

Analysis of activity of the scientific journal *Computer Optics*

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Abstract. The author analyzes the significance of the journal *Computer Optics* for the development of science in Russia. A particular attention is given to research areas covered and journal publications that attracted a special interest of the research community in the fields of diffractive optics and nanophotonics, optical information technology, pattern recognition, and image processing. The author gives credit to the efforts of the editorial staff that contributed to the Journal success and outlines prospects of the journal development.

Keywords: scientific journal, the editorial board, optical information technology, image processing, computer vision, diffractive nanophotonics, micro- and nanotechnologies

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Introduction

This year we celebrate the 40th anniversary of the Computer Science Faculty of Samara State Aerospace University (National Research University) (SSAU) and the 70th anniversary of the chief editor of the scientific journal *Computer Optics* Professor V.A. Soifer. *Computer Optics* is published jointly by the Image Processing Systems Institute of the RAS (IPSI RAS, scientific leader of IPSI RAS is Prof. V.A. Soifer) and Computer Science Faculty of SSAU. This is a good occasion to look back at the journal accomplishments and give credit to the editorial staff for essential efforts they have contributed to the Journal success.

1. Background and prerequisites

Fundamental research findings jointly made at the turn of the 60-70s of the last century by the research teams from Moscow and Kuibyshev (presently Samara) headed by academician A.M. Prokhorov, professor I.N. Sisakyan, and professor V.A. Soifer enabled the design of new classes of optical elements [1 – 6], making it possible to address problems going beyond the scope of classical optics. The novel optical elements were given the name diffractive optical elements (DOEs), with elements intended for performing specific tasks termed as laser light focusators [1 –

3], modans [4], Bessel-optics elements [5], compensators/equalizers [6], and so on. Some of the above-listed terms, e.g. the term focusator proposed by academician A.M. Prokhorov, have been adopted not only in Russia but also internationally [7 – 10]. As the research community embraced the significance of the new findings, it became evident that we witness the emergence of a new field of research at the interface of information technology, laser physics, optics, and microelectronics, having become known as Diffractive Computer Optics. Thus, a demand arose for a scientific periodical that would promptly peer-review and publish articles dealing with the new, rapidly developing area. In May 1986, the decision of the kickoff meeting on *Computer Optics* (the city of Zvenigorod) to start the publication of a new journal was approved by the Russian science leadership. In 1987, the first issue of the international scientific collection *Computer Optics* with a subtitle Physical Principles was published.



Fig. 1. – Academician Alexander Mikhailovich Prokhorov (1916-2002)

2. Kick-start beginning

Among the co-founders of *Computer Optics*, there were the International Center for Scientific and Technical Information (ICSTI), Institute of General Physics of the USSR Academy of Sciences, Institute of Information Transmission Problems of the USSR Academy of Science, with the ICSTI also acting as a publisher. The publication was funded as part of the information support of the complex program of scientific and technical progress of member-states of the Council for Mutual Economic Assistance (CMEA). In the initial years, the collection of papers *Computer Optics* was edited by academicians Ye.P. Velikhov and A.M. Prokhorov. The first issues were compiled by I.N. Sisakyan, V.A. Soifer, R.V. Matveeva, S.A. Orekhov, A.M. Kostin, and V.A. Danilov, with the essential contribution made by scientists of Kuibyshev Aviation Institute (presently, SSAU).

In the Foreword to the very first issue, academician Ye.P. Velikhov, in particular, wrote [11], ‘Truly revolutionary has been the role played by the computer in designing totally new classes of optical elements like light focusators, wavefront correctors, modal content analyzers, to name just a few. In computer optics, the computer serves a wide variety of functions from solving the inverse problem of diffraction and conducting numerical simulations to numerically controlling the automated machinery, interpreting and visualizing the experimental data, designing elements with optimal characteristics, to developing databanks, and so on’. The following words by Ye.P. Velikhov have recently become particularly relevant, ‘...computer optics is not just computers in optics, but optics in computers as well. A number of optical elements intended for information processing and capable of addressing a broad range of interesting problems have been already designed’. Actually, advanced components for diffractive nanophotonics, such as resonant diffraction gratings [12 – 14], nanocavities [15 – 18], and other devices [19] are able to perform analog operations of the differentiation and integration of optical signals and, when combined with diffractive optics elements such as beam splitters [20] and multi-purpose DOEs [21 – 22], form a basis for the development of analog optical computers [19]. Taking a retrospective view at the progress made on the way from the first diffraction grating to diffractive optics elements, Nobel Prize laureate A.M. Prokhorov noted [23], ‘Flat optics took a drastic turn, essentially resulting in the advent of a new field of diffractive optics, when focusators of laser light were designed in 1980. The very first focusator was created jointly by researchers of the Institute of General Physics of the USSR Academy of Sciences and Kuibyshev Aviation Institute. Before long, mathematicians from the Moscow University became actively involved in the work. Over a short time span of less than 10 years, a variety of diffractive optics elements were designed and diffractive optics was formed as a new research area ...’

