
DAVE SCHNEIDER, University of Saskatchewan

Kac goes to work: Stochastic processes as probes of the architecture of plant root systems

The past decade has seen a rapid development of data-driven plant breeding strategies based on the two significant technological developments – high throughput DNA sequencing and the use of high resolution digital imaging to estimate quantitative traits related to plant architecture. Imaging above-ground structures such as shoots, leaves and flowers has developed rapidly. In contrast, below-ground structures are much more difficult to study. In part, this difficulty is associated with the lack of mathematical tools to characterize multi-scale, dendritic structures such as plant root systems. The focus of this talk, inspired by the analytical results of Kac, van den Berg and many others in the area of spectral geometry, is to describe a computational and statistical methodology that employs stochastic processes as quantitative measurement tools suitable for characterizing images of multi-scale dendritic structures. The substrate for statistical analyses in Wasserstein space are hitting distributions obtained by Monte Carlo simulation. The practical utility of this approach is demonstrated using 2D images of sorghum roots of different genetic backgrounds and grown in different environments. The work presented here is the result of collaborations with Young-Heon Kim, Hugo Lavenant, Brendan Pass, Yujie Pei and Geoff Schiebinger.