DAYS OF THE SCIENCE of the Technical University of Sofia, SOZOPOL 2024
ДНИ НА НАУКАТА на Технически университет – София, СОЗОПОЛ 2024
ДНИ НАУКИ Технического университета – София, СОЗОПОЛЬ 2024

34th INTERNATIONAL SCIENTIFIC SYMPOSIUM
XXXIII МЕЖДУНАРОДЕН НАУЧЕН СИМПОЗИУМ
XXXIII МЕЖДУНАРОДНЫЙ НАУЧНЫЙ СИМПОЗИУМ

METROLOGY AND METROLOGY ASSURANCE 2024

МЕТРОЛОГИЯ И МЕТРОЛОГИЧНО ОСИГУРЯВАНЕ 2024

МЕТРОЛОГИЯ И МЕТРОЛОГИЧЕСКОЕ ОБЕСПЕЧЕНИЕ 2024

PROGRAMME
ПРОГРАМА
ПРОГРАММА

September 7 – 11, 2024, Sozopol, Bulgaria
7 – 11 Септември 2024 г., Созопол, България
7 – 11 Сентября 2024 г., Созополь, Болгария

ORGANISED BY

Technical University of Sofia

- ***Department of Electrical Measurements***
- ***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

Bulgarian Academical Association of Metrology

Kozloduy Nuclear Power Plant

WITH THE SUPPORT OF

RESEARCH AND DEVELOPMENT SECTOR BY THE TU-SOFIA

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

ОРГАНИЗИРАН ОТ

Технически университет София

- ***Катедра "Електроизмервателна техника"***
- ***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

Българско академично метрологично дружество

"АЕЦ Козлодуй" ЕАД

С ПОМОЩТА НА

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

СИМПОЗИУМ ОРГАНИЗУЕТСЯ

Техническим университетом София

- ***Кафедрой Электроизмерительной техники***
- ***Кафедрой Прецизионной техники и приборостроения***

Институтом инженеров по электротехнике и электронике, Болгарская секция

С УЧАСТИЕМ

Болгарского института метрологии

Союза метрологов Болгарии

Болгарского академического метрологического сообщества

"АЭС Козлодуй" ОАО

ПРИ ПОДДЕРЖКЕ

ТУ-СОФИЯ - НАУЧНО-ИССЛЕДОВАТЕЛЬСКИЙ СЕКТОР

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

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PROGRAMME / ПРОГРАМА / ПРОГРАММА

REGISTRATION / РЕГИСТРАЦИЯ	Hotel Lobby or On-line	7.09.2024	10:00 – 13:00 14:00 – 17:00
OPENING / ОТКРИВАНЕ / ОТКРЫТИЕ	Hall/Зала/Зал 1	8.09.2024	10:00 – 10:30
PAPERS AND SCIENCE NOTES ДОКЛАДИ И НАУЧНИ СЪОБЩЕНИЯ ДОКЛАДЫ И НАУЧНЫЕ СООБЩЕНИЯ	Hall/Зала/Зал 1	8.09.2024	10:30 – 11:15 11:30 – 12:30 13:00 – 15:00 15:15 – 16:45 17:00 – 19:00
		9.09.2024	09:00 – 10:30 10:45 – 12:15 13:00 – 14:45 15:00 – 16:45 17:00 – 18:15
		10.09.2024	09:00 – 10:30 10:45 – 11:45
WELCOME / ДОБРЕ ДОШЛИ / ДОБРО ПОЖАЛОВАТЬ		8.09.2024	19:30
COCKTAIL / КОКТЕЙЛ / КОКТЕЙЛЬ		9.09.2024	19:00
CLOSING / ЗАКРИВАНЕ / ЗАКРЫТИЕ	Hall/Зала/Зал 1	10.09.2024	12:00
DEPARTURE / ОТПЪТУВАНЕ / ОТЪЕЗД		11.09.2024	

7 September / Септември / Сентября 2024 (Saturday / Събота / Субота)	
10:00 – 13:00	**Registration / Регистрация**
14:00 – 17:00	**Registration / Регистрация**

8 September / Септември / Сентября 2024 (Sunday / Неделя / Воскесение)	
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 – 13:00	**Free time / Свободно време / Свободное время**
13:00 – 15:00	**Section / Секция I:** CONTINUES / ПРОДЪЛЖЕНИЕ / ПРОДОЛЖЕНИЕ
15:00 – 15:15	**Coffee break / Кафе пауза / Кофе перерыв**
15:15 – 16:45	**Section / Секция IV** Measurements in the Industry Измервания в индустрията Измерения в промышленности
16:45 – 17:00	**Coffee break / Кафе пауза / Кофе перерыв**
17:00– 19:00	**Section / Секция IX** Metrology Practice Метрологична Практика Метрологическая Практика
19:30	**Welcome / Добре дошли / Добро пожаловать**

9 September / Септември / Сентября 2024 (Monday / Понеделник / Понедельник)	
09:00 – 10:30	**Section / Секция III** Measurement and Information Systems and Technologies Измервания и информационни системи и технологии Измерительные и информационные системы и технологии
10:30 – 10:45	**Coffee break / Кафе пауза / Кофе перерыв**
10:45 – 12:15	**Section / Секция III:** CONTINUES / ПРОДЪЛЖЕНИЕ / ПРОДОЛЖЕНИЕ
12:15 – 13:00	**Free time / Свободно време / Свободное время**
13:00 – 14:45	**Section / Секция VI** Measurements in the Electrical Power Engineering Измервания в електроенергетиката Измерения в электроэнергетике
14:45 – 15:00	**Coffee break / Кафе пауза / Кофе перерыв**
15:00 – 16:45	**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
16:45 – 17:00	**Coffee break / Кафе пауза / Кофе перерыв**
17:00 – 18:15	**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
19:00	**Cocktail / Коктейл / Коктейль**

