BMC Neuroscience

Poster presentation

Open Access

Directed intermittent search model of microtubule cargo transport

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from Eighteenth Annual Computational Neuroscience Meeting: CNS*2009
Berlin, Germany. 18–23 July 2009

Published: 13 July 2009

BMC Neuroscience 2009, **10**(Suppl 1):P24 doi:10.1186/1471-2202-10-S1-P24

This abstract is available from: http://www.biomedcentral.com/1471-2202/10/S1/P24

Introduction

Microtubule motor driven transport has been implicated in many critical processes in neurons. Examples include mRNA transport in dendrites and mitochondria transport in axons. We present a model of microtubule cargo transport that builds upon previous models by accounting for delivery of the cargo to the correct target. Using random search theory [1], we derive equations for the probability that a motor driven cargo moving along a one-dimensional track will find its target. We also derive equations for the average time to find the target, called the mean first passage time or mfpt. We then utilize a model reduction to approximate the governing system of hyperbolic master equations to a standard Fokker-Plank equation. The accuracy of our reduction can be verified by comparison to Monte-Carlo simulations. Using this reduction, we can consider a detailed biophysical model of bidirectional motor transport, known at the tug-of-war model, within the random search model. We conclude by proposing a model for ATP dependent transitions between search-oriented behavior and directed-transport-oriented behavior.

References

1. Bressloff PC, Newby J: **Directed intermittent search for hidden targets.** *New J Phys* in press.