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"SPACE SCIENCE AND TECHNOLOGY" JOURNAL: STATISTICS AND SCIENTOMETRICS FOR 1995—2020 YEARS

The paper deals with statistical and scientometric analysis of articles published in the scientific-practical journal "Space Science and Technology" of the NAS of Ukraine for the period of 1995–2020 (127 issues and 19 supplements). Statistical analysis includes the data on the number of articles by year of publication and by headings, by the geographical distribution of institutions where the authors work, etc. A preliminary analysis of the relationship between the number of articles on various topics of the journal and the development of relevant areas of space research in Ukraine is presented.

Keywords*: space research, journal, scientometrics.*

1. INTRODUCTION

The "Space Science and Technology" is the journal of scientific and applied space research of the National Academy of Sciences of Ukraine (NAS of Ukraine). The Journal publishes original and review scientific papers in all the multidisciplinary research fields of space activity. The Journal was established in 1995 by the Resolution № 307 of the Presidium of the NAS of Ukraine on December 28, 1994. The State Space Agency of Ukraine was the co-founder of the Journal till the end of 2018.

The Journal is intended for professionals in space science and technology as well as for those who use space technologies for various applications. It is useful also for the readers who want to get acquainted with achievements of the space-rocket industry and space science of Ukraine. The Journal became a worthy successor of the previous specialized journals, which were established by the NAS of Ukraine, such as the "Space Research in Ukraine" (1973—1984) and the "Space Science and Technique" (1986—1992).The idea of creating a new "Space Science and Technology" journal, on the

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pages of which the various aspects of space industry activity would be discussed, was proposed by Prof. Yaroslav S. Yatskiv (Director of the Main Astronomical Observatory of the NAS of Ukraine) and supported by Prof. Borys E. Paton (President of the NAS of Ukraine in 1962—2020, Editor-in-Chief of the Journal in 1995—2020).

The main stages of development of the Journal during the period of 1995—2015 were presented in papers by Kislyuk V. S., Klymenko O. V., and Klymenko V. M. [1–4].

In 2015—2020 the digitization of all the publications was provided under the support of the Yangel Yuzhnoye State Design Office (Dnipro, Ukraine) and its General Director, Prof. Olexander V. Degtyarev, as well as the Ukrainian Branch of the International Academy of Astronautics. The archive and current papers are fully available through the website of the Journal [5].

Thematically, the Journal is organized as follows: space-rocket complexes, spacecraft design and manufacture, scientific payload of spacecraft, control systems, dynamics, and energetics of space vehicles and spacecraft; study of the Earth from space; space physics and astronomy, space biology and medicine, space material science, space communications and satellite navigation, monitoring of space debris, social sciences in space exploration (management, legal, education, philosophical aspects), and history of space research.

In the course of twenty-six years of activity, the "Space Science and Technology" journal has gained wide recognition in Ukraine and abroad as well as has significantly provided space research in Ukraine. Thanks to the efforts of the Editorial Board and Editorial Office, the 26 volumes (namely 127 issues and 19 supplements) had been published by the end of December 2020 (Table 1). These issues contain 2002 articles (30 % of them were prepared with the participation of foreign authors). These articles were prepared by 2673 authors and are of a different type: 1868 scientific papers with DOI and 134 articles likely brief reports of results presented at the conferences, forewords to the issues, memorial publications, etc.

The topics of Supplements in 1995–2007 are described below ([5], http://space-scitechjournal.org.ua/en/archive):

* (History of Space Research) Borodenkov A. M., Volkov M. V., Dormidontov A. G., Stegniy A. I. (1995); Yuri Kondratyuk – the space trajectory predictor [6]; Zavalishin, A. P. (1995) Who are you, Yuri Kondratyuk? [7];

* (Space Geoinformatics and Geodesy) Bolotin, S., Gaiovitch, I., Khoda, O.A., Samoilenko, A., Yatskiv, Ya.S. (1995). GPS Observational Campaign in the Geodynamics Test Area "Simeiz-Katsiveli": Data Processing and Results [8];

