



In Memoriam

By Valery Adzhiev



Professor Alexander Pasko

Alexander Pasko was born in Krasnoyarsk, one of the oldest cities in Siberia, on 18.12.1960 and passed away, after a long illness, in Moscow on 15.11.2022. For more than 25 years, Alexander led an international research team working on foundational mathematical and algorithmic frameworks for procedural function-based geometric modelling, solid modelling and heterogeneous volume modelling with broad applications in CAD, 3D printing, biology, medicine, geology, physical simulations, computer animation, and computer art.

Alexander initially planned to study art at the Stroganov Art School but finally ended up studying Computer Science at the Moscow Engineering Physics Institute (MEPhI), which was one of the top soviet universities producing a substantial number of Nobel laureates. Alexander married his wife Galina in 1981 and they had three children, two sons and a daughter, and three grandsons.

Alexander received his Master's degree in Computer Engineering in 1983 from MEPhI with distinction and then worked there, as a research student and as a senior researcher until 1992. The geometric modelling student research group under the supervision of Prof. Victor Pilyugin was established around that time. Through this group our friendship and collaboration started and lasted these many years. His talent and ability were recognised very early: in 1984 he was awarded the first

Prize in the National Competition of Young Specialists in Computer Science for his work in the field of scientific visualisation of physical phenomena. He received his PhD in Computer Science in 1988. His thesis was already based on an approach to geometric modelling that later became a trademark associated with him and us, his collaborators. This representation of objects as well as transformations over them had to be mathematically solid and, whenever possible, exact. I remember our half-serious slogan when this new approach, Function Representation (FRep), was introduced: “Death to polygons!”. Much later we concluded that “polygons” were needed and it was better to develop a hybrid framework, which combined polygons and FReps.

Gorbachev’s “perestroika” in late 1980s made it possible for Soviet science to become more open and global. Alexander’s first paper published in the West, was “Geometric modeling in the analysis of trivariate functions” appeared in the special issue “Computer Graphics in USSR” of the Computers and Graphics journal in 1988. In 1993 Alexander received an invitation from Prof. Kunii, a founder and president of the University of Aizu, and joined its Shape Modeling Lab as an Assistant Professor. In 2000, he moved to Hosei University, Tokyo, first as an Associate Professor, and then, from 2001 as a Full Professor. The family moved with him and during that time his wife Galina earned a PhD in Computer Graphics and collaborated and co-authored papers with him on a number of occasions.

In 2007 he moved to the UK where he was appointed Professor with a Chair in Computer Animation and became a member of the “Modeling, Animation, Games and Effects” (MAGE) research group at the National Centre for Computer Animation (NCCA) of Bournemouth University. In 2011 the NCCA was awarded the “Queen’s Anniversary Prize” for its outstanding contribution to teaching in the field of Computer Animation. The NCCA also received the highest grade in research in Computer Animation in the UK. From 2018, he, keeping a part-time position at Bournemouth, joined the Skolkovo Institute of Science and Technology (Skoltech) in Moscow, which had been founded in 2011 in a partnership with MIT.

In 1995, the paper “Function representation in geometric modeling: concepts, implementation and applications”, with Alexander as the first author and V. Adzhiev, A. Sourin and V. Savchenko as co-authors, was published in the journal *Visual Computer*. This paper systematically described FRep as a mathematically substantiated multidimensional extension of CSG and implicit surfaces approaches. This paper has been recognised as seminal and has been cited more than 700 times. In subsequent years, the FRep was further extended to deal not only with geometry but also with internal structure and physical/material properties of objects. This has opened opportunities for using it in applications, such as computer animation and 3D printing. A number of original techniques that Alexander invented, such as “Bounded blending”, “Space-Time blending” and “Controlled metamorphosis”, to mention but a few, have proved to be practical and widely used.

The theoretical FRep framework was first applied and supported by the development of the “HyperFun” software tools, which were widely used in industry and in universities in many countries. Alexander had been a great enthusiast of involving children in modelling, graphics and animation (our paper about this was published in the *Communications of the ACM*). There were numerous events in Japan, Norway and Russia with schoolchildren quickly mastering the HyperFun programming language and producing models and 3D printed artifacts. In 2015 the “SHIVA project: 3D Sculpting and Printing for Disabled Children”, funded by a European Union Interreg grant with Alexander as a co-leader, was a winner of the most prestigious UK “Times Higher Education Award”, in the category of an “Outstanding Digital Innovation in Teaching or Research”. The paper describing the project appeared in *IEEE Computer Graphics and Applications* in 2016.

Another notable interest of Alexander’s was concerned with Computer Art. In particular, he made significant contributions to our group’s work concerned with the development of the “4D Cubism”,

the “Augmented Sculptures” and the “Escher’s models” projects. Several papers were published in the journal Leonardo, some resulting artifacts had been exhibited.

Through his research, Alexander helped to found a number of international organisations, both academic and commercial, including Shape Modeling International (SMI) conference series where he served on the steering committee for many years, the Digital Materialization Group and the Norwegian based company, Uformia AS. Uformia developed and released the first commercially available field based modeling kernel, API and framework. The application of this technology in areas such as mass-customization, meta-materials, constraint based simulation and topology optimization is continuing to drive novel advancements in the additive and digital manufacturing space.