10 September / Септември / Сентября 2024 (Tuesday / Вторник / Вторник)	
09:00 – 10:30	**Section / Секция VIII** Ionizing Radiation Measurements Измерване на Йонизиращи Лъчения Измерение Ионизирующих Излучений
10:30 – 10:45	**Coffee break / Кафе пауза / Кофе перерыв**
10:45 – 11:30	**Section / Секция VIII:** CONTINUES / ПРОДЪЛЖЕНИЕ / ПРОДОЛЖЕНИЕ
12:00 – 12:30	**Closing Session / Закриваща сесия / Заключительное заседание**

11 September / Септември / Сентября 2024 (Wednesday / Сряда / Среда)
Departure / Отпътуване / Отъезд

S C I E N T I F I C   P R O G R A M M E
Н А У Ч Н А   П Р О Г Р А М А
Н А У Ч Н А Я   П Р О Г Р А М М А

8 September / Септември / Сентября 2024
(Sunday / Неделя / Воскесение)

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 63	Valentin Starev CHALLENGES TO THE BULGARIAN INSTITUTE OF METROLOGY (BIM) IN ENSURING TRACEABILITY AND IMPLEMENTING CONTROL OF MEASURING INSTRUMENTS FOR ALTERNATIVE FUELS
P.2. EC 17	Philippe Cassette METROLOGY OF RADIOACTIVITY AND RADIONUCLIDES: PAST, PRESENT AND FUTURE
P.3. EC 52	Roald Taymanov and Kseniia Sapozhnikova MEASUREMENTS AND ARTIFICIAL INTELLIGENCE. A NEW STAGE
P.4	George Milushev INFORMATION ABOUT IMEKO 2024 WORLD CONGRESS

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
13:00 – 15:00
Chairman: A. Yovcheva, PhD
Secretary: Assist. Prof. I. Blagov, PhD
N. Gurov, MEng

I.1. EC 5	Tetyana Gordiyenko and Oleh Velychko REGULAR TRAINING OF METROLOGISTS ON NATIONAL LEVEL
I.2. EC 8	Velizar Vassilev STUDY OF THE CAPABILITIES OF A RETROFITTED ROUNDNESS MEASURING INSTRUMENT

I.3. EC 25	Sergii Shevkun, Maryna Dobroliubova and Oleksii Statsenko MEASUREMENT UNCERTAINTY EVALUATION DURING CALIBRATION OF PRECISION LCR METERS ON NATIONAL CAPACITY AND INDUCTANCE STANDARDS IN THE FULL FREQUENCY RANGE AND RANGE OF VALUES

I.4. EC 27	Krasimir Bosilkov, Snezhana Spasova and Elena Nikolova INTERLABORATORY COMPARISON OF DIGITAL THERMOMETER IN THE TEMPERATURE RANGE FROM MINUS 40 °C TO 200 °C
1.5. EC 28	Branko Sotirov, Miryana Masheva and Tzvetelin Gueorguiev METHOD FOR TAXIMETER VERIFICATION WITH ROLLER TEST BENCH
I.6. EC 38	Oleksandr Degtiarov, Oleg Zaporozhets, Volodymyr Skliarov, Mykola Moskalets and Viktor Lutsenko DEVELOPMENT OF METHOD AND MEASURING EQUIPMENT IN FIELD OF RESEARCH OF LOW-FREQUENCY MAGNETIC FIELD PARAMETERS
I.7. EC 51	Igor Zakharov, Olesia Botsiura and Iryna Zadorozhna MEASUREMENT UNCERTAINTY EVALUATION OF OBJECTS COORDINATES IN A PLANE
I.8. EC 62	Igor Zakharov, Olesia Botsiura and Kiril Banev APPLICATION OF THE LAW OF PROPAGATION OF EXPANDED UNCERTAINTY TO MEASUREMENT DATA PROCESSING AT CALIBRATION
I.9. EC 64	Dimitar Dichev, Iliya Zhelezarov, Borislav Georgiev, Ivo Malakov, Oleksandr Kupriyanov, Dimcho Pulov, Ralitza Dicheva and Hristofor Kovachev ANALYSIS OF ERRORS IN ROLL AND PITCH MEASUREMENTS FOR MOVING OBJECTS
I.10. EC 65	Dimitar Dichev, Iliya Zhelezarov, Oleksandr Kupriyanov, Ivo Malakov, Borislav Georgiev, Dimcho Pulov, Ralitza Dicheva and Hristofor Kovachev KALMAN FILTER INTEGRATION IN ORIENTATION MEASUREMENT SYSTEMS WITH MEMS SENSORS UNDER DYNAMIC CONDITIONS
I.11. EC 67	Dimcho Pulov PASSIVE ATHERMALIZATION OF COMPACT IR LENSES FOR ACCURATE MEASUREMENTS AND VISUALIZATION OF TEMPERATURE FIELDS
I.12. EC 47	Oleksandr Samoilenko, Serhii Pronenko and Yevheniia Volkova ORGANIZING THE METROLOGICAL MEASUREMENTS NETWORK — THE WAY TO UPGRADE THE ESTABLISHMENT OF TRACEABILITY AND COMPARABILITY OF MEASUREMENTS RESULTS

<u>Section / Секция IV</u>

MEASUREMENTS IN THE INDUSTRY
ИЗМЕРВАНИЯ В ИНДУСТРИЯТА
ИЗМЕРЕНИЯ В ПРОМЫШЛЕННОСТИ

15:15 – 16:45

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

IV.1. EC 10	Alexander L. Shestakov, Denis K. Lebedev, Vladimir V. Sinitsin, Ivan I. Fedosov and Olga L. Ibryaeva INTELLIGENT MULTI-ZONE TEMPERATURE SENSORS DATA PROCESSING FOR ROLLING BEARINGS DIAGNOSIS
IV.2. EC 11	Ivan Fedosov and Alexander Shestakov A METHOD TO ESTIMATE A MEASUREMENT VALUE STATUS FOR A MEASUREMENT CIRCUIT OF FOUR-WIRE THERMOELECTRIC CONVERTER