* (Space Geoinformatics and Geodesy) Demchyk, M. I., Kirichenko, A. G., Kizyun, L. M., Klimik, V.U., Kudak, K.A., Matso, G. M., Starodubtseva, O. E. (1996). The observations and identification of space geosynchronous objects [9];

* (Space-Rocket Complexes, History of Space research) Andreev, V. L., Konyukhov, S. N. (1996). M. K. Yangel — chief designer of space-rocket systems [10];

* (History of Space Research) Zavalishin, A. P., Datsenko, A. V. (1997). Yu. V. Kondratyuk (O. G. Shargei) – the founder of cosmonautics [11];

* (Study of the Earth from Space) Lyalko, V.I., Fedorovskyi, O.D. (1997). Ukraine from space. Atlas of decoded images of the area of Ukraine from space platforms [12];

* (Space Instruments) Kucherov, V. A., Ivanov, Yu.S., Efimov, Yu. S., Berdyugin, A. V., Shakhovskoy, N. M. (1997). Ultraviolet Low-Resolution Spectropolarimeter for the Space Mission Spectrum-UV (UVSPEPOL Project) [13];

* (Space Geoinformatics and Geodesy) Kizyun, L. M., Kirichenko, A. G., Rudenko, S. P., Demchyk, M. I., Klimik, V. U., Kudak, K. A., Matso, G. M., Starodubtseva, O. E. (1998). Catalogue GOCKU96 of positions and orbital elements of geosynchronous space objects observed in 1996 [14];

Table 1. **The summarized general statistics of issues of the "Space Science and Technology" journal**

Total	Issues	Publications	Authors
Numbers + Supplements	127 + 19	2002 (1868 papers with DOI)	2673

* Proceedings of the II International Young Scientific Conference "Human & Space" held in 2000, Dnipro, Ukraine (2001);

* Proceedings of the VIII Conference and School on Plasma Physics and Controlled Fusion held in 2000, Alushta, Crimea, Ukraine (2001);

* Proceedings of the III International Young Scientific Conference "Human & Space" held in 2001, Dnipro, Ukraine (2002);

* Proceedings of the II Ukrainian Conference for Perspective Space Research held in 2002, Katsiveli, Crimea, Ukraine (2002);

* Proceedings of the IV International Young Scientific Conference "Human & Space" held in 2002, Dnipro, Ukraine (2003);

* Proceedings of the III Ukrainian Conference for Perspective Space Research held in 2003, Katsiveli, Crimea, Ukraine (2003);

* Proceedings of the V International Young Scientific Conference "Human & Space" held in 2003, Dnipro, Ukraine (2004);

* (Astronomy and Astrophysics) Shkuratov, Yu. G., Kislyuk, V. S., Lytvynenko, L. M., Yatskiv, Ya. S. (2004). Model of the Moon 2004 for the «UkrSelene» project [15];

* Proceedings of the V International Young Scientific Conference "Human & Space" held in 2004, Dnipro, Ukraine (2005);

* Author Index of the "Space Science and Technology" journal in 1995—2005 to the Volumes 1–11. (Eds.) Kislyuk V. S., Klymenko V. M., Klymenko O. V. (2005);

* Proceedings of the I Scientific Conference "Science on the Earth and Space — to the Humanity" held in 2007, Kyiv, Ukraine (2007).

During 2000—2020, the specialized issues and reviews were published, which covered such topics as the Ukrainian scientific research and technological experiments proposed for the International Space Station ([16], 2000, Is. 4), important cornerstones in the cosmic era ([17], 2001, Is. 1), space navigation and communications (2001, Is. 4, see, for example, [18]), study of the Earth from space (2002, Is. 2–3, see, for example, [19]), space oceanology and space system "Ocean–Sich" (2007, Is. 5, see, for example, [20]), reports on "The Target Program of the NAS of Ukraine of the Space Scientific Research" (see, for example, [21]), spatio-temporal dynamics of traveling ionospheric peturbations [22], to the 100th anniversary of the birthday of Prof. Borys E. Paton, President of the NAS of Ukraine, Editor-in-Chief of the "Space Science and Technology" journal (2018, Is. 5) as well as the results of space research presented during the International conferences "Space Technologies: Present and Future", Dnipro, Ukraine (see, for example, [23—25]), and other topics.

