Research Highlight: The Continuum Disordered Pinning Model
Work of Associate Professor SUN Rongfeng

The disordered pinning model is a classic disordered system, which models a linear polymer interacting with a line of defects (disorder). Before introducing disorder, the points of contact between the polymer and the line forms a renewal process governed by a renewal exponent a. As the model parameters vary, the polymer undergoes a transition between two phases: a localized phase where the polymer stays close to the line of defect for all time, and a delocalized phase where the polymer ignores the presence of the defect. An extensively investigated question is whether introducing disorder will or will not fundamentally alter the nature of this phase transition, and it is now known that the answer is yes when a lies between ½ and 1. In recent joint work with F. Caravenna and N. Zygouras, Rongfeng Sun from NUS shed new light on this question. They showed that when introducing disorder fundamentally alters the nature of the phase transition, one can construct a continuum space version of the disordered pinning model as the universal scaling limit of the disordered pinning model, irrespective of the microscopic details of the model. The underlying discrete renewal process is now replaced by a continuum alpha-stable regenerative set (e.g., the set of times when a Brownian motion hits zero), and the disorder is given by a one-dimensional white noise. The continuum disordered pinning model has interesting properties: for almost every realization of the disorder, the continuum polymer has the same Hausdorff dimension as the underlying regenerative set, and yet their laws are singular with respect to each other.

Reference: F. Caravenna, R. Sun and N. Zygouras, "The continuum disordered pinning model". Probability Theory and Related Fields, 164, no. 1 (2016): 17-59