Analysis of dense suspensions by network-based methods

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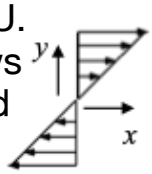
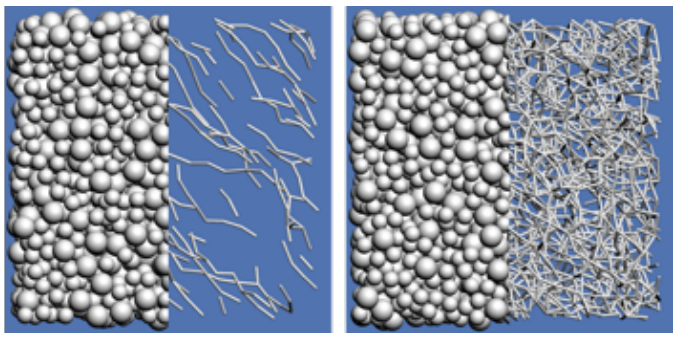
The project focuses on developing fundamental new directions in dynamic material science by studying the network topology in flowing dense suspensions. The aim is to develop clearly and place on a robust mathematical foundation the physical relationship of these properties to the underlying networks of contacts and forces between particles. The suspensions will be described via simulations, which have the potential to generate vast amounts of data due to large particle numbers in time-dependent ensemble calculations. These data will be analyzed using tools based on persistent homology (PH) and k-core analysis (KCA). These methods allow for enormous data reduction and significant enhancement of physical understanding based on elucidating essential structural measures by the two network theoretical approaches. From a mathematical perspective, the coupled study of PH and KCA, one based upon physical cluster classification by connectivity and one based on well-defined metrics of the overall network structure, will deepen our understanding of both methods. The project will be carried out in collaboration with the materials science group at CCNY and the theoretical group at the U. Oklahoma. The figure shows the spontaneously formed interaction networks in sheared suspensions.





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