The international R&D Digital Materialization Group lead by Alexander has published in excess of 150 papers in academic journals and conferences. Alexander, who was an ACM SIGGRAPH Pioneer member, had been on the editorial boards of the journal Computer-Aided Design and several other international research journals, he chaired and co-chaired multiple international conferences and gave many invited talks and tutorials worldwide.

Alexander (Sasha to his friends) was in many ways a larger-than-life personality and had an ability to attract very different people to work together, which in many cases resulted in life-long friendships. Although he served as a Digital Media Department chair at Hosei University, he was not that interested in a management career of taking important positions in prestigious institutions. He would rather informally create a light and friendly working environment, which was usually stretched to also spending free time together. His numerous colleagues and friends are shocked by his untimely passing and are eager to share their good and vivid memories. These are some of them.

Prof. Peter Comninos: I remember first meeting Alexander during the coffee break of conference in Lausanne. I think we both recognised a kindred spirit. During a long dinner with Alexander and Valery the same evening, we set out an ambitious research plan to combine a physically inspired geometric modelling and animation system. Even to create a hybrid representation that combines function and polygon representations and to use these interchangeably, and to easily translate from one to the other. A goal that I believe we have not yet fully realised – perhaps in another lifetime. This first meeting led to a friendship and a research collaboration that culminated with me convincing Alexander to join us at the NCCA in Bournemouth. What I will miss most about him is his warmth, open-mindedness and the stimulating conversations about computer science, maths and art. Farewell my friend.

Dr Leigh McLoughlin: AP was certainly a unique and remarkable person. I was always impressed by his technical brilliance, his memory and his ability to mentally switch between complex tasks in an instant. I learned a lot from him and he always gave opportunities and encouragement to push further. He also had a remarkable ability to forage for food at networking events - there were several times I saw him magically appear with plates full of food from nowhere! Above all though, I will remember and miss his kind heart and enthusiastic and positive outlook on life.

Dr Oleg Fryazinov: Alexander has worked in many different countries and was very aware of cultural differences and all the possible misunderstandings that might occur because of these differences. In his office at Bournemouth university, he had a poster with the following two phrases “ьгерфд ьшыгтвукыефтвштп” and “dpfbvyst ytgjybvfybz”. The first represents the English phrase “mutual misunderstanding” when typed using a Cyrillic keyboard layout. The second is the Russian translation of the exact same phrase when typed using an English keyboard layout. His point was that our differences might make understanding very difficult and hard to decode. Now I think that

this poster with the two gibberish phrases was in fact a profound statement or even, perhaps, a piece of conceptual art.

Dr Pierre-Alain Fayolle: There are two possible conventions for implicit modelling for the sign of the function defining the object. In graphics, they use ' <0 inside and >0 outside' because the gradient then matches the (surface) outward pointing normal. The FRep convention is the opposite. One day I asked Alexander why this convention, his reply was something like: "FRep are like people, it is better to be good (positive) inside. Why would *you* want to be negative inside?"

Dr Meurig Beynon: Perhaps one of my earliest memories is of standing by a lake in the volcanic region near Aizu, watching Sasha swimming like a great big bear. And I remember when we had the most enormous meal together and I marvelled at his capacity for eating! I doubt if anyone whom I have met and worked alongside has experienced such serious and disruptive situations in their lives as Sasha did. To be able to conjure positive and creative lives out of such experiences ideally needs a capacity for not taking things too seriously and a readiness to find and enjoy elements of the world as ridiculous. Only then it is possible to sustain work on the projects that tax our imagination to the limits, where our understanding is most consistently challenged and we simply must from time to time confess bemusement and acknowledge wonder. And though I cannot begin to understand what it is like to have lived inside the history of modern Russia, I can relate to the idea that what matters most is beyond the absurdities of political and bureaucratic reality and I really appreciated how Sasha championed such a philosophy.

Turlif Vilbrandt: Alexander's passion for the development and open sharing of exact computational languages was unyielding. He disliked the given term "Implicits" for our area of research as it was not "exact enough". We had a running jest or maybe it was a futuristic vision about one day creating a "Second Earth" - a digital twin - exactly describing, as a geological mathematical material model, Earth in all of its details, including soil composition, forests, cities, oceans, and atmosphere. Not to escape ourselves and live in an endless meta-reality or to sow domination, but to better understand, appreciate, steward and meaningfully interact with what we are and the world we live in. He was a true mage of his time and fundamentally believed the transformative nature of understanding, in all things.

Dr Eike Anderson: Shortly after Alexander started at Bournemouth University I remember meeting him on the stairs at the university, and in passing asking him "How are things?", to which he replied that I should never ever ask a Russian that question, unless I was prepared to listen to his life's story.

Now, it's our, his friends, duty to ensure that his life's story is heard and appreciated, along with all his professional achievements.

Dr Valery Adzhiev

Principal Academic

The National Centre for Computer Animation (NCCA)

Bournemouth University, Poole, UK

Email: vadzhiev@bournemouth.ac.uk