

Contact Localization using Velocity Constraints

Sean J. Wang¹, Ankit Bhatia², Matt T. Mason², and Aaron M. Johnson¹

Motivation

Robots operating in unstructured environments must localize contact to detect and recover from failure. For example, the figure below shows a Minitaur robot that must localize where it has unexpectedly contacted the stair's edge so that it can properly step over it.



Methods

The robot can identify candidate contact points that satisfy the following constraints:

- 1) The contact point's velocity must be tangent to the robot's surface. Equivalently, the line joining the contact point to the center of rotation is co-linear with the surface normal.
- 2) The initial contact point must have positive outward velocity before impact.



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1Department of Mechanical Engineering, Carnegie Mellon University, Pittsburgh, PA, USA 2Robotics Institute, Carnegie Mellon University, Pittsburgh, PA, USA



DDHand Experiment

One of the robot's fingers was swept over a curved surface. During the sweep, contact location was estimated to track the edge of the object (shown below).



In cases with more than one possible contact point, a particle filter can be used to reduce uncertainty of the contact location. Preliminary particle filtering results are shown below.



Carnegie Mellon University Robomechanics Lab







