

*Scientific Research Centre  
"MachineStructure"*

*Amazon Kindle Direct Publishing*



**ISSN 2474-5901**

# **Journal of Advanced Research in Technical Science**

**Issue 40**

**Seattle, USA, 2024**

**Journal of Advanced Research in Technical Science. –**  
Seattle, USA: SRC MS, AmazonKDP. –  
2024. – Issue 40. – 101 p.

ISSN 2474-5901

Themes of journal: 1) Mechanical engineering and engineering science; 2) Mathematics and mechanics; 3) Mechatronics and robotics; 4) Transport, mining and construction machinery; 5) Power, metallurgical and chemical engineering; 6) Instrument making, metrology and information-measuring devices and systems; 7) Electrical and Electronics; 8) Informatics, computer engineering and management; 9) Engineering geometry and computer graphics; 10) Materials science; 11) Technology, machinery and equipment of Agroengineering systems; 12) Transport; 13) Construction and architecture; 14) Problems of personnel training in mechanical engineering.

*Editor in Chief:*

Ivan A. Zhukov – Saint-Petersburg mining university. Department of mechanical engineering. Doctor of sciences

*Editorial Board:*

Elvira R. Zvereva – Kazan state power engineering university. Departments of technology in energy and oil and gas processing. Doctor of sciences

Daba N. Radnaev – Buryat state academy of agriculture. Department of mechanization of agricultural processes. Doctor of sciences

Vladimir I. Sarbaev – Moscow polytechnic university. Department of Land Vehicles. Doctor of sciences

Lev A. Saruev – Tomsk polytechnic university. Department of Oil and Gas Business. Doctor of sciences

Aleksandr B. Filimonov – MIREA – Russian technological university. Department of automatic systems. Doctor of sciences

Elena S. Gebel – Omsk state technical university. Department of automation and robotics. Candidate of sciences

Azamat K. Djamankulov – Kyrgyz-Russian Slavic university. Department of mechanics. Candidate of sciences

Oleg S. Krol – Volodymyr Dahl East-Ukrainian National University. Department of engineering, machines and tools. Candidate of sciences

Nikita V. Martyushev – Tomsk polytechnic university. Department of Materials Science. Candidate of sciences

Copyright © 2024 Authors, SRC MS  
All rights reserved.

## CONTENTS

### Mechanical engineering and engineering science

- Rakov D.L., Bardenhagen A., Pecheykina M.A., Todorov V.T.** Selection of reference design solutions and innovation assessments within the morphological analysis..... 5
- Biryukov V.P., Yakubovsky A.A.** Analysis of abrasive wear of polymers and their composites..... 9

### Mechatronics and robotics

- Biryukov N.S., Eliseev I.V.** Development of a grinding unit for a cylindrical product processing complex..... 14
- Evdokimov A.P.** Development of a methodology for the analysis and synthesis of kinematic structures of drilling manipulators..... 22
- Pham Q.P.** Optimization of uav flight routes for group border patrolling using genetic algorithm ..... 28
- Yang Shuai.** Optimal consensus control of multi-agent systems ..... 36

### Power, metallurgical and chemical engineering

- Kaigorodov S.Yu., Rumenko D.N., Harahordina A.Yu., Kosovenko A.A., Varlakova A.R.** Analysis of the efficiency of hydraulic and pneumatic straight-through diode ..... 43
- Lipatov M.S., Kozlov V.V.** Analyzing the protection of heat network pipelines ..... 49

### Electrical and Electronics

- Lazarev N.I., Kuznetsov N.M.** Solar energy for power supply of remote consumers in Murmansk region ..... 55

Informatics, computer engineering and management

**Golubnichiy A.S., Semenov D.V.** Social media and big data analysis: study of user behavior and trends ..... 59

**Talagaev Yu.V., Shvets D.A.** Synchronization of two chaotic Sprott systems based on superstability conditions..... 66

**Shifrin B.M.** Development of information model for the sulphate pulp production..... 71

**Andreev R.A., Dulesov A.S.** Prospects for the development of software architecture ..... 75

Materials science

**Roshchin M.N.** Carbon-containing material Carbon dioxide in friction nodes when temperature and load change ..... 80

**Roshchin M.N.** Effect of coating thickness on laser reflow time on VT6 titanium alloy..... 83

**Korobchuk M.V.** Fluoropolymer coatings in subsea production systems: status and issues, necessary solutions ..... 86

Construction and architecture

**Zenkov E.V.** Joint application of bim and cae technologies on the example of the development of capital construction facilities ..... 91

Problems of personnel training in mechanical engineering

**Lashina E.N.** The use of information and communication technologies in teaching a foreign language to students of technical specialties at a university ..... 96

Scientific periodical issue

ISSN 2474-5901

# Journal of Advanced Research in Technical Science

Issue 40

---

*Founder:* Elena V. Zhukova.

*Editorial:* Scientific Research Centre «MachineStructure».

*Editor in chief:* Ivan A. Zhukov.

*Printed by* AmazonKDP, Seattle WA.

*Publication Date:* 11.03.2024.

*Title ID:* 24-04.

*Trim Size:* 7" x 10" (17.78 x 25.4 cm).

*Number of copies:* 50 min.

Seattle, USA:

Scientific Research Centre «MachineStructure», Amazon Kindle Direct Publishing  
2024