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Geometric Mechanics for Continuous Swimmers on Granular Material JIN DAI, Carnegie Mellon Univ, HOSSEIN FARAJI, Oregon State University, PERRIN SCHIEBEL, Georgia Institute of Technology, CHAOHUI GONG, MATTHEW TRAVERS, Carnegie Mellon Univ, ROSS HATTON, Oregon State University, DANIEL GOLDMAN, Georgia Institute of Technology, HOWIE CHOSET, Carnegie Mellon Univ, THE BIOROBOTICS LAB COLLABORATION, LABORATORY FOR ROBOTICS AND APPLIED MECHANICS (LRAM) COLLABORATION, COMPLEX RHEOLOGY AND BIOMECHANICS LAB COLLABORATION — Animal experiments have shown that *Chionactis occipitalis* (N=10) effectively undulating on granular substrates exhibits a particular set of waveforms which can be approximated by a sinusoidal variation in curvature, i.e., a serpenoid wave. Furthermore, all snakes tested used a narrow subset of all available waveform parameters, measured as the relative curvature equal to 5.00.3, and number of waves on the body equal to1.80.1. We hypothesize that the serpenoid wave of a particular choice of parameters offers distinct benefit for locomotion on granular material. To test this hypothesis, we used a physical model (snake robot) to empirically explore the space of serpenoid motions, which is linearly spanned with two independent continuous serpenoid basis functions. The empirically derived height function map, which is a geometric mechanics tool for analyzing movements of cyclic gaits, showed that displacement per gait cycle increases with amplitude at small amplitudes, but reaches a peak value of 0.55 body-lengths at relative curvature equal to 6.0. This work signifies that with shape basis functions, geometric mechanics tools can be extended for continuous swimmers.

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