЛОГИИ

14:45 – 16:00
16:15 – 17:15

Chairman: A. Yovcheva, PhD
Secretary: Assist. Prof. A. Pandelova, PhD
Assist. Prof. B. Dzhudzhev, PhD

III.1. EC 2	Teodor Popov, Bozhidar Dzhudzhev, Antonia Pandelova and Nikolay Stoyanov DEVELOPMENT OF AIR PURIFICATION DRONE
III.2. EC 3	Teodor Popov, Bozhidar Dzhudzhev, Antonia Pandelova and Nikolay Stoyanov RESEARCH ON AIR PURIFICATION DRONE
III.3. EC 4	Maryna Miroshnyk, Olga Zaichenko, Anatolii Miroshnyk and Nataliia Hapon MULTIPLE-FREQUENCY ANALYSIS METHOD FOR NON-DESTRUCTIVE TESTING OF 3D FILAMENT PARAMETERS
III.4. EC 12	Marina Miroshnyk, Boris Sytnik, Volodymyr Bryksin, Anatolii Miroshnyk, Yurii Pakhomov and Andrei Shafranskyi SYSTEM OF INDEX IDENTIFICATION OF PARAMETERS OF THE EQUIVALENT MODEL OF SUBSTITUTION OF OBJECTS WITH DISTRIBUTED PARAMETERS
III.5. EC 18	Boris Velev, Bozhidar Dzhudzhev, Vladimir Kamenov and Vladimir Dimitrov DEVICE FOR RAPID TESTING OF LITHIUM-ION BATTERIES
III.6. EC 20	Aleksey Erpalov, Vladimir Sinitsin, Olga Ibryaeva and Aleksander Shestakov DECOMPOSITION-BASED AUGMENTATION OF MULTIVARIATE TIME-SERIES MEASUREMENT DATA
III.7. EC 24	Krasimir Bosilkov, Snezhana Spasova and Elena Nikolova AUTOMATED WORKPLACE FOR METROLOGICAL VERIFICATION OF INDUSTRIAL PLATINUM RESISTANCE THERMOMETER
III.8. EC 26	Stoyan Doynov and Filip Filipov AUTOMATED SYSTEM FOR SILICA MEASURING - “AMI SILICA” TYPE

III.9. EC 49	Dimitar Dichev, Iliya Zhelezarov, Tsanko Karadzhov, Borislav Georgiev, Oleksandr Kupriyanov, Ralitza Dicheva and Krasimir Drumev IMPROVING ACCURACY IN DYNAMIC SYSTEMS THROUGH ADAPTIVE IDENTIFICATION OF MODEL ERRORS WITHIN THE KALMAN FILTER STRUCTURE

Section / Секция VI

MEASUREMENTS IN THE ELECTRICAL POWER ENGINEERING
ИЗМЕРВАНИЯ В ЕЛЕКТРОЕНЕРГЕТИКАТА
ИЗМЕРЕНИЯ В ЭЛЕКТРОЭНЕРГЕТИКЕ

17:30 – 18:45

Chairman: Assoc. Prof. G. Milushev, PhD
Secretary: Assist. Prof. K. Galabov, PhD
N. Gurov, Meng

VI.1. EC 23	Anton Pavlovich, Artem Orlov, Gennady Antipov, Elizaveta Koniushenko, Nikolay Serov and Andrey Serov COMPARATIVE ANALYSIS OF THE EFFICIENCY OF WINDOW FUNCTIONS FOR THE FREQUENCY MEASUREMENT METHOD BASED ON THE AMPLITUDE SPECTRUM ANALYSIS
VI.2. EC 29	Mykola Kundenko, Ivaylo Blagov, Antonina Rybalka, Vitalii Mardziavko and Andrii Rudenko METHODOLOGY FOR ASSESSING THE INFLUENCE OF GEOMETRIC PARAMETERS OF OPEN RESONATORS ON THE METROLOGICAL CHARACTERISTICS OF ENERGY LOSSES
VI.3. EC 35	Elizaveta Budkina, Alsu Nurtdinova, Ekaterina Dolgacheva, Alexander A. Shatokhin, Nikolay Serov and Andrey Serov APPLICATION OF THE VERNIER METHOD TO REDUCE THE EFFECT OF AMPLITUDE SPECTRUM LEAKAGE
VI.4. EC 54	Iliyana Bogdanova, George Milushev and Krasimir Galabov INCOMING INSPECTION OF VACUUM CIRCUIT BREAKERS
VI.5. EC 55	George Milushev ELECTRICAL POWER - THE MISSING ELEMENT IN ELECTRICAL POWER QUALITY ASSESSMENT AND STANDARTISATION

