

**ISSN 1813-1166 print**  
**ISSN 2306-1472 online**

MINISTRY EDUCATION AND SCIENCE OF UKRAINE  
National Aviation University

# **PROCEEDINGS**

## of the National Aviation University

---

Scientific journal \* 4 times a year \* Established in November 1996

---

**1 (58) 2014**

KYIV

## Proceedings of the National Aviation University, N 1 (58), 2014

<http://jrn1.nau.edu.ua/index.php/visnik/>

**Journal Scope:** The Scientific Journal is intended for publishing original papers concerning the following fields of research: aerospace systems for monitoring and control; modern aviation and space technology; airports and their infrastructure; information technology; environment protection; chemmotology and chemical technology; biotechnology; economic development strategy; professional education.

**History:** The Scientific Journal “Proceedings of the National Aviation University” was founded in 1996. The first volume of the Scientific Journal was published under the title Proceedings of the Kyiv International University of Civil Aviation in 1998. Since 2001 the Scientific Journal has been issued under the title Proceedings of the National Aviation University. Scientific journal “Proceedings of the National Aviation University” is referred to Ukrainian professional and scientific publications in the field of Engineering, Chemical (Ecological Safety) and Pedagogical Sciences.

**Abstracts & Indexing:** EBSCO, Google Scholar; Directory of Open Access Journals (DOAJ); Russian Science Citation Index (Elibrary.ru); Chemical Abstracts Service (CAS); Index Copernicus International (IC), WorldCat; DRIVER; Academic Journals Database, Simple Search Metadata (SSM); the Vernadsky National Library of Ukraine; Scientific and Technical Library of the National Aviation University; Bielefeld Academic Search Engine (BASE); Ulrichsweb global serials directory; Directory of Research Journal Indexing (DRJI); Journal TOCs; SHERPA/RoMEO; Journal Finder University Libraries, Sjournals, Universal Impact factor, Research Bible, Periodicos.capes.gov.br.

**Disclaimer:** The Editorial Board of the Scientific Journal “Proceedings of the National Aviation University” makes every effort to ensure the accuracy of all the information (the 'Content') contained in its publications. However, the Editorial Board is not responsible for authenticity of facts, names, photos and other Content of the article and disclaims all representations and warranties whether express or implied to the maximum extent permitted by effective legislation of Ukraine. Any views expressed in this publication are the views of the authors and are not necessarily the views of the Editorial Board of the Scientific Journal “Proceedings of the National Aviation University”.

**Copyright © 2014 National Aviation University.** All rights reserved. No part of this publication may be reproduced, stored, transmitted, or disseminated, in any form, or by any means, without prior written permission from National Aviation University, to whom all requests to reproduce copyright material should be directed, in writing.

Certificate of State Registration KV 5091 of 28 April 2001.

Approved for publication by the Academic Council of the National Aviation University  
(Minutes 10 of 18 December 2013).

**Submissions:** All submissions should be made online at the Proceedings of the National Aviation University (<http://jrn1.nau.edu.ua/index.php/visnik/author>). Complete guidelines for preparing and submitting a manuscript to this Scientific Journal are provided at the Scientific Journal website.

Enquiries to Scientific Journal Proceedings of the National Aviation University should be addressed to the Editorial Board:

Kosmonavta Komarova avenue 1  
Kyiv, Ukraine, 03680  
Phone: +38044 408 24 29  
Fax: +38044 406 72 12  
E-mail: [vesnik\\_nau@nau.edu.ua](mailto:vesnik_nau@nau.edu.ua)

**EDITORIAL BOARD**

**Editor-in-Chief:** Prof. **Mykola Kulyk**  
National Aviation University, Ukraine. E-mail: kms@nau.edu.ua

**Deputy Editor-in-Chief:** Prof. **Volodymyr Kharchenko**  
National Aviation University, Ukraine. E-mail: kharch@nau.edu.ua

