Abstract

Intracellular transport of cargoes, such as organelles, are enabled by nano-scale bio-mechanical agents called 'motor proteins', which attach to the cargo and transport it to their destination by 'walking' over filaments. The motors carry cargoes against load forces that are less than their characteristic 'stalling force'. Often transport is mediated by teams of motors, possibly of the same or different types. We develop a semi-analytical method to analyze the emergent transport properties of motor ensembles, by investigating the relative arrangements of motors while carrying a cargo. Study reveals that the relative configurations approach a unique steady state distribution, enforcing the robustness of the motor-cargo assembly. As the load on the cargo increases, motors tend to cluster together. Under high loads, akin to sudden obstacles, motors assume configurations that favor immediate cargo translocation when the load eventually subsides. Furthermore, participation by motors with varying stall forces reveals surprising results. Results indicate that a minority of motors with altered stall forces can determine average run-length and velocity of the cargo. Such mutations are related to neurological disorders, providing a potential insight into the onset of neuro-degeneration.