HUMBOLDT-UNIVERSITÄT ZU BERLIN

ZMP based Walking

Overview and our experience

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What is ZMP?

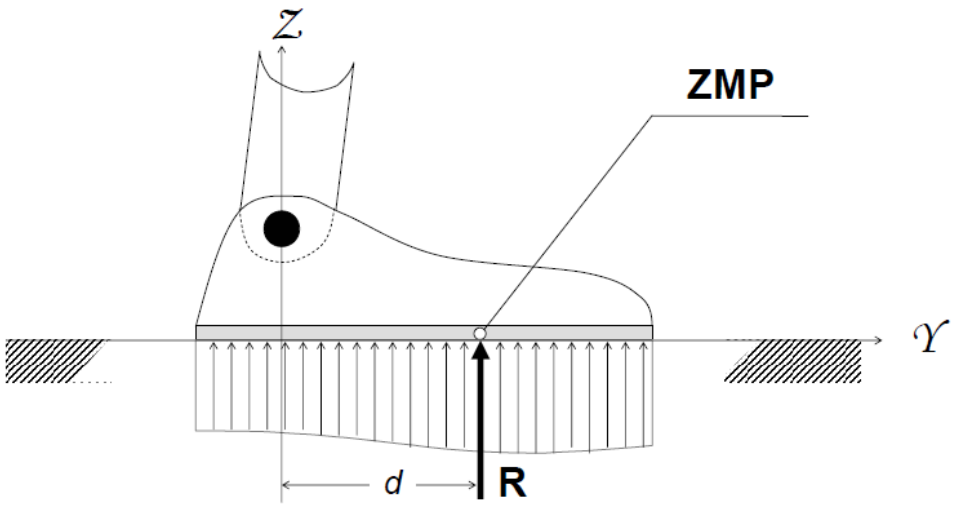
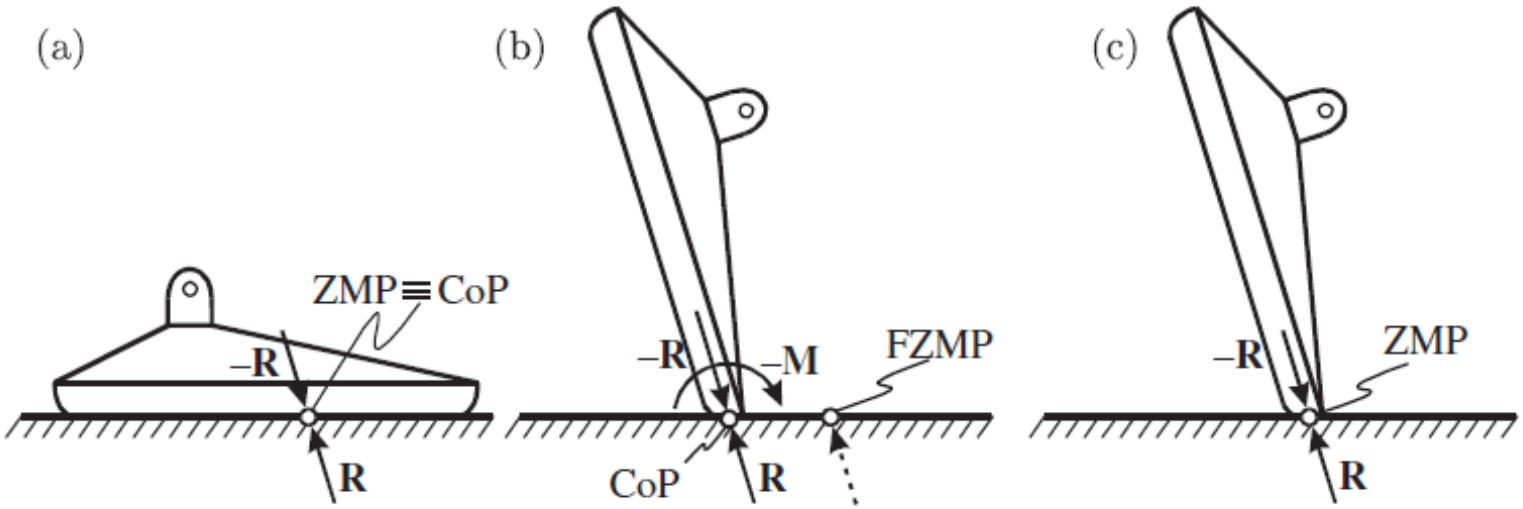
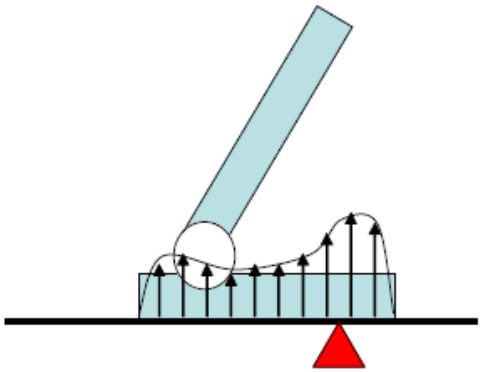


Figure: The distributed floor reaction force can be replaced by a single force acts on Zero-moment Point (ZMP).