9 September / Септември / Сентября 2025
(Tuesday / Вторник / Вторник)

Round Table
Кръгла маса
Круглый стол

DIGITALIZATION IN METROLOGY
ДИГИТАЛИЗАЦИЯ В МЕТРОЛОГИЯТА
ЦИФРОВИЗАЦИЯ В МЕТРОЛОГИИ

Organised with UMB in Parallel in Hall 2
Организирана със СМБ паралелно в зала 2
Организован с СМБ параллельно в зале 2

10:00 – 12:30

Chairman: D.Ivanova, PhD
Secretary: A. Yovcheva, PhD
Assoc. Prof. G. Milushev, PhD

RT.1.	A. Yovcheva EURAMET AND DIGITAL TRANSFORMATION

RT.2.	Tzvetelin Petkov DIGITALIZATION IN METROLOGY - TECHNOLOGY TRANSFORMATION OR WAY OF THINKING
RT.3.	DEMONSTRATIONS OF DIGITAL SOLUTIONS IN METROLOGY

<u>Section / Секция II</u>

SENSORS, TRANSDUCERS AND DEVICES FOR MEASUREMENT OF PHYSICAL QUANTITIES

СЕНЗОРИ, ПРЕОБРАЗУВАТЕЛИ И УРЕДИ ЗА ИЗМЕРВАНЕ НА ФИЗИЧНИ ВЕЛИЧИНИ

СЕНСОРЫ, ПРЕОБРАЗОВАТЕЛИ И ПРИБОРЫ ДЛЯ ИЗМЕРЕНИЯ ФИЗИЧЕСКИХ ВЕЛИЧИН

9:00 – 10:15

Chairman: Assoc. Prof. N. Stoyanov, PhD
Secretary: Assist. Prof. D. Komarski, PhD
Assist. Prof. B. Dzhudzhev, PhD

II.1. EC 10	Nikolay Koshevoy, Tatiana Rozhnova, Olena Kostenko, Oleksandr Zabolotnyi, Vitalii Siroklyn and Andriushko Andrii NEW FIBER-OPTIC TRANSDUCERS OF PHYSICAL QUANTITIES
II.2. EC 17	Oleksandr Zabolotnyi, Andrii Khodieiev, Roman Trishch and Vitalii Zabolotnyi INFRARED TURBIDITY SENSORS APPLICATION FOR THE WATER IN DIESEL EMULSION STABILITY CONTROL
II.3. EC 19	Artem Yakovenko and Alexander Shestakov SELF-DIAGNOSING MULTI-POINT THERMOCOUPLE MEASUREMENT CIRCUIT WITH DECISION TREE-BASED ERROR CORRECTION
II.4. EC 21	Denys Onishchuk, Kyrylo Titov and Vitalii Svitlychnyi DEVELOPMENT OF A DIGITAL COLOR MEASUREMENT SENSOR
II.5. EC 25	Luboslav Hristov, Momchil Lazarov and Ivan Ivanov AUTOMATED METROLOGY VERIFICATION AND DIAGNOSTICS OF PRESSURE TRANSDUCERS

<u>Section / Секция X</u>

QUALITY MANAGEMENT AND CONTROL, STANDARDIZATION, CERTIFICATION, ACCREDITATION

УПРАВЛЕНИЕ И КОНТРОЛ НА КАЧЕСТВОТО, СТАНДАРТИЗАЦИЯ, СЕРТИФИКАЦИЯ, АКРЕДИТАЦИЯ

УПРАВЛЕНИЕ И КОНТРОЛЬ КАЧЕСТВА, СТАНДАРТИЗАЦИЯ, СЕРТИФИКАЦИЯ, АКРЕДИТАЦИЯ

10:30 – 12:30

Chairman: Prof. B. Sotirov, PhD
Secretary: Assist. Prof. D. Komarski, PhD
Assist. Prof. B. Dzhudzhev, PhD

X.1. EC 1	Velizar Vassilev and Dobri Komarski STUDY OF THE CAPABILITIES OF A RETROFITTED ROUNDNESS MEASURING INSTRUMENT
X.2. EC 9	Tzvetelin Gueorguiev, Iliya Zhelezarov and Miroslav Kokalarov APPLICATION OF QUALITY TOOLS IN THE AUTOMOTIVE INDUSTRY
X.3. EC 15	Ivan Ivanchev EXPERIMENTAL DETERMINATION OF CURVATURE OF RC ELEMENTS SUBJECTED TO BENDING

