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Whitehead Prize: citation for Tom Hutchcroft

Short citation:

Professor Tom Hutchcroft of the California Institute of Technology is awarded a Whitehead Prize for solving numerous fundamental problems in several areas of probability theory. He has exhibited deep creativity and ingenuity, primarily in the interplay between the geometry of graphs (especially Cayley graphs of groups) and the behaviour of probabilistic processes on them.

Long citation:

Professor Tom Hutchcroft of the California Institute of Technology is awarded a Whitehead Prize for solving numerous fundamental problems in several areas of probability theory. He has exhibited deep creativity and ingenuity, primarily in the interplay between the geometry of graphs (especially Cayley graphs of groups) and the behaviour of probabilistic processes on them. His most important works concern percolation, unimodular and nonunimodular graphs, uniform spanning forests, and the Ising model. Hutchcroft is one of the top people in probability of any age.

Bernoulli percolation is the most important model of percolation, studied intensively since the 1950s by mathematical physicists and mathematicians alike. The study of Bernoulli percolation beyond Euclidean lattices was promoted especially by some fundamental conjectures of Benjamini and Schramm (1996). With Hermon, Hutchcroft proved a very general result on cluster size in Bernoulli percolation, which, among other consequences, answered positively a question of Benjamini, Lyons, and Schramm (1997): almost surely every infinite cluster in supercritical percolation on a transitive nonamenable graph has anchored expansion. In other work, Hutchcroft has shown how to use nonunimodularity in a powerful way to study Bernoulli percolation.

A conjecture of Schramm (from about 2008) asserts that the critical probabilities for Bernoulli bond percolation satisfy a certain local continuity property. Much impressive work has been done on this conjecture in recent years by Hutchcroft and by others. In 2023, Hutchcroft with his grad student Easo resolved the conjecture completely in a tour de force of deep work, involving intricate, multiscale arguments from percolation combined with the structure theory of groups of polynomial growth. In this latter field of structure theory, Hutchcroft and Easo had to extend known, purely algebraic results significantly in a separate paper.

Hutchcroft also has impressive work with Tointon on percolation on finite transitive graphs, which almost completely resolved a conjecture of Benjamini from 2001. This paper combines ideas from several areas (not just in probability) and is the first paper in percolation to use the quantitative structure theory of finite transitive graphs in a serious way. Hutchcroft is unquestionably the leader in understanding percolation on Cayley graphs in general.

The word ‘percolation’ refers not only to Bernoulli percolation, but to any random subgraph of a given graph. In a most beautiful and famous paper with Pete, Hutchcroft proved that every countably infinite group with Kazhdan's property (T) has cost 1, answering a well-known question of Gaboriau in geometric group theory. Hutchcroft's proof used a specially constructed sequence of invariant percolations.

Hutchcroft has several beautiful papers on random walks, but his most important work related to random walks is on uniform spanning forests, which became linked to random walks through an algorithm introduced by Aldous and Broder (both influenced by Diaconis) in 1989. This model of random forests is now considered one of the basic models of modern probability theory. Among Hutchcroft's impressive contributions in this area, he established several fundamental conjectures in the field that had been open since the late 1990s, posed by Benjamini, Lyons, Peres, and Schramm.