IV.3. EC 14	Bondan Dwisetyo, Maharani Ratna Palupi, Denny Hermawanto, Ninuk Ragil Prasasti, Chery Chaen Putri, Asep Hapiddin, Fajar Budi Utomo, Adindra Vickar Ega, Muhammad Azzumar, Miftahul Munir, Rudi Anggoro Samodro, Gigin Ginanjar, Yonan Prihhapso DEVELOPMENT OF AN INDUSTRIAL SCALE ACOUSTIC MEASURING INSTRUMENT CALIBRATION SYSTEM

IV.4. EC 33	Miroslav Kokalarov, Dimitar Dichev, Branko Sotirov and Boris Sakakushev AN APPLICATION OF THE PHOTOGRAMMETRIC METHOD FOR MEASURING IN MECHANICAL STRUCTURES
IV.5. EC 34	Miroslav Kokalarov, Dimitar Dichev, Branko Sotirov and Boris Sakakushev A STEREO PHOTOGRAMMETRIC METHOD FOR MEASURING THE DEFORMATIONS OF MECHANICAL STRUCTURES
IV.6. EC 40	Penko Mitev DESIGN AND PRODUCTION OF A FEEDING AND WEIGHING SYSTEM FOR FASTENERS

Section / Секция IX

METROLOGY PRACTICE
МЕТРОЛОГИЧНА ПРАКТИКА
МЕТРОЛОГИЧЕСКАЯ ПРАКТИКА

17:00 – 19:00

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

IX.1. EC 16	Yosif Munev METHODOLOGY OF SURFACE PROFILE FILTERING AND ROUGHNESS EVALUATION
IX.2. EC 48	Zlatka Chavdarova, Desislava Koleva and Hristiana Nikolova "METROLOGICAL EXAMINATION OF A REFERENCE SYSTEM FOR SPEED MEASUREMENT BASED ON GPS SIGNALS"
IX.3. EC 50	Todor Todorov, Blagovest Bankov, Mihail Zagorski, Todor Gavrilov and Konstantin Dimitrov RAPID PROTOTYPING AND MEASURING ASSESSMENT OF A COMPLEX GEOMETRY
IX.4. EC 68	Dobri Komarski and Dimitar Diakov EXPERIMENTAL STUDY OF THE RADIAL AND AXIAL STIFFNESS OF MICRO-POSITIONING ELASTIC MODULE WITH “BUTTERFLY” FLEXURES
IX.5. EC 69	Dobri Komarski EXPERIMENTAL STUDY OF ROTATIONAL AXIS STABILITY OF MICRO-POSITIONING ELASTIC MODULE WITH “BUTTERFLY” FLEXURES
IX.6. EC 70	Dimitar Diakov, Desislava Dimitrova and Hristiana Nikolova SYSTEMS FOR MEASURING DEVIATIONS OF SHAPE, ORIENTATION AND POSITION
IX.7. EC 71	Dobri Komarski and Dimitar Diakov SIMULATION ANALYSIS OF A GONIOMETRIC MODULE WITH CRUCIFORM ELASTIC GUIDES
IX.8. EC 72	Dobri Komarski INFLUENCE OF GEOMETRIC CHARACTERISTICS AND MATERIAL SELECTION ON THE PERFORMANCE CHARACTERISTICS OF A GONIOMETRIC FOUR-LINK ELASTIC MODULUS

9 September / Септември / Сентября 2024
(Monday / Понеделник / Понедельник)

MEASUREMENT AND INFORMATION SYSTEMS AND TECHNOLOGIES

ИЗМЕРВАНИЯ И ИНФОРМАЦИОННИ СИСТЕМИ И ТЕХНОЛОГИИ

ИЗМЕРИТЕЛЬНЫЕ И ИНФОРМАЦИОННЫЕ СИСТЕМЫ И ТЕХНОЛОГИИ

Section / Секция III

09:00 – 10:30
10:45 – 12:15

Chairman: Prof. I. Zakharov, DSc
Secretary: Assoc. Prof. N. Stoyanov, PhD
Assist. Prof. B. Dzhudzhev, PhD

III.1. EC 54	Rosen Pasarelski, Plamen Tzvetkov, Teodora Pasarelska and Krasen Angelov POWER CONTROL ALGORITHMS IN 5G NETWORKS
III.2. EC 1	Maryna Miroshnyk, Olga Zaichenko, Anatolii Miroshnyk, Nataliia Hapon, Yurii Pakhomov and Liubov Klymenko PULLING FIGURE OF DIELECTRIC RESONATOR FOR 3D FILAMENT DEFECTOSCOPY
III.3. EC 2	Maryna Miroshnyk, Petro Kahanov, Borys Sytnyk, Volodymyr Bryksin, Anatolii Miroshnyk and Andrei Shafranskyi FORMATION OF NONLINEAR TRAJECTORIES OF GUARANTEED ACCURACY IN APPROXIMATION AREAS
III.4. EC 4	Oleh Velychko, Vasyl Dovhan, Denys Nikitenko and Jaroslav Brezytskyi EVALUATION OF THE LONG-TERM DRIFT OF PRECISION RESISTANCE MEASURES
III.5. EC 21	Nikolay Koshevoy, Tetiana Rozhnova, Olena Kostenko, Oleksii Potylchak, Vitalii Siroklyn and Andrey Bychkov FIBER-OPTIC SYSTEMS OF LINEAR AND ANGULAR MOVEMENTS
III.6. EC 32	Filip Filipov, Biser Borisov and Krasimir Bosilkov DATA STORAGE AND PREPARATION OF REPORTING DOCUMENTS FROM METROLOGICAL VERIFICATION OF MEASURING CHANNELS OF ELECTRICAL QUANTITIES FROM THE KIUS "OVATION" SYSTEM WITH A DATABASE IN MS ACCESS
III.7. EC 44	Roumiana Ilieva and Antoni Angelov ADVANCED TECHNIQUES FOR REMOTE CONTROL IN WORK ENVIRONMENT
III.8. EC 53	Oleksandr Samoilenko, Hanna Fursa, Volodymyr Zayets and Yevheniia Volkova THE EXPERIENCE OF THE GEODETIC METHODS APPLICATION FOR TANKS CALIBRATION
III.9. EC 12	Martin Dimitrov VALIDATION OF ULTRASONIC WELDING MACHINE USING CAPABILITY INDEX
III.10. EC 73	R. Miltchev, V. Pechovski, D. Ginchev and M. Zagorski AN APPROACH FOR INTEGRATION OF BIOFEEDBACK AND NEUROFEEDBACK DATA IN SIMULATOR PILOT TESTING
III.11. EC 26	Tsanko Karadzhov, Dimitar Dichev and Miroslav Kokalarov DYNAMIC ACCURACY MEASUREMENT SYSTEM FOR MECHANICAL WATCH VIA COMPUTER'S BUILT-IN MICROPHONE

