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Stochastic Movement of Multiple Motor Transported Cargo
DAVID ANDO, AJAY GOPINATHAN, JING XU, UC Merced — Experimental observations of cargo position during transport by multiple motors are determined by several coupled stochastic processes. During collective transport, each motor can transition between multiple kinetic states, with the state of each motor influencing the states of the others via mechanical coupling through a common cargo. We measured the motion of a micron sized bead as it is transported by two kinesin motors along a single microtubule track, focusing on cargo displacements which are both axial and transverse to the microtubule. We model the effects of inter-motor interference and the state of each motor throughout time, and back out motor properties using a systematic comparison of experimental observations with simulated model traces over a wide parameter space. Our model captures a surface-associated mode of kinesin, which is only accessible via inter-motor interference in groups, in which kinesin diffuses along the microtubule surface and rapidly "hops" between protofilaments without dissociating from the microtubule. This enhances local exploration of the microtubule surface, possibly enabling cellular cargos to overcome macromolecular crowding and to navigate obstacles along micro- tubule tracks without sacrificing overall travel distance.

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