Review of Scientific and Technical Periodicals on Marine Navigation Equipment Engineering

D. O. Taranovskiy* and O. M. Yashnikova

Concern CSRI Elektropribor, JSC, St. Petersburg, Russia *e-mail: tar_do@rambler.ru Received: March 4, 2024; Reviewed: March 29, 2024; Accepted: April 10, 2024

Abstract: The paper presents a brief history of development of modern scientific periodicals covering the theoretical issues, design and application of marine navigation equipment, and the analysis of these publications. The authors describe top five global journals specializing in this scientific discipline. The subjects of their publications are discussed, and the ratings according to the Scopus database are presented. Based on the keywords, ten periodicals publishing the largest number of articles on the navigation equipment engineering in Russia are identified in the Russian Science Citation Index database. Some specific features of these journals are considered, and the ways of their further development are proposed.

Keywords: scientific and technical journal, navigation, instrument-making, scientometrics.

1. INTRODUCTION

Navigation methods have a long history. Already in ancient time, people used different techniques to determine their location at sea and described the results of their studies. One of the first known examples of ancient works on navigation is "Periplus of the Euxine Sea" (Circumnavigation of the Black Sea), an Ancient Greek text describing the voyages and routes across the Black Sea and other water bodies [1]. This document was written in 130s CE in the form of a letter to the Roman emperor; ancient travellers used it willingly for navigation and commerce planning.

In the Middle Ages, the marine affairs were also a subject of interest and study. At that time, navigation was important for commerce, exchange of knowledge, and missionary outreach. Many publications of that time contained the information about sea travelling, geography, cartography, as well as marine battles. One of well-known works on the marine themes of the 15th century was "The Book of the Benefits of the Principles and Foundations of Seamanship" by an Arab scientist Ahmad ibn Majid [2]. This work was written between 1475 and 1490 and told about sea voyages and navigation in the Indian Ocean.

In various countries of Europe and Asia, there were also some chronicles, astronomical tables and other materials containing the information about navigation and maritime trade. In these publications one could find travel descriptions, maps, navigation instructions and other matters related to maritime activities.

Later the need for more intensive exchange of information increased, and scientists could not be satisfied with writing and studying individual works any more. Along with the development of printing technology, this became a prerequisite for the scientific journals to come into existence, due to which the interested parties could receive the research results more quickly. The oldest scientific journals began to appear in the second half of the 17th century, such as the Journal des Scavans (founded in 1665), The Philosophical Transactions of the Royal Society (1665), the Giornale de' Letterati (1668), and the Acta Eruditorum (1682). One of them, The Philosophical Transactions of the Royal Society [3] has been issued without any breaks till present. This journal can be considered the first scientific periodical, because it was the first one to initiate an essential element of such publications: peer reviewing of papers before publishing.

In Russia, the scientific journals appeared in 1728 [4], when a supplement to the governmental newspaper Sankt-Peterburgskie vedomosti (St. Petersburg Gazette) under the title Mesyachnye istoricheskie, genealogicheskie i geograficheskie primechaniya v Vedomostyakh (Monthly Historical, Genealogical and Geographical Notes in the Vedomosti), as well as the bulletin of the Academy of Sciences Commentarii Academiae Scientiarum Imperialis Petropolitanae (Fig. 1) began to be published. Having been renamed and transformed many times, the latter became the Izvestiya Rossiiskoi akademii nauk (Newsletter of the Russian Academy of Sciences); this journal is now issued in a few series, such as Mathematical Sciences, Physical Sciences, etc.



Fig. 1. Cover of the first journal of the Academy of Sciences.

By the middle of the 19th century, the format of scientific journals became close to what we got used to, where the articles were structured (introduction, main part, conclusions) and contained abstracts, references to literature used, and other standard attributes of a scientific publication.

This article presents a brief review of scientific periodicals, the topics of which cover the theory, design, manufacture and application of marine navigation equipment. In the second part of the article, an attempt is made to identify and analyze the periodicals that publish the largest number of articles on this topic in Russia.