X.4. EC 16	Ivan Ivanchev COMPARISON OF EXPERIMENTALLY DETERMINED DEFLECTIONS OF RC BEAMS WITH THOSE CALCULATED ACCORDING EC2 USING THE REAL CURVATURE
X.5. EC 36	Martin Ralchev, Valentin Mateev, Iliana Marinova, Georgi Kotlarski, Stefan Valkov and Maria Ormanova CONTACT FORCE CONTROL FOR SURFACE ELECTRIC IMPEDANCE MEASUREMENTS
X.6. EC 38	Roald Taymanov and Kseniia Sapozhnikova MEASURING THE QUALITY OF PRODUCTS AND SERVICES USING ARTIFICIAL INTELLIGENCE SYSTEMS
X.7. EC 48	Dimcho Pulov and Krasimir Drumev A SYSTEM OF CRITERIA FOR EVALUATING THE QUALITY OF OPTICAL SYSTEMS
X.8. EC 53	Boryana Ilieva-Mihaylova THE ROLE OF STANDARDS IN PROMOTING CIRCULAR CONSTRUCTION AND SUSTAINABLE BUILDING PRACTICES

Section / Секция IV

MEASUREMENTS IN THE INDUSTRY
ИЗМЕРВАНИЯ В ИНДУСТРИЯТА
ИЗМЕРЕНИЯ В ПРОМЫШЛЕННОСТИ

13:00 – 14:15

Chairman: Prof. D. Dichev, DSc
Secretary: Assist. Prof. D. Komarski, PhD
Assist. Prof. I. Blagov, PhD

IV.1. EC 31	Radoslav Keremidchiev ENHANCING DEEP NEURAL NETWORK CLASSIFICATION IN FINANCIAL APPLICATIONS: A HYBRID RULE-BASED ALERT SYSTEM FOR ERROR DIAGNOSIS
IV.2. EC 33	Abdullahi Abdulkadir, Alexander Ichtev, Saheed Salahudeen Abdullahi, Alexander Gegov, Olumiyiwa Mathew and Aliyu Umar OIL WELL PERFORMANCE MODELING UNDER MEASUREMENT UNCERTAINTY USING FUZZY LOGIC
IV.3. EC 37	Teodor Grakov, Valentin Mateev, Iliana Marinova, Georgi Kotlarski, Stefan Valkov and Maria Ormanova TEMPERATURE MODELING OF SOFT METAL FDM 3D PRINTING PROCESS
IV.4. EC 51	Tsanko Karadzhov, Dimitar Dichev, Iliya Zhelezarov, Borislav Georgiev, Dimcho Pulov, Krasimir Drumev and Hristiana Nikolova IMPROVING THE ACCURACY OF TEMPERATURE MEASUREMENT WITH THERMORESISTIVE SENSORS
IV.5. EC 52	Dimitar Dichev, Iliya Zhelezarov, Borislav Georgiev, Tsanko Karadzhov, Oleksandr Kupriyanov, Ralitza Dicheva, Krasimir Drumev and Hristiana Nikolova AN ADAPTIVE APPROACH TO DETERMINING THE NOISE AND MEASUREMENT ERROR VARIANCES IN SYSTEMS USING THE KALMAN FILTER

Section / Секция VIII

METROLOGY PRACTICE
МЕТРОЛОГИЧНА ПРАКТИКА
МЕТРОЛОГИЧЕСКАЯ ПРАКТИКА

14:30 – 15:30
15:45 – 16:45

Chairman: Prof. D. Diakov, DSc
Secretary: Assist. Prof. K. Galabov, PhD
Assist. Prof. I. Blagov, PhD

VIII.1. EC 6	Miryana Masheva, Tzvetelin Gueorguiev and Hristiana Nikolova METHODOLOGY FOR VERIFICATION OF EXHAUST GAS ANALYSERS IN TECHNICAL INSPECTION POINTS
VIII.2. EC 14	Ivaylo Stoyanov VERIFICATION PROCEDURE FOR LOW SPEED AUTOMATIC INSTRUMENTS FOR WEIGHING ROAD VEHICLES IN MOTION AND MEASURING AXLE LOADS
VIII.3. EC 28	Petko Sinapov METHODOLOGY FOR THE VERIFICATION OF ROLLER BRAKE TESTERS FOR ROAD VEHICLES
VIII.4. EC 30	Valerii Semenikhin, Dmytro Taran and Inna Moshchenko SPECIAL REQUIREMENTS FOR CALIBRATION OF CLIMATE CHAMBERS
VIII.5. EC 50	Borislav Georgiev, Dimitar Dichev, Iliya Zhelezarov, Tsanko Karadzhov and Krasimir Drumev COMPARATIVE ANALYSIS OF CLASSICAL AND HYBRID SIGNAL PROCESSING IN AN ELECTRO-HYDRAULIC SYSTEM
VIII.6. EC 57	Zlatka Chavdarova, Desislava Koleva and Hristiana Nikolova VERIFICATION OF THE METHODOLOGY FOR VERIFICATION OF PRESSURE GAUGES USED IN PRESSURE EQUIPMENT AND RAILWAY TRANSPORT
VIII.7. EC 65	Dimitar Diakov, Desislava Dimitrova and Hristiana Nikolova INDUSTRIAL CMM CLASIFICATION
VIII.8. EC 45	Radoslav Deliyski, Radoslav Vasilev and Veselin Petrov APPLICATION OF INERTIAL MEASUREMENT UNIT GY-521 IN LENGTH MEASUREMENT AND STEPS COUNTING

