Shock Waves (2017) 27:813–815
DOI 10.1007/s00193-017-0751-7

OBITUARY

In memoriam Prof. Petr A. Voinovich (1953–2016)

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Professor Petr (Peter) Aleksandrovich Voinovich passed away on April 20, 2016, at the age of 62 after a quick and unexpected cancer illness. His untimely death devastated all his friends and colleagues worldwide, many of whom actively communicated with him on scientific and other matters just a month earlier and were caught completely off guard by the sad news.

Prof. Voinovich was an outstanding, renown researcher in the general field of gasdynamics and computational fluid dynamics. His prominent contributions are related to shock reflection and diffraction, shock focusing, hydrodynamic cumulation, shock waves in astrophysics, acoustic waves in liquids and solids, blast waves and their propagation and reflection, supersonic flows over bodies and other subjects. He was one of the pioneers in using adaptive unstructured meshes coupled with high-resolution finite-volume schemes for investigation of unsteady shock wave flows.

Petr Voinovich was born on December 4, 1953, in Leningrad, USSR (present day St. Petersburg, Russia). He completed his secondary education in 1971 at the City School No. 239 which was (and still is—today it is Presidential Physics and Mathematics Lyceum No. 239) famous for its very strong academic programs in math and physics. After that, he entered Physico-Mechanical Faculty of Leningrad Polytechnical Institute named after M.I. Kalinin (presently, Peter the Great St. Petersburg Polytechnic University) and graduated from it in 1977 with what is nowadays equivalent to a master's degree in aerodynamics and thermodynamics.

Upon graduation, in 1977–1985, Peter Voinovich worked at the State Institute for Applied Chemistry (Leningrad) as a research intern, then as a junior research associate, and finally, as a research associate. During this period, he had been also working on his Ph.D. thesis. In 1984, he defended it and received his Ph.D. (Candidate of Science) degree in the area of physico-mathematical sciences (specialization in mechanics of liquid, gas, and plasma). Soon afterward, in 1985, he changed his place of employment to the Ioffe Physico-Technical Institute of the Russian Academy of Sciences, where he subsequently held positions of software engineer, research associate, senior research associate, and head of department (Computing Center). In the turbulent period of the 1990s, Petr Alexandrovich worked in research and development companies: Advanced Technology Center (1992–1998, Head of Numerical Modelling Department) and Soft-Impact (1998–2003, Leading Expert).

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Afterward, he returned to the Russian Academy of Sciences as deputy director (research) of the St. Petersburg Branch of the Joint Supercomputer Center, where he worked until his death.

Shock wave propagation and interactions as well as numerical modeling of such phenomena became the central points of Peter Voinovich's research at the very early stages of his career. However, out of his many research interests, one deserves special mention. Since as early as 1986, Peter strongly advocated the use of adaptive unstructured meshes and high-resolution numerical schemes for shock wave research. These works were largely run in parallel with a similar effort by Prof. R. Löhner in the USA. These days, when such an approach has become a standard, mainstream technique—almost a common place—it is not easy to appreciate how innovative this way of thinking was at that time. Apart from purely scientific challenges, there were many technical ones: at that time, computer facilities at the Ioffe Institute were just undergoing transition from operations based on perforated cards to computer displays, and those displays were initially working only in the text mode (without any graphics). One may imagine how difficult it was to debug unstructured grid codes with very limited graphic output capabilities provided by ink plotters of the day. In 1991, a special benchmark poster session was run during the 18th International Symposium on Shock Waves (ISSW, July 21–26, 1991) in Sendai, Japan. The purpose of this session was to compare various CFD schemes on the basis of a 2D planar shock wave diffraction over a 90° sharp corner. Only four submissions to the benchmark featured adaptive unstructured grids (see *Shock Waves*, vol. 1(4), pp. 301–312, 1991), and one of them—and very competitive to say the least—was from the team that included Peter Voinovich, two of his Ph.D. students (Dmitrii Sharov and Evgeny Timofeev), and Andrei Fursenko. Even in 1993, adaptive unstructured meshes were still such a novelty in the research community gravitated around ISSW meetings that out of the four volumes of the ISSW-19 Proceedings (Marseille, France, July 1993) our papers were among only a very few related to unstructured grid technology and its application. One positive side effect of developing unstructured codes on computers with limited capabilities was that, by necessity, a great deal of thought was applied toward memory and CPU usage optimization. Peter's ingenious solutions and ideas for the data structure led to the code which was, arguably, one of the most efficient ones at that time.

