Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Gait Costs and Geodesic Curvature HOSSEIN FARAJI, ROSS HATTON, Oregon State Univ — In a drag-dominated environment, the effort required to change shape can be modeled as the pathlength of the trajectory through the shape space, with a Riemannian distance metric induced by the energy dissipated through friction. For an inertia-dominated system, the Riemannian metric is induced by the inertia matrix for the system, and effort corresponds to accelerations that change the system's momentum. Optimizing costs of trajectories has two fundamental cases: The first case is finding a minimum cost trajectory between two points, where the shortest and least curving trajectory is a geodesic of the drag or inertial tensor. The second case is minimizing the cost to connect three or more waypoints. For a drag-based system, this trajectory is a collection of geodesic segments, but for an inertial system, it is instead a geodesic spline that avoids sharp corners in the path. A geodesic spline with constant speed minimizes geodesic curvature squared. With non-constant speed, it minimizes squared magnitude of the acceleration, comprising tangential acceleration and speed-weighted curvature). We apply a variational approach to find geodesic splines to generate optimal gaits on serpenoid and three-link inertial snakes, and optimal swinging trajectories for legged robots.

Ross Hatton
Oregon State Univ

Date submitted: 11 Nov 2016 Electronic form version 1.4