To the 60th anniversary of Sergey Gennadievich Volotovsky

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Abstract. The paper provides a brief description of the scientific and industrial achievements of the research scientist Sergei Gennadievich Volotovsky.

1. Introduction

The research scientist of Image Processing Systems Institute of Russian Academy of Sciences (IPSI RAS) – branch of the FSRC “Crystallography and Photonics” of RAS Sergei Gennadievich Volotovsky has celebrated his 60th birthday on November 7, 2019. The article briefly describes the scientific developments of S.G. Volotovsky.

In 1984 S.G. Volotovsky graduated from the Department of System Engineering of Kuibyshev Aviation Institute named after academician S.P. Korolev (KuAI) with a degree in applied mathematics. After that he was employed by the Kuibyshev Aviation Plant, where he started to work as a software engineer and later was promoted to the position of chief software engineer (1985-1987). From 1987 till 1991 he worked as a software engineer of the second category at the Scientific and Technical Center of the Volga Automobile Plant in Togliatti. In 1991 S.G. Volotovsky began to work at IPSI RAS [1, 2]. From 1993 he occupied the position of junior researcher, from 1999 - software engineer, from 2001 - leading software engineer, and from 2016 - research scientist of IPSI RAS.

2. Kuibyshev Aviation Institute

As early as in his second semester at KuAI, S.G. Volotovsky was engaged in scientific research on the Russian language analyzer in a group of students lead by L.E. Sternberg. The analyzer was developed on the mnemonic code of the M-6000 machine.

In 1982, the analyzer was adapted to check students’ knowledge of the laboratory sessions of the ACS course. The students answered the questions in no particular form while sitting in front of a monitor, which was quite unusual at that time. Very soon this turned into a game on how to trick a computer.

In the 80s of the last century, symbolic calculations have not yet been formed; computers were used for numerical calculations. However, the need for symbolic calculations has already appeared. Under the guidance of B.P. Semenov, S.G. Volotovsky developed a program for the derivation of formulas for partial derivatives of functions of contour systems modules [3]. The derivation of the formulas was reduced to expansion of determinants, reduction of similar terms, reduction of the common factors of a fraction, simplification of expressions containing the product of sine and cosine, and differentiation of trigonometric expressions. Each formula was easy to derive, but they numbered in the hundreds. Obviously, this task is much easier to perform even on FORTRAN than manually. The result looked very significant: the listing with formulas was over 30 meters. Using these formulas allowed to calculate the speeds and accelerations of any point of complex mechanisms.
3. Kuibyshev Aviation Plant
After the graduation from KuAI S.G. Volotovsky had the placement at Kuibyshev Aviation Plant, where preparations began for the launch of TU-204. For the first time in the USSR aviation industry, Tupolev Design Bureau provided the mathematical models of surfaces and structures instead of drawings. Within six months the young specialists D.P. Itkin and S.G. Volotovsky managed to get an understanding of the mathematical models and the proposed program code, and to develop their own code adapted to the needs of the mould and template workshop. This allowed the plant to mould for the production of a new aircraft promptly. Thus S.G. Volotovsky received the position of senior software engineer just 11 months after admission, and this was the quickest promotion to the position of senior engineer in the history of the plant. A year and a half later, the technology for the development of software for CNC machines based on mathematical models was established, and for the first time in the USSR aviation industry the CAD-CAM chain was implemented in the factory conditions.

4. Scientific and Technical Center of the Volga Automobile Plant
Work at the Scientific and Technical Center of the Volga Automobile Plant allowed S.G. Volotovsky to get a better understanding of various methods of software development, process and workflow descriptions, and to put them into practice. In 1989 S.G. Volotovsky was invited as an advisor to the working group that was gathered to develop a unified technological model for the development of a gearbox. Unfortunately, the mutual hostility and distrust of the process participants (designers, technologists, testers...) hindered the development of the model, and made the introduction of such a model unlikely at that time. But this revealed the main reason for the delays in the development of the gearbox - the human factor.

5. Image Processing Systems Institute of Russian Academy of Sciences
S.G. Volotovsky is a unique specialist in the field of computational mathematics and object-oriented programming [4-8]. He participated in the implementation of dozens of original methods for calculating special functions, new types of optical elements and optical devices. He received 5 Russia patent certificates for state registration of software. Currently S.G. Volotovsky has 65 publications in the Scopus database, the Hirsch index is 16.

During his first years at IPSI RAS, S.G. Volotovsky participated in scientific research under the guidance of Professor M.A. Golub and academician V.A. Soifer [9-15], the said research works were associated both with the solution of Maxwell's equations [12-13] and the calculation of special functions [14-15].

A notable event was the development of the QUICK multifunctional software ordered by FIAT. The software allowed to calculate many diffraction elements, to form masks and to simulate the operation of elements in different ways. All employees of the diffraction optics laboratory took part in the development of this software: N.L. Kazanskiy, L.L. Doskolovich, S.I. Kharitonov, V.S. Pavelyev, A.V. Tsaregorodtsev.

S.G. Volotovsky participated in the implementation of dozens of grants, state-funded and contract-based research work. The software products created with his active participation are used successfully at the FIAT Research Center (Italy), Friedrich Schiller University (Germany), the Berlin Optics Institute (Germany), Hitachi Via Mechanics (USA) and aBeam Technologies (USA), the Directorate for Technical Development of AVTOVAZ Plant OJSC (Togliatti), Samara-Terminal LLC (Syzran), Kuibyshevazot CJSC (Togliatti), in the educational process of SSAU.

At the end of the 20th century, the java programming language became very popular. Simple parallelization of the code, the same result of calculations on all platforms made the language extremely attractive for computational tasks. However, it did not support overlapping operations and functions. As a result, the program code looked awful. The authors of the programming language promised to resolve this contradiction in the near future. In order not to wait for a future solution, S.G. Volotovsky developed a prototype of SubJava pretranslator in 1999. The pretranslator made the
program code shorter and more understandable. The quality of the prototype was high enough (to show the advantages of such a solution), so many people perceived it as a finished product. Unfortunately, the java programming language has never become convenient for computational tasks. As for the pretranslator, it was among the top ten products for java for more than 10 years.

From 2002 to 2008 S.G. Volotovsky participated in the creation of the Scientific and Educational Center “Mathematical Foundations of Diffraction Optics and Image Processing” at the Samara State Aerospace University named after academician S.P. Korolev (now Samara National Research University named after Academician S.P. Korolev) as part of the Russian-American program “Basic Research and Higher Education” [16-18].

In addition, during this period S.G. Volotovsky was actively involved in a project on car identification [19-22]. As a result of this project, the computer vision system was implemented at Samara-Terminal LLC (Syzran), and two years later it was also implemented at Kuibyshevazot CJSC (Togliatti).

2009 was the start of a fruitful cooperation between S.G. Volotovsky and Professor S.N. Khonina on solving complex computational problems of diffraction optics [23-27], which required the development of new algorithms (including parallel ones) for calculating and attracting high-performance computing resources [28-33].

A significant part of the research involved simulation of sharp focusing of vector laser beams [34–42] and the propagation of such beams in anisotropic crystals [43–50].

Recently, S.G. Volotovsky worked successfully on such problems as modeling hyperspectrometers and imaging with harmonic lenses [51-56], calculating the eigenfunctions of optical systems [57-61], simulating the propagation of pulsed radiation [62-65], calculating caustics during focusing [66-71], design of optical elements for various radiation ranges [71-78].

6. Conclusion
In conclusion, we would like to wish S.G. Volotovsky to tackle even more challenging tasks and to expand further the scope of his research activities.

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