2. UPRISE AND DEVELOPMENT OF SPE-CIAL JOURNALS ON NAVIGATION EQUIPMENT ENGINEERING

The first journals that were scientific in the modern sense were interdisciplinary, i.e. they published information on a wide range of scientific ideas in different fields. As the sciences developed, more and more dedicated publications were formed in different science disciplines. For instance, the journals devoted to the issues of geography, shipbuilding and marine navigation were among the first to appear.

One of the most famous publications on marine subjects was *The Naval Chronicle* which was published in Great Britain from 1799 till 1818. This jour-

nal offered information about marine battles, research, new technologies and achievements in the field of navigation [5].

In the 19th century, one of the most well-known maritime journals was *The Nautical Magazine* [6]. It was founded in 1832 and published articles on shipbuilding, marine navigation, meteorology, as well as reviews of new technologies and innovations in the marine industry. *The Nautical Magazine* was an important source of information for engineers, seamen and anyone interested in marine engineering and technology. The journal existed until 2011 and then it was sold and merged with the *Sea Breezes* publication.

In Russia, the first periodical of the expertise area at issue was the journal *Zapiski po gidrografii* (Notes on Hydrography) which was established on February 11 (23), 1842, by the decision of Admiral A.S. Menshikov, the Chief of the General Naval Staff, upon the recommendation of A.G. Villamov, the Director of the Hydrographic Department, to publish the *Notes of the Hydrographic Department* of the Maritime Ministry. This journal was to publish the reports on hydrographic surveys, as well as articles on hydrography and navigation [7]. This journal still exists under the auspices of the Department of Navigation and Oceanography of the Ministry of Defense of the Russian Federation; however, only one issue is released per year.

In 1848, in St. Petersburg, Russia, the Morskoi sbornik (Marine Collection) was founded by the imperial edict of Emperor Nicholas I [8]. The idea to establish the journal belonged to Fedor Litke, an outstanding Russian navigator and geographer, a corresponding member (later the President) of the Academy of Sciences. The journal published articles on shipbuilding, marine navigation, meteorology and other topics related to the marine industry. The Morskoi sbornik was an important source of information for Russian marine specialists. Although this journal cannot be considered as purely scientific, it is extremely valuable as a source of Russian national history, since it has covered various events for more than 175 years. Today the Morskoi sbornik is the official monthly journal of the Navy of the Russian Federation.

Another old-timer of the Russian marine periodicals is the *Sudostroyenie* (Shipbuilding) journal founded in September 1898 as a scientific, engineering and production journal of Russian shipbuilding industry. In the Soviet period, it was the main organ of the USSR Ministry of Shipbuilding Industry. Throughout its history, the journal has reflected advanced scientific and engineering ideas, publishing the articles by leading researchers and experts in shipbuilding and related industries, which certainly facilitated the development of the Russian national science. To the present time, this publication covers the issues of ship design and construction, the state and trends of domestic and global shipbuilding, the activities of shipbuilding enterprises, scientific and engineering institutes; industry-related exhibitions, and the history of the Navy [9].

It should be noted that the issues of theory and development of navigation equipment have been covered in the above journals just sporadically. During the Second World War, the experts felt an urgent need for technical literature and information materials. It was clear that the demand for scientific and technical periodicals on application-specific instrumentation was quite high. In response to this need, in 1943 the People's Commissariat of the Shipbuilding Industry and the People's Commissariat of the Navy of the USSR appealed to the Central Committee of the All-Union Communist Party (Bolsheviks) for permission to publish an industrial bulletin on instrument-making technology, and such a publication was approved by the order No. 657 of the USSR Main Department for Literature and Publishing Affairs (Glavlit) on September 8, 1943. On November 8, 1943, the People's Commissariat of Justice of the USSR issued the Order No. 516 in which Special Design Bureau was made in charge of the bulletin preparation and publication. Later this organization transformed into the Central Research Institute Elektropribor (St. Petersburg).