2. STATISTICAL RESULTS AND SCIENTOMETRICS

"Scientometrics is concerned with the quantitative features and characteristics of science and scientific research. Emphasis is placed on investigations in which the development and mechanism of science are studied by statistical mathematical methods" as well as reflects communication in science and science policy [26]. To illustrate this, the statistics of 2002 publications related to their distribution by years and journal headings, languages, and geography of institutions, where the authors work, is shown in Figures 1—4.

Figure 1 demonstrates that, on average, the publication rate is about 50 articles per year (not considering the proceedings of conferences in 2000—2004 and special issue [16] in 2000).

As for the language of articles (Fig. 2), one can see that 9 % are in English, 29 % in Ukrainian, and 62 % in Russian (185, 580, and 1237 articles, respectively). Figure 3 gives information on the publication activity of the Ukrainian and foreign authors as concerns with their affiliation. The most active Ukrainian authors work in Kyiv, Dnipro, Kharkiv, Odesa, and L'viv, where the largest organizations of the rocket-space industry and institutes/universities engaged in scientific space research are concentrated. The rest part of the Ukrainian authors is grouped as "Others". The foreign authors represent a quarter of the total, both in terms of the number of authors and the number of articles (Fig. 3, top; left down).

If we consider publication activity among universities of the Ministry for Education and Sciences (MES) of Ukraine, institutions of the NAS of Ukraine, and Yangel Yuzhnoye SDO, we see that it is higher for institutions of the NAS of Ukraine (Fig. 3, right down; N.B.: if the article contains authors from

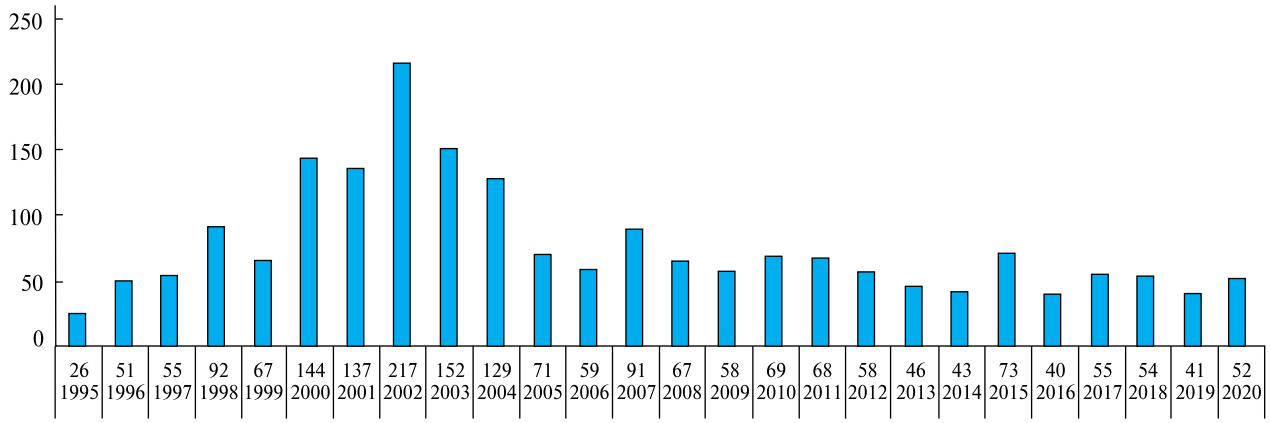

Figure 1. Distribution of 2002 publications in the "Space Science and Technology" journal by years