Since the mid-1990s, Prof. Petr Voinovich also held multiple visiting professor positions abroad: mainly in Japan (Sendai) and France (Lille) but also in Germany (Darmstadt). In 1995–2003, he stayed many times at the Shock Wave Laboratory of the Institute of Fluid Science (IFS), Tohoku University, headed by Prof. Kazuyoshi Takayama. These visits included, apart from many shorter ones, three six-month-long visiting professorships (in 1995, 1997/1998, and 1999/2000). Prof. Takayama recalls:

> I tried to reinforce CFD mode of our shock wave research and invited Prof. Andrei Fursenko of the Ioffe Institute to take our visiting professorship. Prof. Fursenko declined but strongly recommended Peter as his replacement. Thus, Peter started to collaborate with us for over 8 years since 1995. He promoted immensely our shock wave studies. At that time, a Cray C90 and later T3D supercomputers were installed at IFS in order to give a boost to CFD work in Japan. Dr. Tsutomu Saito was a technical staff member supporting the Cray supercomputer. Peter collaborated with him very closely on the development of CFD for shock wave research. It is not my personal exaggeration that we owe Peter for many aspects of the success of shock wave research at IFS.

During his IFS years, as a major next step, Peter Voinovich wrote a three-dimensional adaptive unstructured code for unsteady flows, based on tetrahedral meshes and hierarchical h-refinement. Serial, vectorized (for C90), and parallelized (for T3D) versions of the code were created. Even today such codes are not too numerous around the world due to their complexity. This code was used extensively for a number of important basic and applied projects, for example, basic studies of three-dimensional unsteady shock reflection from an inclined cylinder, and propagation of blast waves induced by potential accidental explosions at rocket launching sites and booster factories (the latter project was run in collaboration with the Japanese Space Agency, NASDA, and real terrain and building geometries were used). Even though it is common wisdom that numerical results do not generally age as well as experimental studies due to breakneck speed of the development of computer technologies, these studies even today, 20 years later, stand as very decent ones.

After the fall of the Iron Curtain, Peter Voinovich was also the first Russian invited to France to the prestigious National French Aerospace Research Center ONERA (Lille division). Later, he started cooperation with CNRS, more specifically, with the French-Russian lab LEMAC (International Laboratory in nonlinear Magneto-Acoustics of condensed matter) in Lille at IEMN (Institut d'Electronique, de Microélectronique et de Nanotechnologie). Initially, his research was mainly related to classical shock wave topics, such as anisotropic point explosions but then Peter discovered for himself a new area related to linear and nonlinear acoustic waves in solids and liquids. This long-term collaboration resulted in many joint papers with the above French institutions, with the latest one dated in 2013. One of them published in *Shock Waves* (vol. 13, pp. 221–330, 2003) was the first simulation of shock

interaction between liquids and elastic solids by an original unified treatment of solid and fluid media.

His host in Lille, Prof. Alain Merlen, recalls:

> During his numerous invitations to France, Peter was also very busy with other tasks in different Western European countries, sometimes too busy as it happened during his first stay in Lille when he was working for ONERA. He received an invitation for giving a talk in Italy and was supposed to stay there for one week. He said, 'See you next week,' to his French colleagues, but the next day in the afternoon he was again in the lab. At the surprise of his colleague, Peter answered, 'I thought that Italy was a Schengen country, but it wasn't; at the airport, a French border agent explained that to me very politely but refused to let me cross the border.' At that time, Spain was a Schengen state but not Italy; unfortunately, Spain (Испания) and Italy (Италия) are quite similar words in Russian, and Peter was too much of a scientist to pay attention to these basic details. As a result, France got one more week of Peter's activity for its best profit.

Peter was a true representative of Russian intelligentsia, not only with deep and broad professional knowledge but also with encyclopedic erudition virtually in all areas of science, art, and humanities, all that combined with modesty, ironic self-criticism, and generosity of heart. Peter will be remembered as a kind and compassionate person who always took great care of his students, junior colleagues, and all members of his laboratories. Those who were honored to be among his friends, in the true Russian sense of this word, knew that Peter was very reliable and supportive regardless of how busy or how far he was. He was a person of out-of-the-box thinking, and not only in scientific matters, who often surprised his colleagues by his unorthodox, paradoxical, and insightful observations. It was a great pleasure to have a discourse with him (depending on the occasion over a glass of wine, beer, sake, and so on, or without any) on a great variety of topics ranging from ever-present politics to linguistic mysteries, from Russian literature to the history of the USA, from tea ceremonies to French cuisine. Peter was fluent in English, and especially liked to discuss, in a comparative way, subtleties of Russian, English, Japanese, and French grammar, vocabulary, and idiomatic expressions. As much as Peter liked to be in front of a computer screen, he also liked to be far away from it, be it at his dacha (country house) on an island in the Gulf of Finland or while traveling in the countries he was visiting. In Japan, he went from Sendai by car as far as Kyoto, climbed Mt. Fuji, and attended many festivals; in Hawaii, one could see him on the summit of Mauna Kea; in Australia, he went scuba diving near the Great Barrier Reef. Photography, fishing, and car repairs were also among his hobbies. Theoretician in science, he was a good handyman in daily life.

Peter's death, still in his prime years, is a great loss for the research community, his colleagues, friends, and relatives. Nobody can replace him in our hearts and minds, but, as a small consolation, his legacy is and will be with us not only in the form of his research publications and accomplishments but also in the form of computer codes he has developed, which are still at work in their original and further developed states in many laboratories worldwide.

Let his great soul rest in peace.

Evgeny Timofeev