In 1944, the first issue of the industrial engineering bulletin *Priborostroenie* (Instrument-Making) was published; it became the first periodical digest on navigation equipment engineering in the USSR [10]. The journal contained the articles primarily related to the experience in the development and production of fire control devices (FCD) for onboard and coastal artillery mounts, and electric navigation devices. From the very beginning, a high scientific level was set. In each of the first 6 issues of the bulletin there were articles on the theory of gyroscopes and gimbals by Aleksands Ishlinskii, PhD (later academician of the USSR Academy of Sciences) and other leading experts in gyroscopy.



Fig. 2. First issue of the "Priborostroenie" digest.

In the ensuing years, the publication was issues under different titles: the <u>Priborostroenie</u> (1944-1968), the Navigatsiya i giroskopiya (Navigation and Gyroscopy) series of the Morskoe priborostroenie (Marine Instrument-Making) journal (1969-1973), the Voprosy korablestroeniya (Shipbuilding Issues) (1974-1985) and the Sudostroitel'naya promyshlennost' (Shipbuilding Industry) (1986-1992). The Central Research Institute Rumb was in charge of publishing the digests. Its main activities in this area were to collect and process the scientific and technical information, including that on international shipbuilding and pricing policies in this industry.

The digest was published as a dedicated publication of the shipbuilding industry. From 1944 to 1978, the editorial board was headed by a prominent scientist, professor Sergei Farmakovskii (in different years he was the chief designer, chief engineer and deputy director for research at the Central Research Institute Elektropribor). He maintained the tendency of publishing the results of in-depth and relevant theoretical research and advanced developments in navigation and gyroscopic technology. This tendency was kept further on. It should be noted that at that time access to the digest was limited, but this did not prevent it from becoming the most famous and respected publication among scientists and experts in navigation equipment engineering in the Soviet Union.

Important changes were made in 1993, when the journal was no more a limited-access publication; it got its present title *Giroskopiya i navigatsiya* (Gyroscopy and Navigation) and little by little began to transform from an industry-specific to an all-Russian, and then into an international journal.



Fig. 3. Covers with old titles in different years and modern cover of the "Giroskopiya i navigatsiya" journal

Since 1983, for more than forty years, Vladimir Peshekhonov, Academician of the Russian Academy of Sciences (since 2000) has been the permanent editor-in-chief of the journal.

As was mentioned above, the professional journals appeared due to the science and technology development level achieved in a particular field of knowledge. The processes similar to those in Russia took place in all technologically most advanced countries.

The Institute of Navigation, an organization founded in 1945 in the United States by representa-

tives of military and civilian aviation industry experts [11], began publishing the *Navigation* journal the very next year after its foundation. The aviation subjects have not been a priority in this publication in a long time; currently, it also includes the articles on terrestrial, marine and space navigation. The main focus is made on the issues related to the development and application of global satellite navigation systems, mainly GPS and BeiDou [12]. The topics of materials published in this journal and in other periodicals discussed in this paper are summarized in Table 1.

Table 1.

Journal (CiteScore 2022) Topics of articles, percentage of publications on the topic	Satellite Navigation (14.6)	Navigation, Journal of the Institute of Navigation (6.3)	<i>Journal of</i> <i>Navigation</i> , Cambridge University Press (5.8)	Gyroscopy and Naviga- tion (2.8)	Journal of Chinese Iner- tial Technol- ogy (1.6)
Inertial navigation systems: algo- rithms and methods	2%	-	-	20%	18%
Inertial sensors: design, research, calibration	-	4%	2%	18%	12%
Integrated systems: development and application	20%	16%	20%	24%	48%
Global navigation satellite sys- tems (GNSS)	70%	72%	14%	10%	-
Information processing in naviga- tion applications	1%	8%	12%	6%	16%
Ship navigation, E-navigation	-	-	50%	1%	-
Gravimetric systems	7%	-	-	12%	-
Miscellaneous	-	-	2%	11%	8%

Topics of publications in specialized journals on navigation



Fig. 4. The Navigation journal cover.