III.12. EC 66	Dimitar Dichev, Iliya Zhelezarov, Oleksandr Kupriyanov, Borislav Georgiev, Ivo Malakov, Ralitza Dicheva, Hasan Hasanov and Kaloyan Libchev IMPROVING THE ACCURACY OF SYSTEMS FOR MEASURING THE ANGULAR POSITION OF MOVING OBJECTS WITH AN ADAPTIVE WIENER FILTER

Section / Секция VI

MEASUREMENTS IN THE ELECTRICAL POWER ENGINEERING

ИЗМЕРВАНИЯ В ЕЛЕКТРОЕНЕРГЕТИКАТА

ИЗМЕРЕНИЯ В ЭЛЕКТРОЭНЕРГЕТИКЕ

13:00 – 14:45

Chairman: Assoc. Prof. G. Milushev, PhD
Secretary: Assist. Prof. A. Pandelova, PhD
N. Gurov, Meng

VI.1. EC 41	Anna Krylovich, Sergey Podobuev, Vadim Loginov, Dmitry Zolkin, Nikolay Serov and Andrey Serov QUADRATURE DEMODULATION AS A TECHNIQUE TO MEASURE SIGNAL PARAMETERS WITH INCREASED ACCURACY
VI.2. EC 42	Sergey Podobuev, Anna Krylovich, Alexandra Evsenkina, Alexander Shatokhin, Nikolay Serov and Andrey Serov COMPARATIVE ANALYSIS OF DFT AND QUADRATURE DEMODULATION ALGORITHMS FOR COMPLEX SPECTRUM MEASUREMENTS
VI.3. EC 58	Georgi Ivanov, Valentin Mateev and Iliana Marinova LOAD CHARACTERISTICS OF LOW POWER STEP-DOWN TRANSFORMER IN LIQUID NITROGEN
VI.4. EC 59	Georgi Ivanov, Martin Ralchev, Valentin Mateev and Iliana Marinova MEASUREMENT OF SN SOLDERING CONTACT RESISTANCE IN LIQUID NITROGEN
VI.5. EC 24	Iurii Kuzmenko, Sergii Shevkun, Maryna Dobroliubova and Oleksii Statsenko COMPARATIVE ANALYSIS OF DAYLIGHT TIME LOSSES AND ELECTRICAL ENERGY LOSSES WHEN TRANSITIONING TO WINTER AND SUMMER TIME
VI.6. EC 61	George Milushev and Antonia Pandelova COMPARATIVE DATA FOR SORT FULL ACCELERATE PERFORMANCE TEST BASED ON POWER LOAD CURVES
VI.7. EC 60	George Milushev ELECTRICAL POWER - THE MISSING ELEMENT IN ELECTRICAL POWER QUALITY ASSESSMENT

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

15:00 – 16:45

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

II.1. EC 7	Velizar Vassilev RETROFIT OF A ROUNDNESS MEASURING INSTRUMENT

II.2. EC 9	Chingiz Hajiyev ORBITAL CALIBRATION OF NANOSATELLITE MAGNETOMETERS VIA LINEAR TWO-STAGE KALMAN FILTER
II.3. EC 20	Nikolay Koshevoy, Tetiana Rozhnova, , Olena Kostenko, Oleksandr Zabolotnyi, Maksym Tsekhovskyi and Denys Kuraksin MODERN FIBER-OPTIC CONVERTERS OF PHYSICAL QUANTITIES
II.4. EC 23	Ivan Ivanchev, Georgi Ivanov, Lachezar Hrischev, Ivan Rostovsky and Maria Gueorguieva ASSESSMENT OF CONCRETE COMPRESSIVE STRENGTH AT EARLY STRIKING BY SONREB METHOD
II.5. EC 37	Siya Lozanova, Avgust Ivanov, Martin Ralchev and Chavdar Roumenin VERTICAL SILICON HALL MICROSENSOR BASED ON THREE-CONTACT ELEMENTS
II.6. EC 39	Ivan Ivanchev MEASUREMENT OF CONCRETE ELECTRICAL RESISTANCE FOR ASSESSMENT OF REINFORCEMENT CORROSION IN REINFORCED CONCRETE ELEMENTS USING THE 4-POINT WENNER PROBE
II.7. EC 55	Bozhidar Dzhudzhev, Radoslav Deliyski and Antonia Pandelova INFLUENCE OF ENVIRONMENT CONDITION ON THE INFRA-RED OBJECT DETECTION SENSOR FC-51