<u>Section / Секция XI</u>

IONIZING RADIATION MEASUREMENTS
ИЗМЕРВАНЕ НА ЙОНИЗИРАЩИ ЛЪЧЕНИЯ
ИЗМЕРЕНИЕ ИОНИЗИРУЮЩИХ ИЗЛУЧЕНИЙ

17:00 – 18:00

Chairman: K. Banev, MEng
Secretary: K. Bosilkov, MEng
Assist. Prof. A. Pandelova, PhD

XI.1. EC 34	Aleks Manchev and Dimitar Dimitrov INTERLABORATORY COMPARISON OF RESULTS OBTAINED BY METHODS FOR ANALYSIS OF LIQUID RADIOACTIVE SAMPLES
XI.2 EC 42	Vladislav Todorov, Strahil Georgiev, Petya Kovacheva and Krasimir Mitev USE OF TDCR SYSTEMS AT SOFIA UNIVERSITY FOR CONTROL OF CERTIFIED RADIOACTIVE SOLUTIONS
XI.3. EC 43	Temenuzhka Stoyanova, Neli Ivanova and Alexander Mladenov METROLOGYCAL ASSURANCE IN IONIZING RADIATION MEASUREMENTS AT KOZLODUY NPP EAD - ACCEPTANCE AND DEVELOPMENT
XI.4. EC 44	Bozhidar Krastev, Strahil Georgiev, Vladislav Todorov, Ivelina Dimitrova and Krasimir Mitev STUDIES ON THE FEASIBILITY OF RAPID TESTING METHODS FOR ELECTRONIC RADON DETECTORS

10 September / Септември / Сентября 2025 (Wednesday / Сряда / Среда)

Section / Секция VII

MEASUREMENTS IN THE ECOLOGY, BIOTECHNOLOGY, MEDICINE, AND SPORT

ИЗМЕРВАНЕ В ЕКОЛОГИЯТА, БИОТЕХНОЛОГИИТЕ, МЕДИЦИНАТА И СПОРТА

ИЗМЕРЕНИЯ В ЭКОЛОГИИ, В БИОТЕХНОЛОГИЯХ, В МЕДИЦИНЕ И В СПОРТЕ

09:00 – 10:15
10:30 – 11:30

Chairman: Assoc. Prof. N. Stoyanov, PhD
Secretary: Assist. Prof. D. Komarski, PhD
Assist. Prof. A. Pandelova, PhD

VII.1. EC 5	Ihor Hryhorenko, Iurii Khoroshailo, Svitlana Hryhorenko and Pavlo Biletskyy METROLOGICAL ANALYSIS OF COLORIMETRIC CONTROL TOOLS FOR BIOLOGICAL OBJECTS
VII.2 EC 8	Olga Ivanets, Rimvidas Khrashchevskyi, Maryna Arkhyrei, Vladyslav Shlykov, Oleksii Horskyi and Nataliia Bilak FEATURES OF USING NONLINEAR DYNAMICS METHODS FOR ANALYZING THE STABILITY OF AN OBJECT'S FUNCTIONING
VII.3. EC 13	Iurii Y. Khoroshailo, Yuriy P. Gnidenko, Maksym V. Korbetskyi, Oleksandr B. Galat and Oleksandr Degtiarov RESEARCH OF APPLICABILITY OF THE ELECTRONIC COLORIMETRY METHOD IN MEDICAL DIAGNOSTICS
VII.4. EC 22	Lidiia Solodovnikova, Volodymyr Semynozhenko, Ilias Shcherbakov, Nadiia Markina, Serhii Chumachenko and Antonina Korotenko ASSESSMENT OF MILITARY OPERATIONS IMPACT ON POLLUTION OF WATER RESOURCES AND SOIL IN KHARKIV CITY AND KHARKIV REGION
VII.5. EC 32	Mykola Kundenko, Antonina Rybalka, Ivaylo Blagov, Larisa Vakhonina, Vitalii Mardziavko and Andrii Rudenko DEVELOPMENT OF A SYSTEM FOR MEASURING THE DIELECTRIC PERMEABILITY OF THE AIR ENVIRONMENT TO IMPROVE THE STORAGE OF POUME FRUITS
VII.6. EC 56	Stamen Sarchev, Antonia Pandelova, Bozhidar Dzhudzhev and Nikolay Stoyanov MONITORING OF PARTICULATE MATTER POLLUTION FOR THE REGION OF THE CITY OF KARDZHALI
VII.7. EC 58	Victor Arsov and Juliana Javorova APPLICATION OF A METHODOLOGY FOR MEDICAL DEVICE CLASSIFICATION TO SELECTED PRACTICAL CASES
VII.8. EC 59	Dimitar Diakov and Hristiana Nikolova SIMULATION STUDY OF FEMORAL-ACETABULAR IMPLANTS FATIGUE
VII.9. EC 60	Dimitar Diakov, Hristiana Nikolova and Alexander Gerchev FATIGUE TESTING OF JOINT IMPLANTS