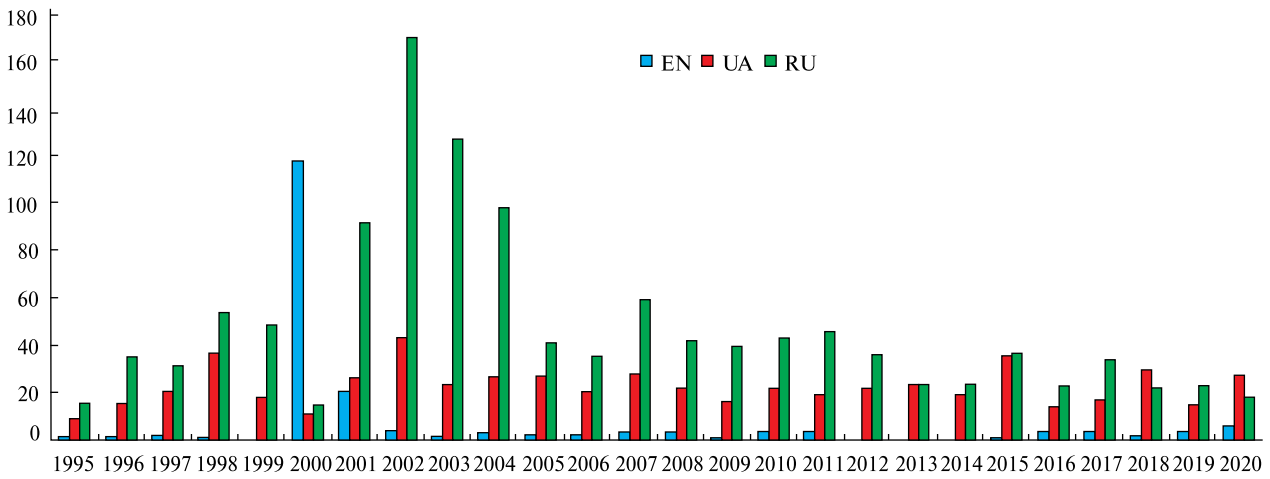

Figure 2. Distribution of 2002 publications in the "Space Science and Technology" journal by the language of publications

the academic institutions and from universities, then the article is counted in both groups). As for universities, the authors from the NTUU "Igor Sikorsky Kyiv Polytechnic Institute", National Aerospace University "Kharkiv Aviation Institute", national universities of Kharkiv and Kyiv most often present results of their research in the Journal. The representation of foreign authors by their country affiliation is as follows: Australia, Austria, Belarus, Belgium, Bulgaria, Czech Republic, China, Denmark, Finland, France, Georgia, Germany, Hungary, India, Italy, Latvia, Mexico, the Netherlands, New Zealand, Poland, Romania, Russia (mostly), Slovakia, South Africa, Spain, Switzerland, United Kingdom, USA, and Uzbekistan. These statistics are given in Fig. 5 (distribution of foreign authors by countries) and Fig. 6 (distribution of articles with the participation of foreign authors).

The list of institutions, where the authors of publications work, is presented in the extended version of this paper on the journal's web-site. We note the most active authors: Chernogor L. F. (64 articles, V.N. Karazin National University of Kharkiv), Cheremnykh O. K. (57, Space Research Institute of the NAS of Ukraine and SSA of Ukraine, Kyiv), Lyalko V. I. (52, Centre for Aerospace Research of the Institute of Geological Sciences of the NAS of Ukraine, Kyiv), Fedorovsky O. D. (40, Centre for Aerospace Research of the Institute of Geological Sciences of the NAS of Ukraine, Kyiv), Ma-