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

17:00 – 18:15

Chairman: Assoc. Prof. N. Stoyanov, PhD
Secretary: Assist. Prof. D. Komarski, PhD
Assist. Prof. I. Blagov, PhD

XI.1. EC 13	Yevhen Volodarskyi, Oleh Kozyr and Larysa Kosheva IMPACT OF MEASUREMENT PROCEDURE ON TECHNOLOGICAL PROCESS CONTROL
XI.2. EC 30	Velizar Zaharinov, Ivo Malakov and Hasan Hasansabri DETERMINING THE INFLUENCE OF MODEL PARAMETERS ON THE CHOOSING OF AN OPTIMAL SIZE RANGE OF LINEAR MODULES FOR AUTOMATED SLIDING DOORS
XI.3. EC 46	Dilyan Georgiev and Albena Antonova ENHANCING KNOWLEDGE SHARING PROCESSES VIA AUTOMATED SOFTWARE DOCUMENTATION MANAGEMENT SYSTEMS USING GEN AI SOFTWARE TOOLS
XI.4. EC 56	Radostina Angelova, Maria Ivanova and Daniela Sofronova TESTING METHODOLOGY FOR MEASURING CARBON DIOXIDE CONCENTRATION, TEMPERATURE, AND HUMIDITY UNDER SURGICAL FACE MASKS
XI.5. EC 57	Radostina Angelova, Maria Ivanova and Daniela Sofronova ASSESSING THERMOPHYSIOLOGICAL COMFORT AND AIRFLOW EFFICIENCY OF VARIOUS FACE MASK TYPES

10 September / Септември / Сентября 2024
(Tuesday / Вторник / Вторник)

Section / Секция VIII

IONIZING RADIATION MEASUREMENTS
ИЗМЕРВАНЕ НА ЙОНИЗИРАЩИ ЛЪЧЕНИЯ
ИЗМЕРЕНИЕ ИОНИЗИРУЮЩИХ ИЗЛУЧЕНИЙ

09:00 – 10:30
10:45 – 11:30

Chairman: Assoc. Prof. K. Mitev, PhD
Secretary: Assist. Prof. B. Dzhudzhev, PhD
Assist. Prof. A. Pandelova, PhD

VIII.1. EC 29	Rusiyan Tsibranski and Mitko Milyovski PARTICIPATION IN INTERLABORATORY COMPARISSONS, A QUALITY CRITERION FOR RADIOANALYTICAL LABORATORY MEASUREMENTS
VIII.2 EC 49	Marian Genovski, Delyan Damyanov, Victor Mladenov and Mihail Balachev EUROPEAN INTERLABORATORY COMPARISON OF TECHNICAL EQUIPMENT FOR WHOLE-BODY COUNT DUE TO GAMMA-EMITTING RADIONUCLIDES PRESENT IN THE HUMAN BODY - EIVIC2020
VIII.3. EC 36	Daniel Hristov, Georgi Vodenicharski and Aleksandar Stoyanov WORLDWIDE PROFICIENCY TEST FROM INTERNATIONAL ATOMIC ENERGY AGENCY IAEA-TERC-2022-01 AND IAEA-TERC-2022-01 ON DETERMINATION OF ANTHROPOGENIC AND NATURAL RADIONUCLIDES IN WATER, SOIL AND SIMULATED CONTAMINATED SURFACE SAMPLES.
VIII.4. EC 19	Krasimir Mitev, Neli Ivanova, Alexander Stoyanov and Daniel Hristov METROLOGICAL STUDY OF A LARGE-AREA GAS-FLOW PROPORTIONAL COUNTER FOR STANDARDIZATION OF LARGE-AREA SOURCES
VIII.5. EC 15	Strahil Georgiev, Ivelina Dimitrova, Vladislav Todorov, Angelika Popova, Valentin Genov and Krasimir Mitev LARGE VOLUME RADON EXPOSURE SYSTEM FOR CALIBRATION AND STUDIES OF THE DYNAMIC CHARACTERISTICS OF RADON MONITORS
VIII.6. EC 45	Anton Mateev and Boyka Todorova PRACTICAL EXPERIENCE OF THE METROLOGICAL ASSURANCE OF LIQUID SCINTILLATION MEASUREMENTS IN THE "RADIOCHEMISTRY" SECTOR, KOZLODUY NPP
VIII.7. EC 18	Vladislav Todorov, Philippe Cassette, Strahil Georgiev, Hristiana Stoycheva, Radostina Vasileva and Krasimir Mitev PRIMARY STANDARDIZATION OF RADON-IN-WATER SAMPLES BY TDCR COUNTING
VIII.8. EC 35	Temenuzhka Stoyanova, Borislav Dobrinov, Yana Georgieva and Aleksandar Stoyanov METROLOGY ASSURANCE OF NEUTRON DOSIMETERS
VIII.9. EC 31	Hristiana Stoycheva and Krasimir Mitev AN APPROACH FOR CORRECTION FOR TRUE COINCIDENCES IN HPGE MEASUREMENTS IN CLOSE GEOMETRIES BASED ON MONTE CARLO AND ETNA CALCULATIONSS

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 34TH ISS MMA 2024
C.2.	I. Kodjabashev SCIENCE NOTES REGARDING 34TH ISS MMA 2024 AND THE NEXT 35TH ISS MMA 2025

Important for authors! The presentation of the paper on English, shall be uploaded up to the Symposium EasyChair system up to 05.09.2024 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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Fiber-optic systems of linear and angular movements

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Abstract - Developed fiber optic systems for measuring such physical quantities as liquid level, deformations, angular displacements. The proposed systems make it possible to increase the accuracy of measurements, simplify the design, increase the reliability and manufacturability, and expand the functionality.

