Nikolai Andreev and the art of mathematical animation and model-building

Tadashi Tokieda

Abstract

The Leelavati Prize of the IMU was awarded at the ICM 2022 to Nikolai Andreev, for his original development of mathematical animation and of mathematical model-building, in a style which inspires the young and the old alike, and which mathematicians around the world can adapt to their varied uses—as well as for his indefatigable efforts to popularize genuine mathematics among the public.

Mathematics Subject Classification 2020

Primary 97A80; Secondary 97U80, 97U60

Keywords

Leelavati, Andreev, animation, model, popularization

ICM INTERNATIONAL CONGRESS OF MATHEMATICIANS 2022 JULY 6—14

Preliminary version, to appear in Proc. Int. Cong. Math. 2022, Vol. 1.
DOI 10.4171/ICM2022/215

In the realm of visual and tactile mathematics, Nikolai Nikolayevich Andreev is a master of a wondrous art of animation and of model-building. Animation differs from simulation: it is a cartoonish video of a story unfolding in front of our eyes and precipitating some mathematical surprise, delightful to watch. Models differ from 3D-printing: they are made by hand, of wood or paper, entertaining to touch and manipulate. His animation and models are minimalist yet executed with consummate craftsmanship. Andreev's signature style of this art captures the imagination of both the young and the old, and offers potential for a variety of uses in the popularization of mathematics. In parallel, he is recognized for tremendous resilience in often overcoming hardship to continue kindling enthusiasm for mathematics among a large number of people of all life-circumstances, via web resources, lectures, and a book. For these he is being awarded the 2022 Leelavati Prize.

Eastern Europe has a grassroots tradition, harking back to the era of Tchebyshev, of organizing nationwide ladders, so to speak, of mathematical activities from small children to college students; some of it has been exported abroad, as witnessed by 'math circles' that flourish in hubs of initiative around the globe today. Out of this tradition came *Kvant*, arguably the highest-quality magazine of popularization in mathematics and theoretical physics that the world has seen, commanding in its heyday a circulation of 2×10^5. (As of 2012 a younger sibling *Kvantik* [1] came into action.) It is to this tradition that Andreev, or Kolya to his many friends, was born in 1975 in Saratov, and to this tradition that he has claim to be a leading successor in our 21st century.

His early training was as a researcher. Andreev graduated from the Faculty of Mechanics and Mathematics of Moscow State University, completing a candidate's degree (PhD) in 2000 in the area of extremal problems and approximation theory, codes and designs. In the same year he began working at Steklov Mathematical Institute, where he has been based ever since.

2002 marked a watershed: Andreev gathered a team of R. A. Koksharov (senior developer, web design), M. A. Kalinichenko (graphics, video producer), N. M. Panyunin (mathematics), and created the project 'Mathematical Études' [2]. The project is a treasure trove of animation videos, available to everybody free of charge. Each video gives a brief but genuine mathematical experience of an interesting point that is elementary but little known;

as such, it is orthogonal to the common practice of presenting journalistically a fashionable topic. He also recruited A. D. Leshinskii, a wright of stunning skill who realizes curious mathematical phenomena in beautiful wooden models. In 2010 Andreev was appointed Head of the Laboratory of Popularization of Steklov Institute. The productions of his Lab include, alongside the ongoing growth of Études plus models, the collection 'mechanisms by Tchebyshev' [3], moveable gadgets which make intriguing uses of classical mathematics, and the book *Matematicheskaîa sostavlîaîûshchaîa* (which we may translate freely as *Mathematical take on things*) [4], an anthology of about 30 mathematicians on a luxuriant diversity of material reminiscent of *Kvant*. The book, first published 2015 by him, S. P. Konovalov, N. .M. Panyunin, R. A. Koksharov, earned a gold medal for scientific writing 2017; the second edition, more than double in content, followed in 2019.

Andreev travels the length and breadth of a vast continent to deliver lectures, well over 1000 in 20 years, reaching out to by now countless members of the public, especially the adolescents. Time and again extraordinary dedication and perseverance saw his cause through: chronic administrative and financial trammels, endless negotiations and set-backs. Whenever his team's funding dried up, he divided his own salary in equal parts among himself and the other staff of the team, in order to keep the work alive.

For all his accomplishments, much of Andreev's career is still ahead of him. We salute Kolya, as one representative of the community of mathematicians through the centuries who gave of themselves selflessly to doing mathematics with each rising generation. We look forward to being raised by his future work for decades to come.

References

[1] https://kvantik.com/en/

[2] https://etudes.ru

[3] https://tcheb.ru

[4] https://book.etudes.ru

Tadashi Tokieda

Department of Mathematics, Stanford University, Stanford CA 94305-2125, USA,
tokieda@stanford.edu