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Proximal-to-distal Molecular Motor Asymmetry Controls Flagellar Wave Reversal[1] FENG LING, YI MAN, EVA KANSO, Univ of Southern California — Beating eukaryotic flagella exhibit a wide range of waveforms despite their conserved '9+2' axonemal structure. While most spermatozoa propel head-first using base-to-tip flagellar waves, other organisms like the parasite Trypanosomes primarily move with forward-pointing flagella using tip-to-base flagellar waves. In addition, certain Trypanosomes can actively reverse the direction of propagation of their flagellar wave for fast reorientation. Although experiments on genetic mutants linked reversed beating to structural asymmetries of dynein motors along the flagellum length, the underlying physical mechanism of the active switching is not fully understood. By introducing proximal-to-distal asymmetry to molecular motor activities of a known geometric feedback model, we show such flagellar wave reversals are only possible if the dominant feedback mechanism is based on sliding-control. We conclude by commenting on the implications of our results to flagellar waveforms in other organisms, as well as the feasibility of a universal geometric feedback mechanism for explaining the diverse waveforms in cilia oscillations.

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