Great contribution to the creation of initial issues of Computer Optics collection was made by Professor Iosif Norairovich Sisakyan [24]. In particular, the article entitled ‘Computer Optics. Achievements and Challenges’ written jointly by I.N. Sisakyan and V.A. Soifer [25] became a hit publication of the first issue, having determined the vector of development in the field for decades to come. Among the contributors to the first issue, there were leading soviet researchers active in computer optics in those years, such as A.M. Prokhorov, M.A. Golub, G.I. Greysukh, A.V. Goncharov, V.A. Danilov, N.L. Kazanskiy, B.E. Kinber, D.D. Klovsky, S.G. Kryvoshlykov, V.V. Popov, S.A. Stepanov, A.B. Shvartzburg, S.M. Shirokov, and others. A number of publications included in the first issue opened up new directions of computer/diffractive optics. For instance, synthesis of optical elements and systems intended to generate desired radiation directivity diagrams [26] has led to the design of various lighting devices which were proposed both in *Computer Optics* [27 – 31] and in leading international scientific journals [32 – 35]. Diffraction analysis of the focusing elements by means of numerical simulation [36] went on to be actively developed in follow-up publications [37 – 45]. Great interest was attracted by an article reporting on techniques for focusators design [46]. In the follow-up research, those techniques were essentially improved and extended onto new focal regions of interest [47 – 52]. An important research area concerned with generating a

diffraction microrelief of optical elements was first proposed in Ref. [53] and was further developed in numerous publications in Russian [54 – 60] and foreign [61 – 63] Editions.

The first issue of *Computer Optics* became internationally recognized, having attracted interest from “Pergamon Press” that published two volumes of the journal in English in the years 1989–1990 (Vol. 1, N 1, 1989; Vol. 2, N 1 & N 2, 1990) with world-wide distribution (with cities like Oxford, New York, Beijing, Frankfurt, San Paolo, Sidney, Tokyo, Toronto indicated on the journal cover). Volume I in English was compiled on the basis of the first Russian issue, and Volume II included papers from Russian issues 3 and 4.

Following I.N. Sisakyan’s appointment to the position of director of Central Design Bureau of Unique Instrumentation (CDB UI) of the USSR Academy of Sciences, the list of co-founders changed. Since 1988 (issues 3 – 9), the ICSTI and the CDB UI of the USSR Academy of Sciences acted as the collection’s co-founders. Especially noteworthy in issue 3 is a paper [64] devoted to the technological applications of focusators, which laid the basis for a new direction of diffractive optics that was thriving in the subsequent years [65 – 68]. This research topic was among others which allow a group of SSAU researchers (V.A. Soifer, V.P. Shorin, V.A. Barvinok, V.I. Mordasov, V.I. Bogdanovich and A.G. Zidulko) jointly with I.N. Sisakyan to receive the RF State Prize for outstanding achievements in science and technology in 1992.



Fig. 2. – Professor Iosif Norairovich Sisakyan (1938-1995)

3. Help from Samara

Collapse of the USSR followed by the disintegration of the CMA, temporarily brought the publication of *Computer Optics* to stop in 1992, which was associated with the termination of the Complex program of scientific & technical progress of the CMA member-states. Being the RAS establishment, the CDB UI was run on the self-financing basis, not having a financing from the state budget. With the collapse of the Soviet Union, the contract-based financing of scientific research was drastically decreased. In those circumstances, in 1992 the research group headed by Prof. V.A. Soifer had to take care of the financial back-up of the publication, with the SSAU having become a third cosponsor of the collection. 1992 saw the publication of a twin issue 10-11 and issue 12, with issue 13 published in 1993. Unfortunately, since those years were marked by the growth of publication and distribution costs significantly exceeding the financing of scientific research, *Computer Optics* was not published in 1994.

However, in 1995, thanks to the assistance of academician N.A. Kuznetsov, director of Institute for Information Transmission Problems of the Russian Academy of Sciences (IITP of the RAS), and Dr. N.S. Merzlyakov, the head of digital optics sector at the IITP of the RAS, the financing was obtained, which enabled the publication of a two-part twin issue 14-15. Alongside the ICSI, SSAU, and CDB UI of the RAS, the IITP of the RAS and Image Processing Systems Institute of the Russian Academy of Sciences (IPSI of the RAS, before 1993 known as Samara branch of CDB UI of the RAS) also acted as a cosponsor of twin issue 14-15 of *Computer Optics*. Twin 14-15 issue became the last to be compiled and edited with participation of I.N. Sisakyan, who soon untimely passed away.