CLOSING SESSION / ЗАКРИВАЩА СЕСИЯ / ЗАКЛЮЧИТЕЛЬНОЕ ЗАСЕДАНИЕ

12:00 – 12:30 *Chairman: Prof. D. Diakov, PhD*
Secretary: Assoc. Prof. G. Milushev, PhD
Assist. Prof. B. Dzhudzhev, PhD

C.1.	G. Milushev SUMMARY REPORT ON 35TH ISS MMA 2025
C.2.	I. Kodjabashev SCIENCE NOTES REGARDING 35TH ISS MMA 2025 AND THE NEXT 36TH ISS MMA 2026

Important for authors! The presentation of the paper on English, shall be uploaded up to the Symposium EasyChair system up to 05.09.2025 and saved on flash-memory shall be present to the secretary of the section not later than 15 min before the beginning of the section work.

Notes / Бележки / Ноты

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Methodology for Developing Measuring Transducers of Physical Quantities

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Abstract - When developing measuring transducers of physical quantities, the current tasks are the problems of increasing their sensitivity and accuracy, expanding functional capabilities, simplifying the design and reducing mass and dimensions, and increasing reliability and manufacturability. To solve these problems, a methodology for constructing measuring transducers with optimal design parameters has been created. The methodology has been tested in the development of linear displacement, pressure difference and temperature sensors.

Keywords – methodology, developing, measuring transducers, physical quantities

IV. INTRODUCTION

Today, the development of measuring transducers of physical quantities is an important area of research, since they are used in various sectors of the national economy [1-3].

At the same time, these studies are aimed at building measuring transducers with optimal design parameters. Therefore, it is advisable to create a methodology that will allow to generalize and simplify the process of developing measuring transducers without harming the quality of the transducer itself.

V. RESOURCES AND PUBLICATIONS ANALYSIS

Every year, many scientific articles, patent applications, are published, which are devoted to the development of measuring transducers [3-8].

Analysis of publications shows that they are aimed at improving individual indicators of measuring transducers, such as sufficient reliability, measurement speed, displacement coding ambiguity error, simplified device design, manufacturing processability, weight and dimensional characteristics, and others. When developing measuring transducers, attention is also paid to ensuring control and diagnostics of the device during its operation and the possibility of obtaining output information in binary code.

In this regard, it is necessary to create methods for developing measuring transducers of physical quantities with optimal design parameters.

VI. RESEARCH

The first stage of developing measuring transducers of physical quantities with optimal design parameters requires a patent search to find analogues and a prototype design.

As result of analyzing the shortcomings of the prototype and analogues, a measuring transducer design is developed that eliminates these shortcomings. For further improvement of measuring transducers, it is necessary to find the optimal values of design parameters. The solution of this problem is possible by applying the methods of optimal cost and time-consuming experimental planning [9-11].

The following stages are performed: development of an experimental plan, optimization of the experimental plan in terms of cost and time using computer programs. A list of copyright certificates for a work (computer program) is given in [3].

After implementing the optimal experimental plan in terms of cost and time, a mathematical model of the measuring transducer of a physical quantity is built. Using the mathematical model, the optimal design parameters of the measuring transducer are found.

The design of the measuring transducer of a physical quantity with optimal parameters is built.

The stages of the developed methodology are given in Table.

The created methodology has been tested in the development of linear displacement, pressure difference, temperature sensors, and contactless DC current meter.

