Research done in IHMC

Gabriel Garcia

1-Step-Capturability:

Found full Capture Region using current foot LIP and Stepping foot VHIP on flat terrain.

Minimum slope for Capturability in 3D VHIP V. COP

3D VHIP V. COP Flat Terrain discartment (Foot over ballistic trajectory)

3D VHIP V. COP 0-Step Capturability Necessary condition. (CoP Region below ballistic trajectory)

For no restrictions on maximum Force or slipping.

Region for LIP with “Fixed CoP”.

Increased region for LIP with Variable CoP.

(Maximum force and friction can be solved with Convex Optimization)

*“Capturability-Based Analysis and Control of Dynamic Scrambling with Multiple Contacts on Rough Terrain”*

Region for LIP with “Fixed CoP” through Variable CoP.

*“A Computational Approach for Push Recovery in case of Multiple Noncoplanar Contacts”*

LIP Control Strategy: Minimize instantaneously Kinetic Energy with iterations.

Shows that Polygonal Planar contact surface are equivalent to point contact with augmented restrictions on wrench vectors.

<https://ieeexplore.ieee.org/abstract/document/6094874>

*“Zero Step Capturability for Legged Robots in Multicontact”*

Still LIP: Transforms system into a 1-D Problem. Force is opposite to speed (Not always feasible).

<https://ieeexplore.ieee.org/document/8383993>

*“Capturability-based Pattern Generation for Walking with Variable Height”*

VHIP + Trajectory Optimization for 0-Capturability and 1-Capturability. Considers stiffness and CoP given in time.

<https://arxiv.org/abs/1801.07022>

0-Step-Capturability w. Multicontact

Non-equivalence of Variable CoP and Fixed CoP

Projection to a “Virtual Plane”

Additional:

Found Region of attraction for the 0-Step Capturability of the 2D FWIP with maximum torque and angular velocity.

“Impacts” included in 2D FWIP with maximum torque, angular velocity and angle.

Full Capture Region using current foot LIP and Stepping foot FWIP on flat terrain.