Title: Just so stories à la carte around Geometry, Dynamics, and PDEs.

Speaker: Dmitri Burago, Penn State University

Date and Time: Tuesday, April 4, 2017, 2:20–3:20pm

Location: Rome Hall 351

Abstract: The lecture consists of several mini-talks with just definitions, motivations, some ideas of proofs, and open problems. I will discuss some (hardly all) of the following topics, based on the input from the audience.

1. "A survival guide for feeble fish". How can a fish get from A to B in turbulent waters which might be much fasted than the locomotive speed of the fish provided that there is no large-scale drift of the water flow. This is related to homogenization of G-equation which is believed to govern many combustion processes. Based on a joint work with S. Ivanov and A. Novikov.
2. One of the greatest achievements in Dynamics in the XX century is the KAM Theory. It says that a small perturbation of a non-degenerate completely integrable system still has an overwhelming measure of invariant tori with quasi-periodic dynamics. What happens outside KAM tori has been remaining a great mystery. The main quantitative invariants so far are entropies. It is easy, by modern standards, to show that topological entropy can be positive. It lives, however, on a zero measure set. We are now able to show that metric entropy can become infinite too, under arbitrarily small C^∞ perturbations, answering an old-standing problem of Kolmogorov. Furthermore, a slightly modified construction resolves another long-standing problem of the existence of entropy non-expansive systems. In these modified examples positive positive metric entropy is generated in arbitrarily small tubular neighborhood of one trajectory. Based on a joint work with S. Ivanov and Dong Chen.
3. "What is inside". Imagine a body with some intrinsic structure, which, as usual, can be thought of as a metric. One knows distances between boundary points (say, by sending waves and measuring how long it takes them to reach specific points on the boundary). One may think of medical imaging or geophysics. This topic is related to minimal fillings and surfaces in normed spaces. Based on a joint work with S. Ivanov.
4. How well can we approximate an (unbounded) space by a metric graph whose parameters (degree of vertices, length of edges, density of vertices etc) are uniformly bounded? We want to control the ADDITIVE error. Some answers (the most difficult one is for $\mathbb{R}^2$) are given using dynamics and Fourier series. Based on a joint work with S. Ivanov.
5. How can one discretize elliptic PDEs without using finite elements, triangulations and such? On manifolds and even reasonably "nice" m-spaces. A notion of ρ-Laplacian and its stability. Based on a joint work with S. Ivanov and Kurylev.
6. A solution of Busemann's problem on minimality of surface area in normed spaces for 2-D surfaces (including a new formula for the area of a convex polygon). Based on a joint work with S. Ivanov.

Short Bio: Dmitri Burago is a Distinguished Professor of Mathematics at Penn State University. His research interests include dynamical systems, algorithmic complexity, Finsler geometry, combinatorial group theory, and partial differential equations. In 1997, Burago was the recipient of an Alfred P. Sloan Research fellowship and, in 1995, he received Penn State's Faculty Scholar Medal for Outstanding Achievements. He has been a member of the St. Petersburg Mathematical Society since 1992. Before joining the Eberly College of Science faculty at Penn State in 1994, Burago was a faculty member at the University of Pennsylvania, a researcher at the St. Petersburg Institute for Informatics and Automation, and an assistant professor in the Department of Mathematics and Mechanics at St. Petersburg State University in Russia. He received doctoral and master's degrees from St. Petersburg State University in 1992 and 1986, respectively.