TABLE – STAGES THE METHODOLOGY FOR DDEVELOPING CONVERTERS OF PHYSICAL QUANTITIES

Number	Stages of the methodology
1	Conduct a patent search

2	Analyze the shortcomings of the prototype and analogues
3	Develop a design for a measuring transducer that eliminates the shortcomings
4	Develop an experimental plan for studying the converter
5	Optimize the experimental plan in terms of cost and time using computer programs
6	Conduct an experiment
7	Build a mathematical model of the converter
8	Using a mathematical model, find the optimal design parameters of the converter
9	Build a fiber optic converter design with optimal design parameters

To increase measurement accuracy and expand functionality, a linear displacement sensor is proposed in a Ukrainian patent № 159092.

The principle of operation of the sensor is based on the conversion of the linear movement of the rod 3, on which the optical radiation source 4 is installed, into the movement of the light flux along the input ends of the light guides 5; converting the light flux transmitted from the optical radiation source 4 through the optical fibers 5 on the photodetector of the fiber-optic converter 12 into a binary code; determining the magnitude of the linear displacement from the received binary code in the computer 13.

Fig. 1 shows a simplified design of a linear displacement sensor.

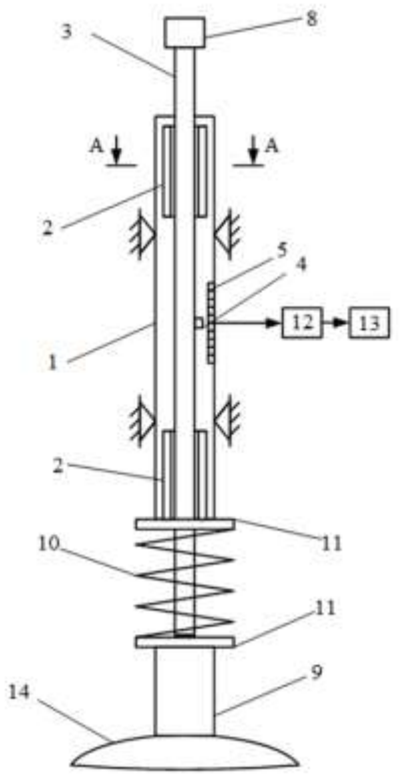

Fig. 1. Simplified design of the linear displacement sensor

Fig. 2 shows an enlarged view along A-A in Fig. 1.

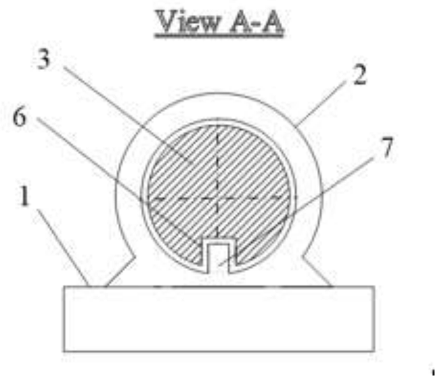

Fig. 2 – Enlarged view along A-A of Fig. 1

Fig. 3 shows the placement of light fibers in a fiber-optic converter to obtain information about linear displacement in binary code.

The sensor contains a rod 3 installed in the housing 1 with the possibility of movement in the supports 2. An optical radiation source 4 is installed on the rod 3, and on the housing 1 in front of the optical radiation source 4 in a line, in the direction of movement of the rod 3, the input ends of the optical fibers 5 are placed and fixed. To prevent rotation of the rod 3 and, as a result, loss of contact between the optical radiation source 4 and the light guides 5, a groove 6 is provided on the rod, and a protrusion 7 is provided on the inner surface of the support 2 (Fig. 2). At the opposite ends of the rod 3, movement limiter 8 and a pusher-stop 9 are placed. To return the rod 3 to its original position, a spring 10 is placed in the sensor design between the housing 1 and the pusher-stop 9, which is secured with washers 11. The output ends of the light guides 5 are optically connected to a fiber-optic converter 12 (Fig. 3), connected to a computer 13. The sensor housing 1 is fixed to the object of study, and the pusher-stop is installed in front of the element 14, the linear displacement of which must be measured.

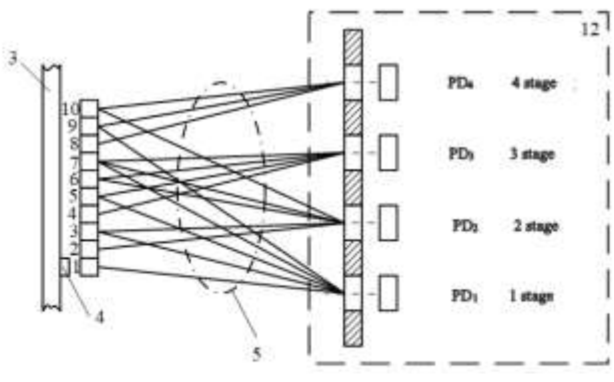

Fig. 3. Placement of optical fibers in a fiber-optic converter to obtain information about linear movement in binary code

The linear displacement sensor works as follows.

