LONDON MATHEMATICAL SOCIETY
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Whitehead Prize: citation for Perla Sousi

Short citation:

Professor Perla Sousi of the University of Cambridge is awarded a Whitehead prize for her groundbreaking contributions to the study of mixing and cutoff phenomena for Markov chains; to the study of random walks and Brownian motion in fixed and changing environments; and to the development of the potential theory of branching random walks on d-dimensional lattices.

Long citation:

Professor Perla Sousi of the University of Cambridge is awarded an LMS Whitehead prize for her groundbreaking contributions to the study of mixing and cutoff phenomena for Markov chains; to the study of random walks and Brownian motion in fixed and changing environments; and to the development of the potential theory of branching random walks on d-dimensional lattices.

Sousi's work on Markov chain mixing and cutoff helped to revitalize this field of study. Cutoff is a fascinating property of many Markov chains, whereby the chain passes from poorly mixed to rapidly mixed over a timescale much smaller than the mixing time itself. One of the main research questions in the field right now is to find characterizations of which Markov chains exhibit cutoff. Sousi has made major contributions to this line of research, notably establishing universality of cutoff for any graph after a small random perturbation (the perturbation consists of a random perfect matching). Turning to the theory of Markov chain mixing, Sousi's fundamental results include, inter alia, establishing the equivalence of total variation mixing and of hitting times of large (static or dynamic) sets.

In a series of works with Amine Asselah and Bruno Schapira, Sousi obtained fine results on the capacity of the Wiener sausage (the set of points within a given distance of a Brownian path) and of the range of a random walk. In the random walk case, these include a central limit theorem in all dimensions greater than 5, a law of large numbers in dimension 4 and a non-standard central limit theorem in dimension 4. These are striking new contributions to this interesting and developing field. The behaviour in dimension 4 echoes the classical results of Le Gall for the volume in dimension 2.

Professor Sousi is currently leading the development of the potential theory of branching random walk on Z^d; once complete, this theory will form a standard part of the probability toolkit. Of particular note in this regard is her work on intersection equivalence, which establishes that in dimension at least five, critical branching random walks conditioned to survive are intersection equivalent to the Minkowski sum of two independent (non-branching) random walks. This allows the study of many questions about branching random walk to be transferred to a setting possessing greater independence, which greatly simplifies analysis. Like in most of her other work, Sousi's insights on this subject will have a lasting impact on the field.