Another journal taking a leading position among the international scientific periodicals on navigation equipment engineering has a similar title—*The Journal of Navigation*. It appeared in 1948 in Great Britain [13] and, unlike the American counterpart, it pays more attention to marine navigation: about half of the papers published in this journal are devoted to the theory of control and practical solutions to the navigation problems, as well as various aspects of motion automation at sea and control of unmanned vessels.



Fig. 5. The Journal of Navigation cover.

Among the dedicated publications, the *Journal of Chinese Inertial Technology* (*Zhongguo Guanxing Jishu Xuebao*) founded in 1989 is also worth mentioning. It is a national academic journal curated by the China Association of Science and Technology, and sponsored by the China Society of Inertial Technology and the Tianjin Navigation Instrument Research Institute. This journal publishes articles on various integrated navigation systems, including those for marine applications. It should be noted that the articles are published in Chinese and almost all the authors of the journal are from China. Nevertheless, due to modern computer-aided translation technologies, one can easily get the content of the papers.



Fig. 6. The Journal of Chinese Inertial Technology cover.

Overviewing the world's leading journals in the field of navigation equipment engineering, it is also worth noting that in 2010 an English-language version of the *Giroskopiya i navigatsiya*, the *Gyroscopy and Navigation* journal appeared; today, as will be shown below, it occupies a firm niche in the discussed thematic area.

The most recent newcomer to this series, which should be told about, is the *Satellite Navigation* journal of the Chinese Aerospace Information Research Institute. This publication with amazingly rapid growth of ratings was launched in 2020 at Springer Nature publisher and originally specialized in the global satellite navigation systems. However, its scope has been considerably expanded and now also includes the issues of integrated navigation systems, geodetic support and satellite gravimetry. Most of authors are from China.



Fig. 7. Web-site of the Satellite Navigation journal.

At present, the above professional journals are the most reliable sources of knowledge in their field of science, mainly due to the elected community of reviewers—qualified and active researchers who study the articles before publication.

Besides the specialized journals, a lot of articles are published in periodicals with a broader profile. For example, only the Nature journal, one of the topranked scientific publications in the world, has published more than 100 articles related to the navigation subjects. A significant number of publications devoted to inertial sensors and navigation applications are currently published in the journals of the IEEEXplore electronic library and the MDPI publisher.

3. PAPER SUBJECTS AND RATINGS OF RUSSIAN AND INTERNATIONAL JOURNALS

The analysis of the contents of the abovementioned four international specialized scientific journals which have a fairly long history and are relied on by the scientific community gives a general idea of the articles published in this field of science. The distribution of articles by topics is shown in Table 1 [12]. The impact factor of the journal in the Scopus international scientific citation database (CiteScore 2022) is given in parentheses after the journal title.

The *Gyroscopy and Navigation* is the only specialized publication on navigation equipment engineering among Russian periodicals, and, as can be seen from Table 1, it reflects the whole scope of issues in this field of science. The main attention is paid to the navigation of marine and underwater vehicles, although the issues related to aerospace and terrestrial vehicles are also discussed in the journal.

It is also necessary to mention other Russian scientific and technical journals where the problems of navigation support are studied within a wide range of issues related to marine equipment engineering. Let us consider these publications.

As the minimum criterion of credibility of a journal, we take its presence in the first rating which appeared in Russia in 2001—the Index of Russian peerreviewed scientific journals where the main research results of dissertations for the degrees of doctor and candidate of sciences should be published (Index of the Higher Attestation Committee, HAC) [14]. The analysis of journals will be carried out using the most comprehensive database of Russian publications to date—the Russian Science Citation Index (RSCI).

Using the keywords, the journals have been found in the RSCI database, in which the articles on marine vehicles navigation are most frequent. They are listed in Fig. 8 in descending order of their impact factors. There is also the information about the databases where these publications are indexed.

