Citation for Clarice Poon (Whitehead Prize)

Short citation

Dr Clarice Poon of the University of Warwick is awarded a Whitehead Prize for her pioneering work at the intersection of optimisation, imaging sciences, and machine learning. She has made groundbreaking contributions to the design and analysis of large-scale optimisation schemes aimed at solving ill-posed inverse problems and advancing supervised machine learning techniques. Poon has provided in-depth mathematical analysis of the super-resolution capabilities of these approaches, showcasing an impressive breadth that covers imaging problems, compressed sensing, neural network training, and optimal transport.

Long citation

Dr Clarice Poon of the University of Warwick is awarded a Whitehead Prize for her outstanding contributions to optimisation, imaging sciences, and machine learning, effectively bridging theoretical frameworks with practical applications across a spectrum of challenges such as super-resolution in signal processing, compressed sensing, and supervised learning. Her work, marked by innovation and depth, advances new mathematical and numerical tools in diverse areas, including non-smooth optimisation, calculus of variations, optimal transport, and random matrices. These theoretical and practical contributions work in tandem with the development of large-scale numerical solvers, which Poon distributes as open-source software, facilitating broader access and application.

A prominent set of her works focuses on compressed sensing reconstruction, where Poon has made significant advances from both theoretical and practical standpoints. She has contributed extensively to the recovery of sparse signals/data, including in continuous settings, achieving several pioneering results. Her research exposes the complex relationships between compressed sensing, Fourier measurements, and piecewise constant signals and images, including in particular the 'total variation' model. Through innovative use of tools from random matrix theory and kernel methods, Poon has developed a unifying mathematical framework that significantly enhances our understanding of sparse signal recovery from random compressive measurements. This body of work not only showcases her technical prowess but also her ability to address and solve complex problems by bridging various mathematical disciplines.

A related stream of work focusses on the rigorous definition and analysis of super-resolution phenomena. She successfully derived sharp theoretical conditions under which sparse recovery methods can surpass the Rayleigh optical limit for a broad spectrum of imaging devices. These groundbreaking efforts address long-standing mathematical challenges while also holding significant practical relevance for applications such as image deblurring and medical imaging reconstruction.

Alongside these theoretical advancements, Poon has developed large-scale optimisation methods that surpass existing standards in terms of both speed and recovery performance.

These techniques cleverly integrate concepts from both smooth and non-smooth optimisation, facilitating rapid convergence speeds and reduced computation time per iteration. Her ability to provide a comprehensive mathematical analysis of these methods, demonstrating their relevance and precision across a wide array of scenarios in imaging and learning, is particularly noteworthy.

It is evident that Poon's work has profoundly influenced the mathematics of data sciences. Her ability to understand and mathematise the critical applied questions in these domains renders her contributions not only groundbreaking but also highly pertinent and impactful.