The impact of the element 14 on the pusher-stop 9 causes the rod 3 to move. In this case, the light flux from the optical radiation source 4 through the corresponding input ends of the optical fibers 5 falls on the photodetectors of the fiber-optic converter 12, at the output of which a binary code is obtained, which is sent to the computer 13. In the computer 13, the linear displacement value is determined based on the received binary code.

Thus, the proposed linear displacement sensor allows to increase the accuracy of measurements and expand its functionality by introducing new elements into the sensor, namely, an optical radiation source, optical fibers, a fiber-optic converter and connections between these elements.

In order to expand the functionality of the prototype by measuring the pressure difference, a differential fiber-optic pressure difference sensor is proposed in the Ukrainian patent for a utility model №159094.

The introduction of new elements and connections between them into the fiber-optic pressure sensor allows expanding the functionality of the prototype by measuring the pressure difference.

Fig. 4 shows a simplified design of a differential fiber-optic pressure difference sensor, which contains a housing in the form of two threaded fittings 1,2 with channels 3,4 for supplying working media, which pass into receiving cavities 5,6, ending with plugs 7,8 in the form of membranes. On the back sides of the membranes are placed racks 9, 10, which are rigidly connected to each other in pairs using washers 11 and screws 12. An optical fiber 13 with two Bragg gratings 14, 15 is rigidly fixed between the first and second pairs of racks. In this case, the first section of the optical fiber 13 with the Bragg grating 14 is located between the racks 9, 10, and the second section of the optical fiber 13 with the Bragg grating 15 is located on the back side of the racks 9, 10. The optical fiber 13 is fixed between the first and second pairs of racks 9, 10 by means of clamps 16, an adhesive composite 17, washers 11 and screws 12. The casing 18 and the housing in the form of two threaded fittings 1, 2 form a support cavity. The optical fiber 13 is placed with the possibility of connecting to the radiation source 19.

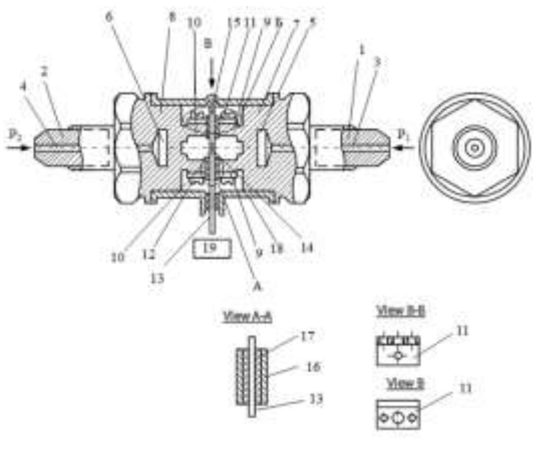

Fig. 4. Simplified design of differential fiber optic pressure difference sensor

The differential fiber-optic pressure difference sensor works as follows.

The working medium under pressure P1 through the channel 3 in the threaded fitting 1 enters the receiving cavity 5 and acts on the membrane 7. Under the action of the working medium, the membrane 7 is deflected, which leads to the movement, relative to each other, of the sides of the racks 9. The working medium under pressure P2 through the channel 4 in the threaded fitting 2 enters the receiving cavity 6 and acts on the membrane 8.Under this action of the working medium, the membrane 8 is deflected, which leads to the displacement of the racks 10 in opposite, relative to each other, sides. As a result of the action of pressures P1 and P2, a deformation of the rigidly fixed optical fiber 13 occurs in the area with the Bragg grating 14, which is proportional to the difference in pressures P1 - P2. The deformation of this area leads to a change in the length of the reflected light wave in the Bragg grating 14. By changing the length of the reflected light wave, the value of the pressure difference P1 - P2 is determined. The Bragg grating section 15 is used for temperature compensation.

Thus, the proposed differential fiber-optic pressure difference sensor allows you to expand the functionality of the prototype by measuring the pressure difference P1 - P2.

In order to expand the functionality of the prototype by providing information about the temperature value in digital form, a device for measuring temperature is proposed in the Ukrainian patent for a utility model № 159093.

The introduction of new elements into the temperature measurement device (a prism with a translucent surface, a photodetector, two adjustable diaphragms, photodetector current amplifiers, rectangular pulse shapers, a logic circuit, a reversing counter) and the connections between them allow us to expand the functionality of the prototype.

Fig. 5 shows a simplified design of a device for measuring temperature.