Keywords - ***Information and Measurement Systems, Fiber-Optic Sensors, Liquid Level, Deformation, Angular Movements, Accuracy, Construction***

IV. INTRODUCTION

Fiber-optic devices for measuring various physical quantities are widely used in information and measurement systems for industrial purposes [1-6].

Systems for measuring liquid levels, monitoring deformations of reinforced concrete structures, systems for determining angular movements of objects, etc. are used in various branches of the industrial sector.

The design and development of such systems are related to the problems of increasing the accuracy of measurement, simplifying the design, increasing the reliability and manufacturability of sensors, and expanding the functionality

V. RESOURCES AND PUBLICATIONS ANALYSIS

Known devices [2-7] are characterized by the following disadvantages: the complexity of the design and the process of their manufacture, insufficient reliability, the need to expand functional capabilities. In this regard, it is necessary to develop new fiber-optic sensors for measuring physical quantities free from the listed disadvantages.

VI. RESEARCH

In order to simplify the design of the system and expand its functionality, a fiber-optic liquid measurement system is proposed in the utility model patent of Ukraine No. 152268, co-authored.

Fig. 1 shows a simplified design of the fiber-optic liquid level measurement system, and Fig. 2 – a fragment of placement of input and output optical fibers for obtaining information about the liquid level in single and binary codes.

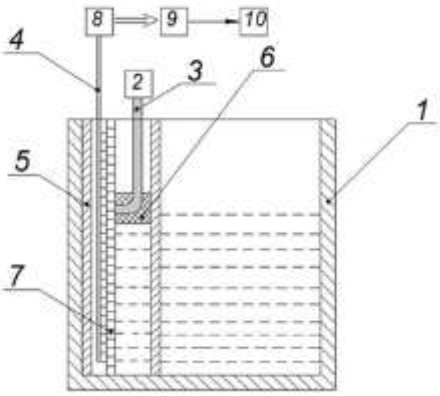

Fig. 1. Construction of fiber-optic liquid level measurement system

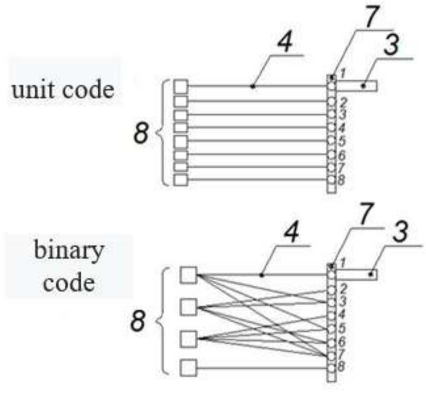

Fig. 2. Fragment of placement of input and output optical fibers for receiving information in single and binary codes

The fiber-optic liquid level measurement system (Fig. 1) contains a container for liquid 1, a radiation source 2, input 3 and output 4 optical fibers, a pipe 5, the cross-section of which can be round or rectangular. A float 6 and a ruler 7 are placed in pipe 5, on which the input ends of the output optical fibers 4 are fixed and turned to the output end of the input optical fiber 3 mounted in the float 6. The output ends of the output optical fibers 4 are connected to the radiation receivers 8 according to the corresponding code (Fig. 2). The radiation receivers 8 are connected to the serially connected digital signal processing unit 9 and the liquid level display unit 10. The float 6 has the ability to move along the guides in the pipe 5, and the input 3 optical fiber has a sufficient margin in length to move along the depth of the container 1 for liquid.

The fiber-optic liquid level measurement system works as follows.

In the initial state (when the entire container 1 is filled with liquid), the float 6 is located in the upper part of the pipe 5. The optical signal from the radiation source 2 through the input 3 optical fiber enters the input end of the first output 4 optical fiber and flows through this fiber to the first radiation receiver 8. The electrical signal from the output of receiver 8 is fed to the serially connected digital signal processing unit 9 and the information display unit 10, which form a liquid level indication signal (the container is filled with liquid).

When the liquid level changes, the float 6 moves down the pipe along the guides, and the output end of the input optical fiber 3 stops opposite the corresponding input end of the output 4 optical fibers fixed on the ruler 7. In this case, the optical signal transmitted from the radiation source 2 enters through corresponding output 4 optical fibers (see Fig. 2) to corresponding receivers 8 radiation. Electrical signals from the outputs of the radiation receivers 8 (see Fig. 2) in the digital signal processing unit 9 are formed in the form of binary codes. In the information display unit 10, a liquid level indication signal is generated.

Thus, the proposed fiber-optic liquid level measurement system allows simplifying the design and increase its manufacturability, as well as expanding the functionality. In addition, this system has absolute spark safety, explosion safety and fire safety.

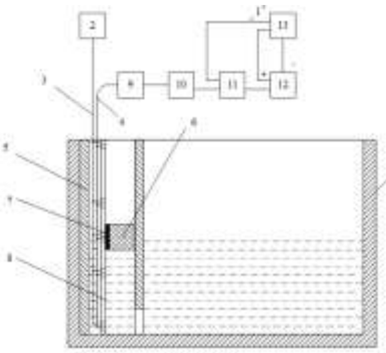

Fig. 3 Simplified design of a fiber-optic liquid level measurement system

To further simplify the design of the system, increase its reliability and manufacturability, a fiber-optic liquid measurement system is proposed in the utility model patent of Ukraine No. 155846 in co-authorship.

Fig. 3 shows a simplified design of a fiber-optic liquid level measurement system.

The fiber-optic liquid level measurement system includes a container for liquid 1, a radiation source 2, input 3 and output 4 optical fibers, a pipe 5 with an opening, the cross-section of which can be round or rectangular. In the pipe 5 there is a float 6 with a mirror surface 7 and a ruler 8, on which the output ends of the input optical fibers 3 and the input ends of the output optical fibers 4, alternating, are fixed. The input optical fibers 3 are optically connected to the radiation source 2, and the output optical fibers 4 to the radiation receiver 9, which is connected to the series-connected amplifier 10, the logic circuit "I" 11 and the binary reversing counter 12. The mirror surface 7 of the float 6 is directed towards the ends of the input 3 and output 4 optical fibers, and the float 6 can move along the guides in the pipe 5. The first output of the control unit 13 is connected to the first input of the logic circuit "I" 11, and the other two - to binary reverse counter 12.