**Managing Editor:** Prof. **Svetlana Pavlova**  
National Aviation University, Ukraine. E-mail: psv@nau.edu.ua

E-mail of Editorial Office: vesnik\_nau@nau.edu.ua

**Members****Engineering Sciences**

Prof. **Oleksandr Aksyonov**, National Aviation University, Ukraine  
Prof. **Andrii Bieliatynskyi**, Academician of the Ukrainian Transport Academy, National Aviation University, Ukraine  
Prof. **Sergii Boichenko**, National Aviation University, Ukraine  
Prof. **Oleksandr Danilov**, All-Russian Research Institute of Oil Refining, Russia  
Prof. **Serhiy Dmitriyev**, Laureate of the State bonus of Ukraine in the branch science and technique,  
National Aviation University, Ukraine  
Prof. **Werner Hufenbach**, Institute of Lightweight Structures and Polymer Technology, Technical University,  
Dresden, Germany  
Prof. **Hikmet Karakoc**, Anadolu University Civil Aviation School, Turkey  
Prof. **Georgiy Konahovych**, Honored Worker of Transport of Ukraine, National Aviation University, Ukraine  
Prof. **Kazimierz Lejda**, Technical University of Rzeszow, Poland  
Prof. **Rahim Mamedov**, Azerbaijan State Oil Academy, Azerbaijan  
Prof. **Robert McMillan**, IEEE Life Fellow; Senior Member of Optical Society of America; Senior Member of Photo-  
Optical Instrumentation Engineers Society; Recipient of Meritorious Presidential Rank Award, US Army Space and  
Missile Defense Command, United States of America  
Prof. **Jozef Modelski**, IEEE Fellow, Member of the Polish Academy of Sciences, Honorary Doctorate of the Military  
University of Technology, Warsaw University of Technology, Poland  
Prof. **Vito Pascazio**, IEEE Senior Member, Department of Technology, University of Naples Parthenope, Italy  
Assoc. Prof. **Olegas Prentkovskis**, Academician of the Ukrainian Transport Academy (Foreign Member)  
Vilnius Gediminas Technical University, Lithuania  
Prof. **Rauf Sadykhov**, Belarusian State University of Informatics and Radioelectronics, Belarus  
Prof. **Maxwell Shauk**, Baylor Aviation University, United States of America  
Prof. **Tetyana Shmelova**, National Aviation University, Ukraine  
Prof. **Mykola Sidorov**, National Aviation University, Ukraine  
Prof. **Henrikas Sivilevicius**, Vilnius Gediminas Technical University, Lithuania  
Prof. **Jonas Stankunas**, Vilnius Gediminas Technical University, Lithuania  
Prof. **Krzysztof Szafran**, Aviation Institute, Poland  
Prof. **Vladimir Tsipenko**, Moscow State Technical University of Civil Aviation, Russia  
Prof. **Anatoliy Tunik**, IEEE Senior Member, Member of the International Academy of Navigation and Motion Control,  
National Aviation University, Ukraine  
Prof. **Uriy Vishnyakov**, Southern Federal University, Russia  
Prof. **Felix Yanovsky**, IEEE Fellow, Ukraine State (President) Award Winner in the Field of Science and Technology,  
Member of the Transport Academy of Ukraine, the International Academy of Navigation and Motion Control, Academy  
of Sciences of Applied Radio Electronics of Belarus, Russia and Ukraine, Electromagnetics Academy at Cambridge,  
MA, USA, National Aviation University, Ukraine  
Prof. **Leonid Yanovsky**, Federal State Unitary Enterprise "Central Institute of Aviation Motorbuilding named  
after P.I. Baranov", Russia  
Prof. **Józef Zajac**, State School of Higher Education in Chelm, Poland  
Prof. **Oleksandr Zaporozhets**, National Aviation University, Ukraine  
Prof. **Edmundas Zavadskas**, Vilnius Gediminas Technical University, Lithuania  
Prof. **Boris Zubkov**, Moscow State Technical University of Civil Aviation, Russia

