

International journal
for science, technics and
innovations for the industry



MACHINES
TECHNOLOGIES
MATERIALS

YEAR XI **Issue 11** / 2017 **ISSN PRINT 1313-0226**
ISSN WEB 1314-507X



Published by
Scientific technical
Union of Mechanical Engineering "INDUSTRY 4.0"



MACHINES. TECHNOLOGIES. MATERIALS

INTERNATIONAL SCIENTIFIC JOURNAL

PUBLISHER

SCIENTIFIC TECHNICAL UNION OF MECHANICAL ENGINEERING “INDUSTRY 4.0”

108, Rakovski Str., 1000 Sofia, Bulgaria

tel. (+359 2) 987 72 90,

tel./fax (+359 2) 986 22 40,

office@stumejournals.com

www.stumejournals.com

ISSN PRINT 1313-0226, ISSN WEB 1314-507X, YEAR XI, ISSUE 11 / 2017

EDITOR-IN-CHIEF

Prof. D.Sc. DHC Georgi Popov,

President of Bulgarian Scientific and Technical Union of Mechanical Engineering

EDITORIAL BOARD

MEMBERS

SCIENTIFIC COMPETENCE

Prof. Dimitar Damyanov	Automatisation of production
Prof. Dimitar Karaivanov	Mechanics of machines
Prof. Dimitar Stavrev	Technologies and materials
Prof. Dimitar Yonchev	National and industrial security
Prof. Galina Nikolcheva	Machines tools and technologies
Prof. Hristo Shehtov	Automatisation of production
Prof. Idilija Bachkova	Automatisation of production
Prof. Ivan Kralov	Mechanics of machines
Prof. Ivan Parshorov	Technologies and materials
Prof. Ivan Yanchev	Machines and technologies
Prof. Ivo Malakov	Automatisation of production
Prof. Kiril Angelov	Industrial Management
Prof. Lilo Kunchev	Transport Equipment and Technology
Prof. Lubomir Dimitrov	Machines and technologies
Prof. Miho Mihov	Agricultural machinery
Prof. Miroslav Denchev	Ergonomics and design
Prof. Mladen Velev	Economics and Marketing
Prof. Nikolay Diulgerov	Technologies and materials
Prof. Ognyan Andreev	Production management
Prof. Petar Kolev	Transport Equipment and Technology
Prof. Roman Zahariev	Robotics
Prof. Sasho Guergov	Robotic systems and technology
Prof. Tsanka Dikova	Technologies and materials
Prof. Vitan Galabov	Mechanics of machines



MACHINES. TECHNOLOGIES. MATERIALS

INTERNATIONAL SCIENTIFIC JOURNAL

ISSN PRINT 1313-0226, ISSN WEB 1314-507X, YEAR XI, ISSUE 11 / 2017

EDITORIAL BOARD FOREIGN MEMBERS

Prof. Adel Mahmoud	IQ	Prof. Marian Tolnay	SK
Prof. Ahmet Ertas	TR	Prof. Mark Easton	AU
Prof. Andonag Londo	AL	Prof. Mart Tamre	EE
Prof. Andrei Firsov	RU	Prof. Maryam Ehteshamzade	IR
Prof. Andrzej Golabczak	PL	Prof. Michael Evan Goodsite	DK
Prof. Anita Jansone	LV	Prof. Movlazade Vagif Zahid	AZ
Prof. Aude Billard	CH	Prof. Natasa Naprstkova	CZ
Prof. Bojan Dolšak	SI	Prof. Oana Dodun	RO
Prof. Christian Marxt	LI	Prof. Oleg Sharkov	RU
Prof. Dale Carnegie	NZ	Prof. Páll Jensson	IS
Prof. Ernest Nazarian	AM	Prof. Patrick Anderson	NL
Prof. Esam Husein	KW	Prof. Paul Heuschling	LU
Prof. Ewa Gunnarsson	SW	Prof. Pavel Kovac	RS
Prof. Filipe Samuel Silva	PT	Prof. Per Skjerpe	NO
Prof. Francisco Martinez Perez	CU	Prof. Péter Korondi	HU
Prof. Franz Haas	AT	Prof. Peter Kostal	SK
Prof. Genadii Bagliuk	UA	Prof. Juan Alberto Montano	MX
Prof. Georg Frey	DE	Prof. Raul Turmanidze	GE
Prof. Gregory Gurevich	IL	Prof. Renato Goulart	BR
Prof. Haydar Odinaev	TJ	Prof. Roumen Petrov	BE
Prof. Hiroyuki Moriyama	JP	Prof. Rubén Darío Vásquez Salazar	CO
Prof. Dr. Ilir Doci	Ko	Prof. Safet Isić	BA
Prof. Iryna Charniak	BY	Prof. Sean Leen	IE
Prof. Ivan Svarc	CZ	Prof. Shi Xiaowei	CN
Prof. Ivica Veza	HR	Prof. Shoirdzan Karimov	UZ
Prof. Jae-Young Kim	KR	Prof. Sreten Savićević	ME
Prof. Jerzy Jedzejewski	PL	Prof. Stefan Dimov	UK
Prof. Jean-Emmanuel Broquin	FR	Prof. Svetlana Gubenko	UA
Prof. Jordi Romeu Garbi	ES	Prof. Sveto Cvetkovski	MK
Prof. Jukka Tuhkuri	FI	Prof. Tamaz Megrelidze	GE
Prof. Katia Vutova	BG	Prof. Tashtanbay Sartov	KG
Prof. Kazimieras Juzėnas	LT	Prof. Teimuraz Kochadze	GE
Prof. Krasimir Marchev	USA	Prof. Thorsten Schmidt	DE
Prof. Krzysztof Rokosz	PL	Prof. Tonci Mikac	HR
Prof. Leon Kukielka	PL	Prof. Vasile Cartofeanu	MD
Prof. Mahmoud El Gammal	EG	Prof. Yasar Pancar	TR
Prof. Manolakos Dimitrios	GR	Prof. Yuriy Kuznetsov	UA
Prof. Marat Ibatov	KZ	Prof. Wei Hua Ho	ZA
Prof. Marco Bocciolone	IT		