N⁰	Название журнала		Показатель		
1.	Гироскопия и навигация Scopus (перев.), RSCI, BAK, Science Index (4%)	1,225			
2.	Подводные исследования и робототехника BAK, Science Index (34%)	0,570			
3.	Вестник государственного университета морского и речного флота им. адмирала С.О. Макарова ВАК, Science Index (41%)	0,568			
4.	Морские интеллектуальные технологии WOS, BAK, Science Index (14%)	0,399			
5.	Эксплуатация морского транспорта BAK, Science Index (68%)	0,341			
6.	Морская радиоэлектроника BAK, Science Index (79%)	0,261			
7.	Навигация и гидрография * ВАК, Science Index (77%)	0,208			
8.	Новости навигации BAK, Science Index (63%)	0,150			
9.	Морской сборник BAK, Science Index (81%)	0,109			
10.	Морской вестник BAK, Science Index (44%)	0,101			

Fig. 8. RSCI rating of journals publishing the papers on marine navigation most frequently (* – RSCI impact factor for this journal is available only for 2019).

The *Gyroscopy and Navigation* journal is the obvious leader among the scientific periodicals in this field, which is evidenced by the highest impact factor.

Based on the analysis of the listed journals, a number of features typical of each journal can be identified (see Table 2).

Pos. No.	Journal	Main publisher	Main topic in the field of marine navigation	SC5, %, and HHI, scores, as of 2022	Category in HAC Index
1.	<i>Giroskopiya i navigatsi-</i> <i>ya</i> (Gyroscopy and Navigation)	Concern CSRI Elektro- pribor, JSC (St. Petersburg)	See Table 1	18.9 643	К1
2.	Podvodnye issledovani- ya i robototekhnika (Under- water Investigations and Robotics)	Institute of Marine Tech- nology Problems of the Far Eastern Branch of the Rus- sian Academy of Sciences (Vladivostok)	Navigation and control in underwater environment	44.2 2113	К2
3.	Vestnik gosudarstven- nogo universiteta mor- skogo i rechnogo flota im. admirala S.O. Makarova (Bulletin of the Admiral Makarov State University of mari- time and River Fleet)	Admiral Makarov State University of Maritime and River Fleet (St. Petersburg)	Water transport operation, navigation at sea and in rivers	52.4 2821	K1
4.	Morskie intellektual'nye tekhnologii (Marine In- tellectual Technologies)	Morintech Research Center (St. Petersburg)	Underwater navigation, ship navigation, unmanned vehicles navigation	33.0 1259	К1
5.	<i>Ekspluatatsiya morskogo</i> <i>transporta</i> (Maritime Transport Operation)	Admiral Ushakov Maritime University (Novorossiisk)	e-Navigation, navigation safety at sea, unmanned vehicles navigation	52.6 3131	К2
6.	Morskaya radioel- ektronika (Marine Radi- electronics)	Trade journals (St. Petersburg)	Ship radio electronic sys- tems, underwater naviga- tion, navigation support of the RF Navy	28.6 1570	К3
7.	<i>Navigatsiya I</i> <i>Gidrografiya</i> (Naviga- tion and Hydrography)	State Research Institute for Navigation and Hydrogra- phy (St. Petersburg)	Navigation support of the RF Navy, radio naviga- tion, map-aided naviga- tion, history of navigation aids development	79.3 <u>6385</u>	<u>K3</u>
8.	Novosti navigatsii (Nav- igation Newsletter)	Internavigation Research and Technical Center of Advanced Navigation Technologies, JSC (Mos- cow)	Global navigation satellite systems, map-aided navi- gation	8.3 2083	К3
9.	Morskoi sbornik (Marine Collection)	Ministry of Defence of the Russian Federation (Moscow)	Navigation support of the Navy in the RF and other countries, history of navi- gation aids development, official information	17.2 679	None
10.	Morskoi vestnik (Marine Bulletin)	MorVest Publisher (St. Petersburg)	e-Navigation, autonomous navigation	32.2 1273	К2

Table 2 also presents some scientometric indicators to assess the influence of the journals among experts. It is necessary to make a reservation that these indicators are based on the RSCI data, which means that they take into account only those scientists who publish their scientific papers. As for the broader circle of readers, including engineers and specialists, their interest can only be assessed by interviewing. The SC5 indicator is a five-year self-citation coefficient which shows the share of references to the papers published in this journal out of the total number of references in this journal to the materials published within recent five years. The self-citation coefficient indicates the popularity of the journal in the scientific community and hence its influence. The more scientists give references to the journal in their papers in various publications, the lower this coefficient is. High-quality periodicals usually have the self-citation coefficient of 20% or less. Too high level of selfcitation may be associated with different factors such as a narrow circle of authors who publish their papers only in this journal; the publication's "cheating" of its impact factor, or too narrow scope of topics not covered by other journals.