Fig. 3 shows the placement of the ends of the input 3 and output 4 optical fibers on line 8 for the following cases of filling the container with liquid: the container is completely filled with liquid; by 2/3 of the volume; by half; by 1/3 of the volume; container without liquid.

The fiber-optic liquid measurement system works as follows.

Before starting work, the control unit 13 sends a signal of the level of the logical unit ("1") to the first input of the logic circuit "I" 11.

When container 1 is filled with liquid, float 6 moves up. When the float 6 is placed in front of the ends of the input 3 and output 4 optical fibers, the optical signal from the radiation source 2 through the input optical fiber 3 falls on the mirror surface 7, is reflected from it and through the output optical fiber 4 illuminates the radiation receiver 9.

The electrical signal from the output of the radiation receiver 9 is amplified in the amplifier 10 and enters the second input of the logic circuit "I" 11. A single pulse from the output of the logic system "I" 11 enters the input of the binary reversible counter 12. Until the container is completely filled with liquid, the binary reversible counter 12 will work in the mode of adding single pulses, provided by the supply from the control unit 13 of the signal on the "+" bus.

When the liquid level changes, the float 6 moves down the pipe 5 along the guides.

In this case, the fiber-optic liquid level measurement system works similarly, but the binary reversing counter 12 works in the mode of subtraction of single pulses, which is ensured by the supply of a signal from the control unit 13 on the "-" bus.

Thus, the proposed fiber-optic liquid level measurement system allows to simplify the design and increase its reliability and manufacturability.

To simplify the design, increase the manufacturability of the strain sensor and expand its functionality, a fiber-optic strain sensor for monitoring reinforced concrete structures is proposed in the utility model patent of Ukraine No. 154907 in co-authorship.

Fig. 4 shows a simplified design of a fiber-optic strain sensor.

The fiber-optic sensor for measuring the deformation of a reinforced concrete structure 1 contains transmitting 2 and receiving 3 optical fibers, LED 4, n photodiodes 5 (PD), where n is the number of bits of the binary code. The metal plate 6 is rigidly fixed on the reinforced concrete structure 1.

The output end of the transmission 2 optical fiber is fixed in the hole of the metal plate 6. The transmission 2 optical fiber has a sufficient margin in length. The receiving 3 optical fibers are placed one under the other in the direction of movement of the metal plate 6, and the output ends of the receiving 3 optical fibers are laid out in the holes of the fiber-optic converter 7 to receive information in an n-bit binary code.

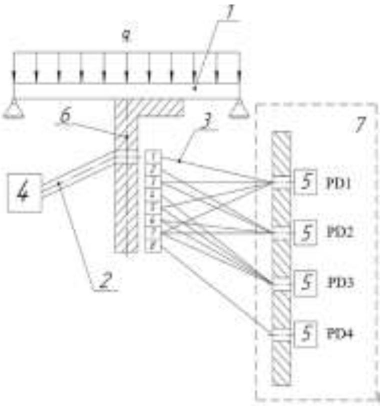

Fig. 4. Simplified construction of a fiber-optic strain sensor

The fiber optic strain gauge works as follows.

The deformation of the reinforced concrete structure 1 causes the downward movement of the metal plate 6. At the same time, its hole is installed opposite the corresponding input end of the receiving 3 optical fibers. The light flow from the LED 4 flows along the transmission 2 optical fiber through the hole in the metal plate 6 to the corresponding input end of the receiving 3 optical fibers and illuminates the corresponding photodiodes 5 (PD) of the fiber-optic converter 7. At the outputs of the photodiodes 5, a binary code is formed, which corresponds to the amount of deformation of the reinforced concrete structure 1.

Thus, the proposed fiber-optic strain sensor allows to simplify the design and increase its manufacturability, as well as to expand the functionality.

To simplify the design of the angular displacement sensor, increase its manufacturability and measurement accuracy, a fiber-optic angular displacement sensor with a digital output signal is proposed in the utility model patent of Ukraine No. 153841 in co-authorship.

Fig. 5 shows the design of the fiber-optic angular displacement sensor.

In the housing 1 of the fiber-optic sensor of angular movements (Fig. 5a), a code disk 2 with a hole 3 (Fig. 5c) is mounted on the shaft, on the opposite sides of which rigidly fixed circular plates 4, 5. The input ends of the input light guides 6 optically are connected to the source of optical radiation 7 (Fig. 5, d), and their output ends are placed in holes bounded by circles of two radii and made in the circular plate 4 (Fig. 5, b).

The input ends of the output light guides 8 are placed in the holes bounded by circles of two radii and made in the circular plate 5 (Fig. 5, d), and their output ends are laid out in the holes of the fiber optic converter 9 for receiving information in binary code (Fig. 5, f).

The fiber-optic angular displacement sensor works as follows.When the shaft with the code disc 2 is rotated through an angle φ, its opening 3 is installed opposite the corresponding input end of the output light guides 8, fixed in the circular plate 5. The light flux from the optical radiation source 7 flows along the corresponding input light guide 6 and through its output end, fixed on the circular plate 4, the hole 3 of the code disk 2, the corresponding input end of the output light guides 8, fixed on the kpyg plate 5, the corresponding output light guide 8 illuminates the corresponding photoreceptors (PR1...PR4) of the fiber-optic converter 9. At the outputs of the photodetectors (PR1...PR4) a binary code is formed that corresponds to the measured turning angle φ.

