



JOINT COMPANY  
«RESEARCH AND PRODUCTION CORPORATION  
«SPACE MONITORING SYSTEMS, INFORMATION & CONTROL AND  
ELECTROMECHANICAL COMPLEXES» NAMED AFTER A.G. IOSIFIAN»  
(JC «VNIEM CORPORATION»)

## ELECTROMECHANICAL MATTERS. VNIEM STUDIES

Scientific and technical journal  
Published since 1959  
Released once every two months

ISSN 2500-1299

Tome 170

№3  
2019

### Chief Editor:

MAKRIDENKO L. A., Director General,  
D. Sc. (Tech.)

### Editorial board:

Vereshchagin V. P., D. Sc. (Tech.)  
Volkov S. N., D. Sc. (Tech.)  
Gecha V. Ia., D. Sc. (Tech.)  
(Deputy Chief Editor)  
Gorbunov A. V., Ph. D. (Tech.)  
Duyshenaliev T. B., D. Sc. of Physics  
and Mathematics (Kyrgyz Republic)  
Zakharenko A. B., D. Sc. (Tech.)  
Zolotoy S. A., Ph. D. (Tech.)  
(Republic of Belarus)  
Kazantsev S. G., D. Sc. (Tech.)  
Karachun N. D., D. Sc. (Tech.)  
Minaev I. V., D. Sc. (Tech.)  
Nurguzhin M. R., D. Sc. (Tech.)  
(Republic of Kazakhstan)  
Pinchuk A. V., Ph. D. of Military Science  
Sarychev A. P., D. Sc. (Tech.)  
Tyutnev A. P., D. Sc. of Physics  
and Mathematics  
Fedotov A. Yu., D. Sc. (Tech.)  
Hodnenko V. P., D. Sc. (Tech.)  
Chunikhina O. A.  
(Editorial board Executive secretary)

### Executive editor:

Gecha V. Ia., D. Sc. (Tech.)

### Subscription index:

Union catalogue  
«Pressa Rossii»  
**87648**

*Editorial office address:*  
JC «VNIEM Corporation», 30 Volnaia st., Moscow, Russian  
Federation. Postcode: 105187.  
Tel.: (495) 365-30-63.  
E-mail: vniem@vniem.ru; redaktori@mail.ru.  
<http://jurnal.vniem.ru>.

Signed for print 28.06.2019. Format: 60×84 1/8.  
Conventional printed sheet 6,86. Circulation: 150 copies.  
Printed at «SAM-POLIGRAFIST» LLC6,  
Protopopovskii pereulok, Moscow. Tel.: (495) 545-37-10.  
[www.onebook.ru](http://www.onebook.ru).

The journal is registered by the Federal Service for Supervision  
of Communications, Information Technology and Mass Media,  
Registration Certificate ПИ № 77-74183 dated 30.11.2018.

The journal is recommended by the Ministry of education and  
science of Russia for publication of scientific works reflecting  
the main scientific content of candidate and doctoral dissertations

Full or partial use of the information published in the journal is  
allowed only after coordination with the editorial department,  
with indication of the source.

© JC «VNIEM Corporation», 2019

## CONTENTS

### GENERAL QUESTIONS OF ELECTROMECHANICS

*E. M. Mikhailov*

Lubrication for ball-bearings of microelectromotors for spacecraft.....3

### SPACE ELECTROMECHANICS. SPACE CRAFTS. NEAR-EARTH SPACE RESEARCH

*I. P. Bezrodnykh, E. I. Morozova,  
A. A. Petrukovich, M. V. Kozhukhov*

Dynamics of solar and geomagnetic activity.

I. Geomagnetic activity sources, coronal mass

ejection, high-speed solar wind streams .....13

### ELECTROMECHANICS AND THE SOCIO-ECONOMIC DEVELOPMENT OF THE NATION

*E. V. Butrova, Iu. V. Denisov,*

*G. V. Kovkov, A. E. Skliarov*

Earth remote sensing and modern management

concepts in the agricultural industry.....28

### HISTORY CHAPTERS OF THE NATIONAL SPACE METEOROLOGY

*L. A. Makridenko, S. N. Volkov, A. V. Gorbunov,  
V. A. Kozhevnikov, V. P. Khodnenko*

«Ionozond» space system.....40

*L. A. Makridenko, S. N. Volkov,*

*A. V. Gorbunov, V. P. Khodnenko*

Unified space platform «Resurs-UKP».....49