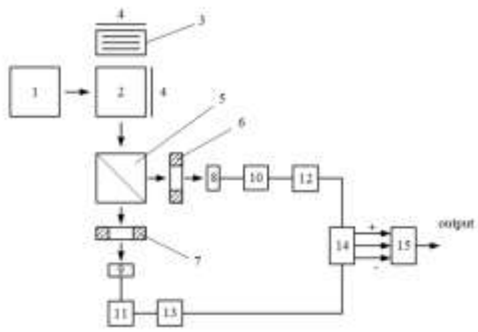

Fig. 5. Simplified design of a temperature measuring device

The temperature measuring device contains a radiation source (laser) 1, a light-distributing cube 2, combined with a thermally sensitive element 3, which is made in the form of a single- or multilayer film of chalcogenide glassy semiconductors resistant to electromagnetic fields and ionizing radiation. Reflective coatings 4 are applied on top of the thermosensitive element 3 and the adjacent sur output the cube 2. Adjustable diaphragms 6, 7 are placed in front of the adjacent surfaces of the translucent prism 5 with photodetectors 8, 9 installed behind them. Photodetectors 8, 9 are connected to series-connected corresponding current amplifiers 10,11 and rectangular pulse generators 12, 13, which are connected to a logic circuit 14 connected to a reversing counter 15.

The temperature measuring device operates as follows.

When the temperature of the cube 2 changes, the radiation of the laser 1, having split into two beams in the cube 2, interferes after interacting with the thermosensitive

3 and reflective 4 coatings. The interfering beams from the translucent prism 5 through the adjustable diaphragms 6, 7 arrive at the photodetectors 8,9. A constant phase shift between the interfering beams by $\pi/2$ is achieved by shifting the diaphragms 6 and 7. The photocurrents obtained at the output of photodetectors 8, 9 are amplified in the corresponding amplifiers 10, 11, and converted into rectangular pulses in shapers 12, 13. Logic circuit 14, comparing the order of arrival of these pulses, determines the nature of the temperature change. Photodetectors 8, 9 are structurally placed in such a way that when the temperature increases, photodetector 8 is the first to send a pulse to the logic circuit 14, and when the temperature decreases, photodetector 9 is the first. When receiving a pair of pulses from photodetectors 8, 9, the logic circuit 14 sends one pulse to the counting input of the reversing counter 15 and simultaneously sends signals to two inputs controlling the counting direction.

Thus, the proposed device allows you to expand the functionality of the prototype, as it provides information about the temperature value in digital form at the output of the reversing meter.

In order to simplify the design of the prototype and increase the manufacturability of manufacturing, a device for non-contact measurement of direct currents is proposed in the patent of Ukraine for utility model No. 157206.

Fig. 6 shows a simplified design of a contactless DC sensor.

The contactless DC sensor contains a ring magnetic core 1, which surrounds a current-carrying conductor 2. A Hall sensor 3 is placed in the gap of the magnetic core, the current terminals of which are connected to the output of a stabilized power supply 4, and its potential terminals are connected to a differential amplifier 5. The differential amplifier is connected to the serially connected analog-to-digital converter 6 and microprocessor 7, which are part of the controller 8. The demagnetization winding of magnetic circuit 1 is connected to the microprocessor 7.

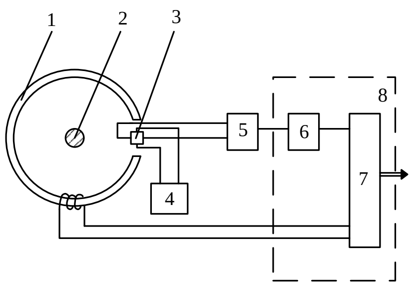

Fig.6. Simplified design of a non-contact DC sensor

The contactless DC sensor works as follows.

When a direct current flows through conductor 2, a constant magnetic field arises, which is concentrated by the magnetic core 1 in the gap and affects the Hall sensor 3, at the potential terminals of which a voltage signal appears, proportional to the magnitude of the magnetic field and current in conductor 2. The magnitude of this signal is amplified in the differential amplifier 5 and fed to the input of the analog-to-digital converter 6. The digital signal from the output of the analog-to-digital converter 6 is fed to microprocessor 7 of the controller 8. The microprocessor outputs a signal in digital form, proportional to the current being measured, and generates a signal that is fed to the demagnetization winding before the next measurement and ensures demagnetization of the magnetic circuit 1.

Thus, the proposed contactless DC sensor allows to simplify the design and increase the manufacturability of the prototype.

CONCLUSIONS

The created methodology for developing measuring transducers can be widely used for building transducers of physical quantities with optimal design parameters. The methodology has been tested in the development of linear displacement, pressure difference and temperature sensors, which are protected by patents of Ukraine for a useful model.

In further research using the proposed methodology, the following fiber-optic transducers will be built: a pressure sensor, a vibration sensor, and an acceleration sensor.

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