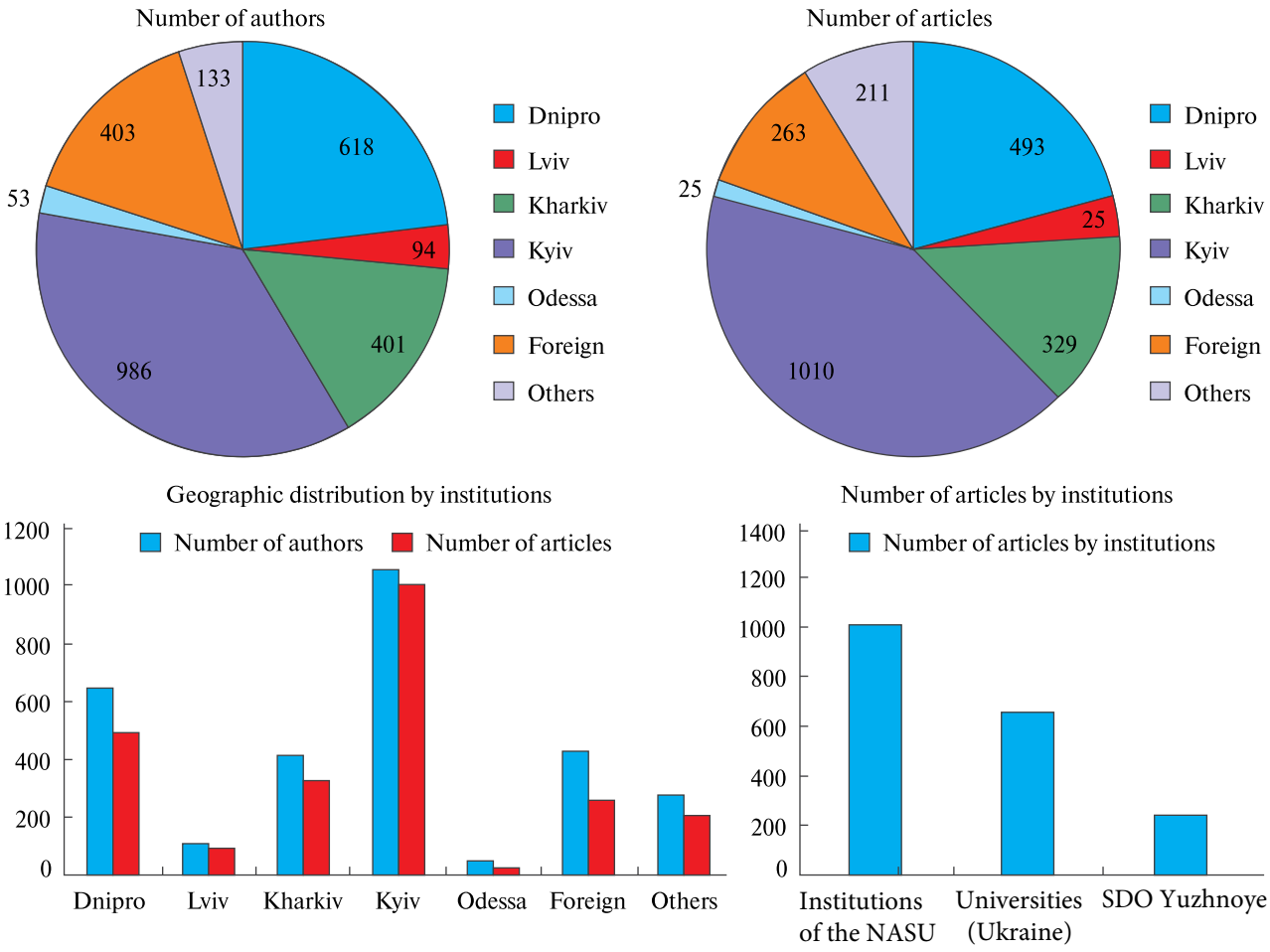

Figure 3. Publication activity of the Ukrainian and foreign authors

karov A. L. (25, Yangel Yuzhnoye SDO, Dnipro), Karachun V. V. (25, National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute», Kyiv, Ukraine).

It's useful to analyze the statistical distribution of articles by journal headings (Figure 4) with their relevance to the development of various fields of space science and technology in Ukraine. Let us briefly consider several of these headings, where the authors have own experience.

"Space-Rocket Complexes — Spacecraft and Payloads": this research field is presented in ~200 scientific papers, mostly by the authors from the Yangel Yuzhnoe SDO and other organizations of the State Space Agency of Ukraine as well as the Institute of Technical Mechanics of the NAS of Ukraine (Dnipro), National Aerospace University (Kharkiv). Among the topics of research, for example, are as follows: "Zenit-3SL" [27], "Cyclone-4M" [28], and airborne-space launch vehicles [29], universal transport power jet propulsion of platforms [30] and gyrostabilized platforms, methods for calculating the strength of rocket-space shell structures, multicriterial comparative analysis of rocket and space technology, methodological aspects of design and development of space launch systems under international cooperation [31], and creation of return orbiter in the form of a remote sensing satellite and launch vehicle [32].

