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The Dynamics of Vesicles Driven through Closed Constrictions by Molecular Motors YOUNGMIN PARK, THOMAS FAI, Brandeis University — Dendritic spines are postsynaptic processes that often appear in excitatory synaptic connections of principle neurons throughout the brain. Normal function depends on regular replenishment of various membrane proteins, which are transported on vesicles that squeeze through the spine constriction. In the present study, we explore the dynamics of that emerge in a reduced model of vesicle transport. The model predicts vesicle movement given motor transport parameters such as the ratio of competing motor forces and constriction geometry. We find that for moderately equal motor ratios and moderate constrictions, the movement may be bidirectional, and velocities gain or lose stability through sets of saddle-node bifurcations. For sufficiently tight constrictions, stable velocities vanish through a cusp bifurcation, resulting in one globally stable velocity. We explore the effects of noise on this system, and establish preliminary conditions for general force-velocity curves for vesicle trafficking.

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