

POSTER PRESENTATION

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# A dynamical systems analysis of afferent control in a neuro-mechanical model of locomotion

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Existing models have represented a locomotor system as a rhythmic driver, or central pattern generator (CPG), coupled to a mechanical limb, with feedback closing the loop. Our collaborators have developed a version of this model in which the CPG establishes a rhythm when activating drive is present, and feedback from ground strike helps control phase switching and rhythm stabilization. Spinal cord injury can be simulated through termination of drive, which ceases the rhythm. We derive and analyze a reduced representation of this model, which will elucidate general principles of phase and frequency control in normal locomotion. We aim to understand how the presence of feedback provides stable locomotion, allowing oscillations at a wider range of drive values to the CPG (specifically at lower values) than the CPG without afferent feedback. Furthermore, increasing the drive intensity to the CPG increases locomotor speed by reducing only the duration of the stance phase, at a relatively constant duration of swing phase [1]. This phase asymmetry has been seen in normal locomotion in cats, rats, and humans, but is not observed in the locomotor model without feedback, so we analyze how feedback facilitates this asymmetry. We will also reveal sufficient conditions for recovering rhythmicity in the injured state - how in the absence of drive, increased feedback can restore locomotion and contribute to locomotor stability, with an analysis of differences in rhythm robustness before and after loss of drive.

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