CONTENTS

MACHINES

FOURTH INDUSTRIAL REVOLUTION. ROBOTS AND PRODUCTION AUTOMATION WITH ELEMENTS OF ARTIFICIAL INTELLIGENCE Prof. Pavlov, V, Phd, Avishay, D. Phd, Pavlova, G	507
PATH PLANNING AND COLLISION AVOIDANCE REGIME FOR A MULTI-AGENT SYSTEM IN INDUSTRIAL ROBOTICS MSc. Ivan Gochev, MSc. Gorjan Nadzinski, Prof. DSc Mile Stankovski	511
PRINCIPLES OF DESIGNING AND DEVELOPING INTELLIGENT MANUFACTURING SYSTEMS OF PACKAGING Prof. dr. Palchevskiy B., PhD. Krestyanpol O., PhD. Krestyanpo L.	515
VEHICLES AND EXHAUST EMISSION: A REVIEW OF THE TECHNOLOGICAL IMPROVEMENTS assistant professor dr. Angelevska B., full professor dr. Atanasova V.	520

TECHNOLOGIES

ANALYSIS OF MANUFACTURING SYSTEMS WITH USE OF SIMULATION SOFTWARE doc. Ing. P. Košťál, PhD. & doc. Ing. Š. Václav, PhD. & Ing. D. Michal & Ing. Š. Lecký	525
INFLUENCE OF FRICTION COEFFICIENT ON MECHANICAL PROPERTIES IN PROCESS OF COLD BULK FORMING Ass. Prof. dr. Leo Gusel, Ass. Prof. dr. Rebeka Rudolf	529
IMPROVEMENT OF TECHNOLOGIES FOR THE DEVELOPMENT OF MODERN RAIL AUTOMATION SYSTEMS Assos. prof. Ph.D.(eng.) Kameniev Oleksandr, Assos. prof. Ph.D.(eng.) Lapko Anton, post grad. Shcheblykina Elena	533
PERFORMANCE OF GARMENT SEAMS STRENGTHENED WITH THERMOPLASTIC STITCHED REINFORCED TAPE Ph.D stud. Ass. M.Sc Golomeova S., Prof. Dr. Demboski G.	537
ANISOTROPY OF THE MECHANICAL PROPERTIES OF HOT ROLLED STEEL COILS FOR WELDED PIPES Prof. Dr. Maksuti Rr.	541
DATA COLLECTION AND ANALYSIS TO IDENTIFY THE TRAFFIC PROBLEMS OF THE EXISTING NETWORK AND APPLICATION OF SOFTWARE FOR SOLUTION PROPOSALS, A CASE STUDY Atanasova, V., PhD., M.Sc. Hadjipetkova, K., M.Sc. Ilievski, D.	545

MATERIALS

STRENGTHENING OF SURFACE LAYERS OF STEELS AND ALLOYS BY BORIDE COATINGS FORMED UNDER THE CONDITIONS OF AN EXTERNAL MAGNETIC FIELD Prof. Dr. Chernega S., Grinenko E., Krasovskiy M.	549
--	-----