"Astronomy & Astrophysics" topics: more than 130 papers, which deal with research on the Moon exploration [33 – 35], activity of the central part of

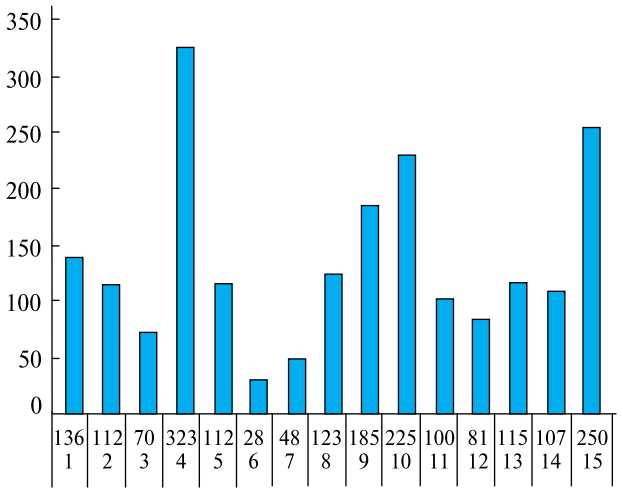

Figure 4. Distribution of 2002 publications by Journal's headings: (1) — Astronomy and Astrophysics; (2) — History of Space Research; (3) —Social Sciences in Space Exploration; (4) —Space and Atmospheric Physics; (5) —Space Energy, Power and Propulsion; (6) — Space Environment Monitoring and Space Debris; (7) —Space Geoinformatics and Geodesy; (8) –Space Instruments; (9) — Space Life Sciences; (10) — Space Materials and Technologies; (11) —Space Navigation and Communications; (12) —Space-Rocket Complexes; (13) — Spacecraft Dynamics and Control; (14) — Spacecraft and Payloads; (15) — Study of the Earth from Space

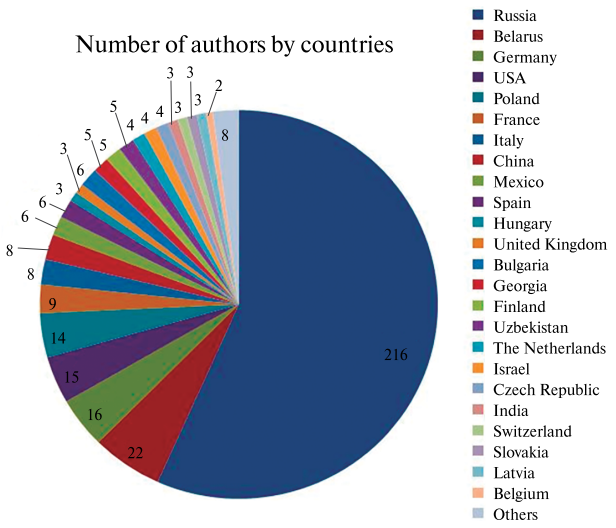

Fig. 5. Distribution of foreign authors by countries

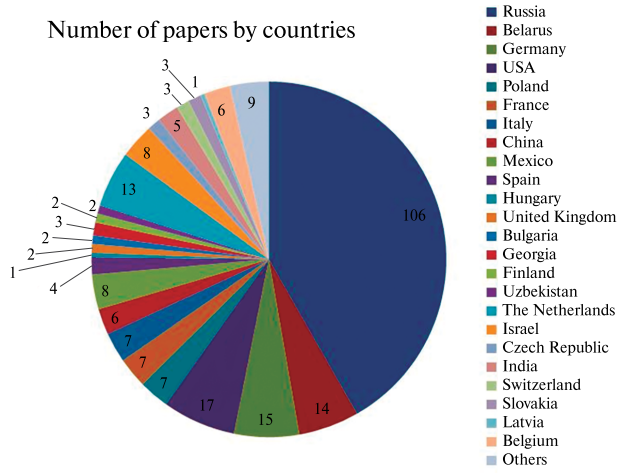

Fig. 6. Distribution of articles with participation of foreign authors

galaxies and quasars [36, 37], the study of the evolution of coronal holes based on ground/space observations, results of the DIFOS-F space experiment on the five-minute Solar brightness oscillations [38, 39] and dynamic models of the photospheric and chromospheric layers of solar flares [40], processes of coronal mass ejection [41] and cosmic gamma-rays [42, 43], space missions in the inner region of the Solar system [44], general relativity tests [45, 46], and principles for development of the Ukrainian virtual observatory [47], radio mm-wave interferometry [48] and decameter wave radioastronomy [49, 50].

