1 — Linear MPC for Multi-contact Walking

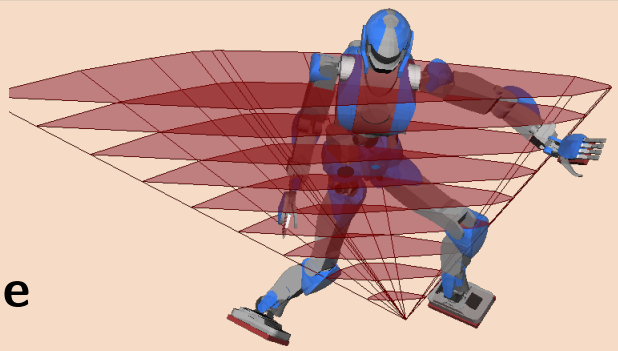
Caron & Kheddar — Humanoids 2016

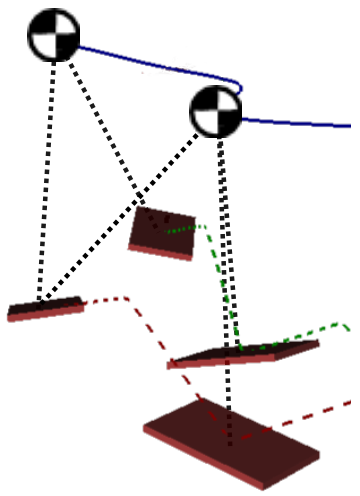
Contact stability

Polyhedral projection

of the Contact Wrench Cone

yields a **COM acceleration cone**





Predictive

$$\boldsymbol{x}(k+1) = \boldsymbol{A}\boldsymbol{x}(k) + \boldsymbol{B}\boldsymbol{u}(k)$$

$\boldsymbol{x}(k)$: COM position and velocity $\quad$ $\boldsymbol{u}(k)$: COM acceleration

Contact stability constraints are **bilinear**: $\boldsymbol{x}(k)^\top \boldsymbol{C}\boldsymbol{u}(k) + \boldsymbol{d}\boldsymbol{u}(k) + \boldsymbol{e} \leq \boldsymbol{0}$

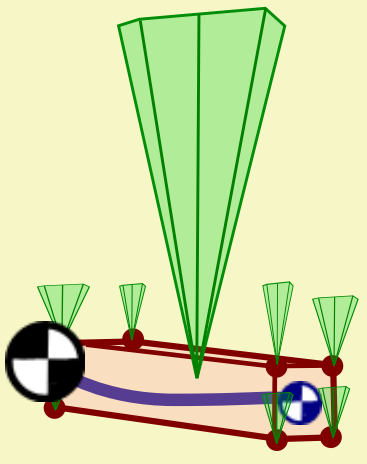
Linear

General method to linearize bilinear inequalities:

– Bound one side of the bilinear inequality

– Compute its linear dual cone by polyhedral intersection

The MPC problem becomes a **Quadratic Program** (QP)



Limitation

Need to specify **step timings** manually: should be discovered from terrain

https://github.com/stephane-caron/mc-walking-lmpc/