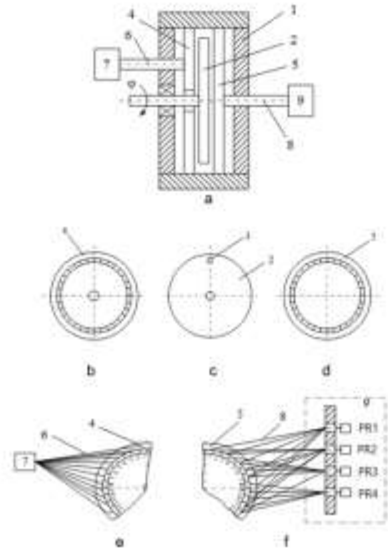

Fig. 5. Design of a fiber-optic sensor of angular movements: a - simplified design; b - a circular plate for placing the output ends of the input light guides; c - a code disk with a hole; d - a circular plate for placing the input ends of the output light guides; d - a fragment of the placement of input light guides; e - a fragment of the layout of the output ends of the input light guides in the holes of the fiber optic converter

Thus, the proposed fiber-optic sensor of angular movements has a digital output signal, simplified processing of measurement results, manufacturability of manufacturing a code disk and reduced overall dimensions, so all this allows to simplify the design, increase its manufacturability and accuracy of measuring angular movements.

In information-measuring systems, such converters of linear displacements as pressure sensors find wide application. In order to expand the functional capabilities by creating a digital signal output in binary code, a fiber-optic pressure sensor has been proposed in collaboration (patent for utility model of Ukraine No. 151594). Figure 6 shows the construction of a fiber-optic pressure sensor, and Figure 7 shows the layout of the output ends of the receiving optical fibers in the holes of the fiber-optic transducer to obtain information in binary code.

The membrane 1 is rigidly connected to the fitting 2. In the center of the membrane 1, an opaque shutter 3 with a hole is rigidly fixed, around which transmitting 4 and receiving 5 fiber optic bundles are located on different sides, rigidly fixed in the housing 6. Alignment of the fiber optic bundles 4, 5 relative to the hole in the shutter 3 is carried out using a metal gasket 7, the thickness of which is selected during the adjustment of the sensor. Before the input ends of the transmitting optical fibers 4, a source of optical signals 8 is installed (Fig. 6), for example, an LED in front of each optical fiber. The output ends of the receiving optical fibers 5 are arranged in the holes of the fiber-optic transducer 9 to obtain information in binary code (Fig. 7)

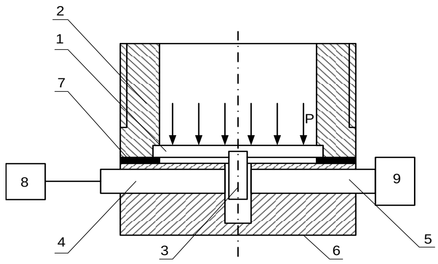

Fig. 6. Fiber-optics presure sensor constuction

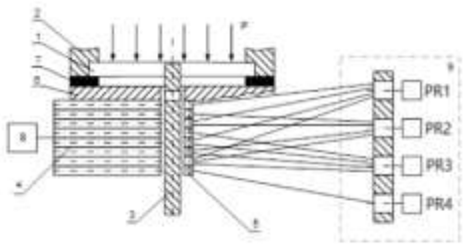

Fig. 7. Layout of the output ends of the receiving light fibers in the holes of the fiber-optic converter

The fiber-optic pressure sensor operates as follows: Under the influence of the measured pressure, P, the membrane 1 bends and displaces the shutter 3. In this case, the hole in the shutter 3 aligns with the corresponding output end of the transmitting optical fiber 4 and the input end of the receiving fibers 5. The light flux from the source 8 of optical signals at the output of the corresponding transmitting fiber 4 passes through the hole in the shutter 3 and reaches the corresponding input end of the receiving fiber bundle 5. After the optical signal passes through the fiber optic bundles 5, the respective photoreceivers PRi of the fiber-optic transducer 9 are triggered, converting optical signals into electrical signals corresponding to the logic level one. If no optical signal reaches the inputs of the photodetectors, there will be no electrical signal at their outputs, corresponding to the logic level zero.

At the outputs of the photoreceivers PRi of the fiber-optic transducer 9, information about the pressure magnitude P will be obtained in binary code. The proposed fiber-optic pressure sensor allows expanding the functional capabilities compared to the closest analogue by creating information about the pressure magnitude in binary code at its output.

CONCLUSIONS

The use of the proposed systems of linear and angular movements allows to simplify their design, increase their reliability, manufacturability and accuracy, and expand their functional capabilities.

At the same time, the fiber-optic liquid level measurement system according to the patent of Ukraine No. 152268, in comparison with analogues, allows not only to simplify the design and expand the functionality due to the output of the initial information about the liquid level in a single or binary code, but also to significantly increase the accuracy of the measurement due to the use set of output optical fibers.

The fiber-optic liquid level measurement system according to the patent of Ukraine No. 155846 allows further simplification of the design, improvement of its reliability and manufacturability due to the registration of the following cases of liquid filling of the container: the container is completely filled with liquid; by 2/3 of the volume; by half; by 1/3 of the volume; without liquid.

For use in monitoring systems of reinforced concrete structures, a fiber-optic deformation sensor (patent of Ukraine No. 154907) is proposed, which allows, in comparison with analogues, to simplify the structure, increase reliability and manufacturability, expand its functionality due to the output of output information in binary code.

The proposed fiber-optic sensor of angular displacements (patent of Ukraine No. 153841) not only allows to simplify the design and increase manufacturability, but also to significantly increase the accuracy of measurement with the output of information in digital form, which simplifies the processing of measurement results.

When manufacturing these systems, it is expedient to use methods of optimal planning of experiments in terms of cost and time costs [8,9,10].

These devices can be widely used in information and measurement systems in various branches of the industrial sector.

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