Starting from issue 16 commemorating I.N. Sisakyan, the collection starts to be entirely published in Samara, with the ICSTI, SSAU, and IPSI of the RAS acting as cosponsors.

4. Journal

Even though *Computer Optics* is no longer published in English, it acquires ever growing recognition in the scientific community. On October 17, 2001 the collection was included into the list of RF Higher-Certifying-Commission-recommended scientific periodicals for publication of research papers relating to key findings of doctoral dissertations. The results published in *Computer Optics* later formed the basis of doctoral dissertations by V.M. Chernov, L.L. Doskolovich, A.I. Danilin, Ye.G. Ezhov, V.A. Fursov, D.L. Golovashkin, O.V. Goryachkin, N.Yu. Ilyasova, V.V. Ivakhnik, N.L. Kazanskiy, S.V. Karpeev, S.I. Kharitonov, S.N. Khonina, A.G. Khramov, A.A. Kovalev, V.A. Kolpakov, A.V. Kupriyanov, I.V. Minin, O.V. Minin, S.P. Murzin, V.V. Myasnikov, V.S. Pavelyev, A.G. Poleschuk, S.B. Popov, V.V. Sergeev, R.V. Skidanov, S.A. Stepanov, A.V. Volkov, and others.

Since 2007 the collection has been a quarterly scientific journal jointly published by the SSAU and IPSI of the RAS. The Editorial Board includes three academicians of the RAS (Yu.I. Zhuravlev, V.Ya. Panchenko and I.A. Scherbakov), three corresponding members of the RAS (S.Yu. Zheltov, B.V. Kryzhanovskiy and V.A. Soifer), six Doctors of Science (N.L. Kazanskiy, V.V. Korlyar, V.S. Pavelyev,

V.V. Sergeev, S.N. Khonina, and V.M. Chernov), as well as scientists from Germany (professor Richard Kowarschik of Friedrich Schieller University, Jena), India (professor Kehar Singh), China (academician Jin Guofan of Tsinghua University, Beijing), and Finland (professor Jari Turunen of Joensuu University). On 22 March 2007, V.A. Soifer was appointed Editor-in-Chief of the journal of *Computer Optics* by Resolution N 2-8 of the RAS' Information Technologies and Computing Systems department. V.A. Soifer outlines [69] the Journal's strategic direction, the scope of research topics to be covered, also dealing with staffing the Editorial Board. The process of reviewing the submitted manuscripts on optical information technologies and diffractive nanophotonics is supervised by professor S.N. Khonina, the Editorial Board's secretary, on image processing and geo-information technologies – by V.M. Chernov, Doctor of Physics & Math. Credit for big work associated with preparation of the Journal for publication should be given to Ya.Ye. Takhtarov, issue editor, S.V. Smagin, M.A. Vakhe, and Yu.N. Litvinova. The Journal is published under financial support of the Samara Region government.

The scope of research topics covered by the Journal has been extended, embracing areas such as plasmonics and diffractive nanophotonics [70 – 79], geo-information technologies [80 – 84], computer vision [85 – 87], interpretation and understanding of nanoscale images [88 – 92], diffractive X-ray optics [93 – 94], optical computations [12 – 16], analysis of hyperspectral data [95 – 98], the development of Hyper-spectral instruments for Earth remote sensing [99 – 102], new types of diffraction conditioners beams with unique properties [103 – 105], sharp focusing [106 – 108]. Further contributing to the development of the above-mentioned new topics, the journal authors have published corresponding articles in the leading international journals [109 – 120]. Promptly responding to emerging research areas and following the cutting-edge scientific trends enables *Computer Optics* to be actively developing, winning the growing recognition in the research community. Online versions of the Journal articles are in open access at www.computeroptics.smr.ru, and can also be found on the scientific e-library website at eLIBRARY.RU. According to the e-library statistics, most widely cited are publications [55 – 56, 66, 121 – 127].

Conclusion

The fact that since 2012 *Computer Optics* has been abstracted and indexed in international databases of scientific publications, such as SCOPUS and Compendex, can be considered a significant success of the Journal, which is lacking the full-text English version. This enabled *Computer Optics* to be included in the list of scientific periodicals recommended by the Higher Certifying Commission of the RF Ministry of Science and Education for publication of key research findings of doctoral dissertations. Synergy of different topics covered by the Journal, which integrates achievements of diffractive optics, diffractive nanophotonics, and digital image processing, is critical for the progress of the world science, also forming the basis for further success of the scientific periodical. The goal of the current stage of the Journal development is its inclusion in the Web of Science Core Collection.

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