Since 2016 the journal has been included in the "Program for Support of Scientific Journals of the National Academy of Sciences of Ukraine", thanks to which the DOI are provided and the bibliography is registered through the international CrossRef database for articles in current issues.The journal is issued by the Publishing House "Akademperyodyka" of the NAS of Ukraine (editing of papers, layout, and printing).

In 2020, according to the orders of the Ministry of Education and Science of Ukraine on 17.03.2020 No. 409, on 02.07.2020 No. 886, on 24.09.2020 No. 1188, on 26.11.2020 No. 1471 concerning "The list of scientific professional journals of Ukraine in which results of dissertations for obtaining scientific degrees of the Doctor of Sciences, Candidate of Sciences, and Philosophy Doctor, Journal "Space Science and Technology" is included in the category "A". Specialty codes for dissertation defense are as fol-

lows: 09 Biology: 091 Biology; 10 Natural Sciences: 103 Earth Sciences, 104 Physics and Astronomy, 105 Applied Physics and Nanomaterials; 11 Mathematics and Statistics: 113 Applied Mathematics; 12 Information Technology: 121 Software Engineering; 122 Computer Science and Information Technology; 124 Systems Analysis; 13 Mechanical engineering: 131 Applied mechanics, 132 Materials science, 134 Aviation and rocket-space technology; 14 Electrical Engineering: 142 Power Engineering; 15 Automation and instrumentation: 151 Automation and computer-integrated technologies,152 Metrology and information-measuring technology; 17 Electronics and telecommunications: 172 Telecommunications and radio engineering; 29 Legal sciences: 293 International law.

The Journal adhers publication ethics. Since 2016 it is integrated with the Web of Sciences and is accessed from the Web of Sciences Core Collections.

Acknowledgements. A large amount of work has been done by the journal's team to present fully research results by scientists and designers in the field of rocket-space science and technology for the period of 1995—2020. Now due to the creation of the journal's digitized archive these papers are included in various scientometrics databases, for example, Web of Sciences, NASA/SAO/ADS, Google Scholar. We are on the way to include the journal in Scopus. This long-termwork was supported by the Ukrainian branch of the International Academy of Astronautics and the Yangel Yuzhnoye State Design Office (agreements № 12/15 on 23.06.2015, № 13/17 on 11.08.2017, № 304/18 on 04.05.2018, № 6/19 on 31.05.2019 p. between Yangel Yuzhnoye SDO and the MAO NAS of Ukraine) and State Space Agency of Ukraine. Several issues (Supplements to the Journal) were digitized under the support of the Makarov National Aerospace Youth Educational Center. The Ltd. "UkrInformNauka" provided DOI and cross-references for all articles published in 1995—2015; it remains a partner of the journal till now.

Besides the authors of this paper, the active role in the preparation of the digitized database of journal publications and the website belongs to T. P. Bulba, L. V. Gladkokhata, S. S. Vavilov as well as O. V. Klymenko, V. M. Klymenko, A. D. Danilova, A. V. Yakymenko. Such work became successful with the support and participation of Prof. Ya. S. Yatskiv (MAO NAS of Ukraine), Editor-in-Chief of the Journal since 2020, as well as the Editorial Board members.

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ЖУРНАЛ «КОСМІЧНА НАУКА І ТЕХНОЛОГІЯ»:
СТАТИСТИКА І НАУКОМЕТРІЯ ЗА 1995—2020 РОКИ

У статті представлено статистичний і науко-метричний аналіз статей, надрукованих у науково-практичному журналі НАН України «Космічна наука і технологія» за період 1995—2020 рр. (127 чисел і 19 додатків). Статистичний аналіз виконано за географією розподілу установ, де працюють автори; кількістю статей за роками видань журналу та за рубриками. Проведено попередній аналіз взаємозв'язку кількості статей за різними тематиками журналу і розвитком відповідних напрямів космічних досліджень в Україні.

Ключові слова: космічні дослідження, журнал, наукометрія.