**Chemical Sciences**

- Prof. **Urii Bilokopytov**, National Aviation University, Ukraine  
Prof. **Fedir Fabuliak**, National Aviation University, Ukraine  
Prof. **Sergii Ivanov**, National Aviation University, Ukraine  
Prof. **Viacheslav Koshechko**, Institute of Physical Chemistry named after L.In. Pisarzhevsky, National Academy of Sciences of Ukraine, Ukraine  
Prof. **Volodymyr Ledovskyh**, National Aviation University, Ukraine  
Prof. **Anatolii Popov**, Institute of Physical Organic Chemistry and Coal Chemistry named after L.M. Lytvynenko, National Academy of Sciences of Ukraine, Ukraine  
Prof. **Borys Tonkonogov**, Gubkin Russian State University of Oil and Gas, Russia

**Biological Sciences**

- Prof. **Mykhailo Baranovski**, National Aviation University, Ukraine  
Assoc. Prof. **Ian Bryndza**, Institute of Biodiversity Conservation and Biosafety, Slovak Agricultural University in Nitra, Slovakia  
Prof. **Kateryna Harkava**, National Aviation University, Ukraine  
Prof. **O. Konoplia**, Kursk State Medical University, Russia  
Prof. **Iaroslav Movchan**, National Aviation University, Ukraine  
Assoc. Prof. **Lilyana Nacheva**, Institute for Ovoscharstvo, Plovdiv, Bulgaria  
Prof. **Volodymyr Patyka**, Danilo Zabolotny Institute of Microbiology and Virology, National Academy of Sciences of Ukraine, Ukraine  
Prof. **Eleonora Popova**, National Aviation University, Ukraine  
Prof. **I. Tikhonovich**, RAAS and NAAS of Ukraine, Director of the All-Russian Research Institute of Agricultural Microbiology, Russia

**Economic Sciences**

- Prof. **Olena Arefyeva**, National Aviation University, Ukraine  
Prof. **Vyacheslav Koba**, Honored Worker of Science and Engineering  
Kyiv State Academy of the Water Transport named after hetman Petr Konashevich-Sagaidachny, Ukraine  
Prof. **Aleksei Nekrasov**, Correspondent member of Russian Academy of Natural Sciences, Academician of the European Academy of Natural Sciences, Academician of the Russian Academy of Quality Problems  
Moscow Automobile-Road State Engineering University, Russia  
Prof. **Alla Novikova**, Honored Worker of Transport of Ukraine,  
State Enterprise “State Road Transport Research Institute” of the Ministry of Infrastructure of Ukraine, Ukraine  
Prof. **Hajiaga Rustambekov**, Baku State University, Azerbaijan  
Prof. **Eugene Sych**, Honored Worker of Science and Engineering, National Aviation University, Ukraine  
Prof. **Bijan Vasigh**, College of Business Embry-Riddle Aeronautical University, United States of America  
Prof. **Leszek Wozniak**, Rzeszow University of Technology, Poland  
Prof. **Valentyn Zagorulko**, National Aviation University, Ukraine

**Pedagogical Sciences**

- Prof. **Liliya Baranovska**, National Aviation University, Ukraine  
Prof. **Leonid Chernovaty**, Kharkiv National University named after V.N. Karazin, Ukraine  
Prof. **Przemyslaw Lozowsky**, University of Technologies and Humanities named after Kazimir Pulawsky, Poland  
Prof. **Elvira Luzik**, National Aviation University, Ukraine  
Prof. **Liliya Morska**, Ternopil National Pedagogy University named after Volodymyr Hnatiuk, Ukraine  
Prof. **Olena Petrashchuk**, National Aviation University, Ukraine  
Prof. **Mykola Smetansky**, Pedagogical Academy in Lodz, Poland  
Prof. **Iryna Zarubinska**, National Aviation University, Ukraine