The second indicator that should be paid attention to is the Herfindahl-Hirschman index (HHI) introduced in the RSCI in 2015 and used in economics to analyze the market monopolization degree. It is calculated as the sum of squares of the percentages of the number of articles published by various organizations in relation to the total number of articles in the journal in the current year. The more organizations whose representatives publish the results of their studies in the journal, and the more evenly the publications are distributed among them, the lower this index is. The maximum value of the HHI is 10 000, which indicates an absolute monopoly, when the materials by authors from only one organization are published in the journal. It is assumed that the values in the range of 1800 $-10\ 000$ are typical for a small variety of organizations; a value from 1000 to 1800 is a moderate level; and less than 1000 means that the journal is quite popular. In contrast to the impact factor, this index is quite difficult to "cheat" by self-citation or mutual citation of authors.

In Table 2, the indicators that fall within the range of values that require attention from editorial boards are highlighted in red. The editorial boards of the journals nos. 2, 3, and 5 should limit the number of references to their journal in published articles and actively promote the publication among specialists [15].

The university journals (nos. 3 and 5) should expand the authorship by involving more researchers from various organizations. These publications typically have a too high level of self-citation. The *Navigatsiya i gidrografiya* journal (no. 7) has the largest concentration of authors representing the founder of the publication, as well as the maximum self-citation in this list, which could be reduced easily with appropriate control by the journal editors.

The content analysis of the issues of the veteran among Russian periodicals, the *Morskoi sbornik* digest (no. 9) showed that its publication policy is not aimed at achieving high ratings. Along with technical articles, there are a lot of informational, historical and journalistic materials. The *Morskoi vestnik* (no. 10) adheres to strictly technical orientation, but cannot increase its rating due to a large number of articles (more than 25 ones) in each issue and a low number of their citations. It can also be noted here that the articles in these two journals usually does not exceed 4– 5 pages, which is the smallest volume out of the reviewed periodicals. This circumstance does not facilitate their citation.

An even larger number of articles are published in the *Morskie intellektual'nye tekhnologii* (no. 4), the only journal of those considered, which is included in the international database Emerging Sources Citation Index on the Web of Science platform. A positive factor in this journal development is that the number of articles that sharply increased 5–6 years ago is no longer increasing; however, the number of citations per article still does not tend to increase.

It is the number of citations per article that the editorial board of the *Gyroscopy and Navigation* journal is focused on seriously. The growth of this parameter is achieved by following the principles of thorough scientific review of the papers, and on the other hand, by taking measures to promote the journal's publications among relevant specialists [15].

Three out of ten journals are included in the top category K1 of the HAC list. In general, judging by the availability of periodicals of different levels, the market is saturated with the publications on the considered scientific discipline, where the works by a wide range of authors, from students to famous researchers and experts in marine navigation equipment engineering, can be found.

4. CONCLUSIONS

Based on a brief analysis of scientific periodicals, the topics of which cover the theory, production and application of marine navigation equipment, the world's five leading dedicated publications have been identified, one of which is the *Gyroscopy and Navigation* journal.

The Russian periodicals publishing the largest number of articles on this topic have been analyzed. In one way or another, these journals need to be further developed; in particular, their editorial policy should be improved in terms of involving more authors from various organizations and countries, monitoring self-citation of the publications, and work on the scientific content completeness, which is characterized, among other things, by the volume (number of pages) and structure of the articles published.

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CONFLICT OF INTEREST

The authors of this work declare that they have no conflicts of interest.

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