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Probability Distributions of Active Sensing

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Probability Distributions of Active Sensing

Fish use active sensing to constantly re-evaluate their position in space. The weakly electric glass knifefish *Eigenmannia virescens* incorporates an electric field as one of its active sensing mechanisms. The motion of the knifefish in a stationary refuge is captured using high-resolution motion tracking and illustrates many small amplitude oscillations inside the refuge coupled with high amplitude "jumps". We show that this active sensing mechanism is not reflected by a Gaussian distribution of the velocities. Instead, we show that the velocities are more accurately reflected by a mixture of Gaussians because of the number of high amplitude jumps in the tails of the velocity distribution. The experimental position measurements were taken in both the light and the dark showing more frequent bursts of faster movement in the dark, where presumably the fish are relying more on their electric sensor than their vision. Computational models of active state estimation with noise injected into the system based on threshold triggers exhibit velocity distributions that resemble those of the experimental data, more so than with pure noise or zero noise inputs. Similar distributions have been observed in gaze control in mice and ear movement in bats.

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