

ISSN 1813-1166 print
ISSN 2306-1472 online

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
National Aviation University

PROCEEDINGS

of the National Aviation University

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

3 (68) 2016

KYIV

Proceedings of the National Aviation University, N 3 (68), 2016

<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; chemmology and chemical technology; biotechnology; economic development strategy; professional education; law; transport technology.

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 © 2016 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 and distribution via the Internet by the Academic Council of the National Aviation University (Minutes 7 of 07 September 2016).

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: vestnik.nau@gmail.com

EDITORIAL BOARD

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 the Editorial Office: vestnik.nau@gmail.com

ENGINEERING SCIENCES

Prof. **Paul R. Bates**, University of Southern Queensland, Australia
 Prof. **Andrii Bieliatynskyi**, Academician of the Ukrainian Transport Academy, National Aviation University, Ukraine
 Prof. **Sergii Boichenko**, National Aviation University, Ukraine
 Prof. **Valery Chepizhenko**, National Aviation University, Ukraine
 Prof. **Oleh Hrynshyn**, Institute of Chemistry and Chemical Technologies, National University "Lviv Polytechnic", Ukraine
 Prof. **Oleksandr Danilov**, All-Russian Research Institute of Oil Refining, Russia
 Prof. **Serhiy Dmitriyev**, Laureate of the State Prize of Ukraine in 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. **Bvung Jong Kim**, Korean Aerospace University, Korea
 Prof. **Oleg Khudolenko**, Research-and-Production Complex "Application of Aviation in National Economy", Russia
 Prof. **Georgiy Konahovych**, Honored Worker of Transport of Ukraine, National Aviation University, Ukraine
 Prof. **Vitali Larin**, National Aviation University, Ukraine
 Prof. **Volodymyr Ledovskyh**, National Aviation University, Ukraine
 Prof. **Kazimierz Lejda**, Technical University of Rzeszow, Poland
 Prof. **Rahim Mamedov**, Azerbaijan State Oil Academy, Azerbaijan
 Assoc. Prof. **Kristina Marintseva**, National Aviation University, Ukraine
 Prof. **Robert Mc Millan**, 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. **Victor Myronenko**, State Economical-Technological University of Transport, Ukraine
 Prof. **Vito Pascazio**, IEEE Senior Member, Department of Technology, University of Naples Parthenope, Italy
 Prof. **Olegas Prentkovskis**, Academician of the Ukrainian Transport Academy (Foreign Member) Vilnius Gediminas Technical University, Lithuania
 Prof. **Volodymyr Reshetilowski**, Institute for Industrial Chemistry of Dresden University of Technology, Germany
 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. **Borys Tonkonogov**, Gubkin Russian State University of Oil and Gas, Russia
 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. **Oksana Vovk**, National Technical University of Ukraine "Kyiv Polytechnic Institute", Ukraine
 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. **Gennadiy Yun**, National Aviation University, Ukraine
 Prof. **Józef Zając**, State School of Higher Education in Chelm, Poland
 Prof. **Oleksandr Zaporozhets**, National Aviation University, Ukraine
 Prof. **Stefan Zaychenko**, National Technical University of Ukraine "Kyiv Polytechnic Institute", Ukraine
 Prof. **Edmundas Zavadskas**, Vilnius Gediminas Technical University, Lithuania
 Prof. **Boris Zubkov**, Moscow State Technical University of Civil Aviation, Russia

BIOLOGICAL SCIENCES

Prof. **Mykhailo Baranovskii**, 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. **Ivan Matushek**, ProjektServis, Trnava, Slovak Republic
 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. **Gianfranco Tamburelli**, Institute for International Legal Studies of the National Research Council of Italy, Italy
 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. **Nataliia Kasianova**, 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. **Olena Lozhachevska**, National Aviation University, 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. **Victoria Prokhorova**, Ukrainian engineering and pedagogical academy, Ukraine.
 Prof. **Hajiaga Rustambekov**, Baku State University, Azerbaijan
 Prof. **Olesya Suntsova**, 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. **Natalya Bidyuck**, Khmelnytsky National University, Ukraine
 Prof. **Eva Blenesi**, Corvinus University, Hungary
 Prof. **Artur Gudmanian**, National Aviation University, Ukraine
 Prof. **Barbara Kolodziej**, Uniwersytet Przyrodniczy, Poland
 Prof. **Przemyslaw Lozowsky**, University of Technologies and Humanities named after Kazimir Pulawsky, Poland
 Prof. **Elvira Luzik**, National Aviation University, Ukraine
 Prof. **Maryana Marusynets**, National Pedagogical Dragomanov University, Ukraine
 Prof. **Natalya Muranova**, National Aviation University, Ukraine
 Prof. **Natalya Pazyura**, National Aviation University, Ukraine
 Prof. **Olena Petrashchuk**, National Aviation University, Ukraine
 Prof. **Lyudmyla Puhovska**, Institute of technical and vocational education NAPS of Ukraine, Ukraine
 Prof. **Hanna Tovkanets**, Mucachevo State University, Ukraine
 Prof. **Mirek Wojcik**, Wyzsza Szkola imieni Kardynala Awgusta Hlonda, Czech Republic

SCIENCES OF LAW

Prof. **Ivan Borodin**, Head of the Department Theory and History of State and Law Teaching and Research Law Institut, National Aviation University, Ukraine
 Assoc. Prof. **Viktoria Cherevatyuk**, National Aviation University, Ukraine
 Prof. **Stanislav Husaryev**, First Vice-Rector, National Academy of Internal Affairs, Ukraine
 Prof. **Alexander Kopylenko**, Director of the Institute of Legislation of the Verkhovna Rada of Ukraine
 Prof. **Ibrahim Orudzh ogy Kuliev**, National Academy of Aviation, Head of the Department, the Republic of Azerbaijan
 Prof. **Sophia Lyhova**, Head of the Department Criminal Law and Procedure Training, Research Institute of Law, National Aviation University, Ukraine
 Prof. **Marek Mozgova**, Maria Curie-Sklodowska University in Lublin; Head of the Department Criminal Law and Criminology Faculty of Law and Administration, Poland
 Prof. **Helena Riabchenko**, Head of the department of management, administrative law and procedure and administration, University of the State Fiscal Service, Ukraine
 Assoc. Prof. **Iryna Sopilko**, Director of Training and Research Institute of Law, National Aviation University, Ukraine
 Assoc. Prof. **Svitlana Vyshnovetska**, Head of the Department of Civil Law and Trial Teaching and Research Law Institute, National Aviation University, Ukraine
 Prof. **Vid Yakulin**, University of Ljubljana, Faculty of Law professor, Slovenia
 Prof. **Jozef Zat'ko**, President of the European Institute of Continuing Education, Slovak Republic