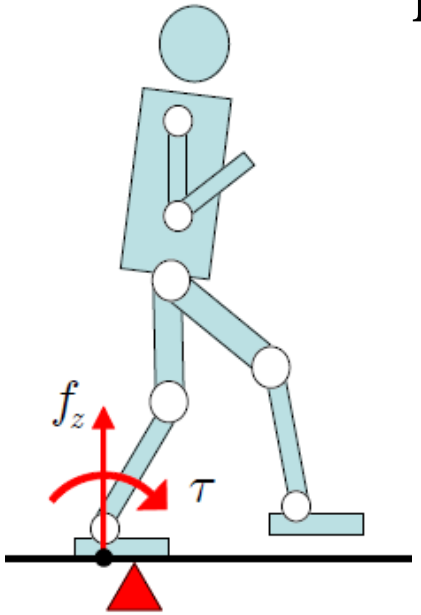
What is ZMP?



Ways to measure ZMP



$$p = \frac{\int x f(x) dx}{\int f(x) dx}$$

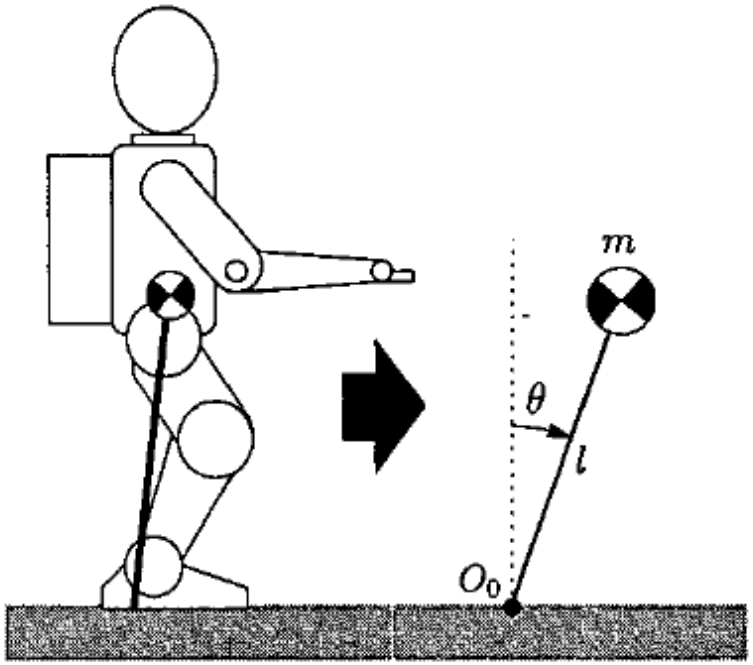


Inverse Dynamics:

$$\begin{bmatrix} f_z \\ \tau \end{bmatrix} = InvDyn(x, \dot{x}, \ddot{x})$$

$$p = -\frac{\tau}{f_z}$$

Simplification



$$p = x - \frac{z\ddot{x}}{\ddot{z} + g}$$

Figure: One mass model

Simplification

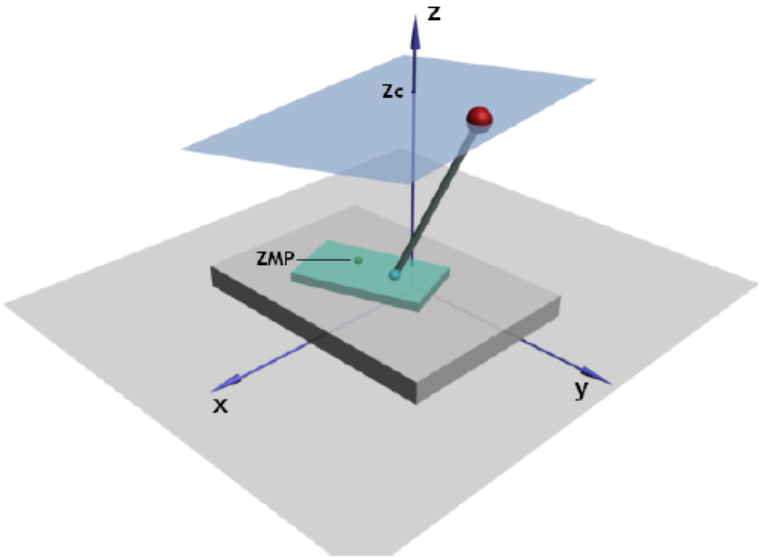
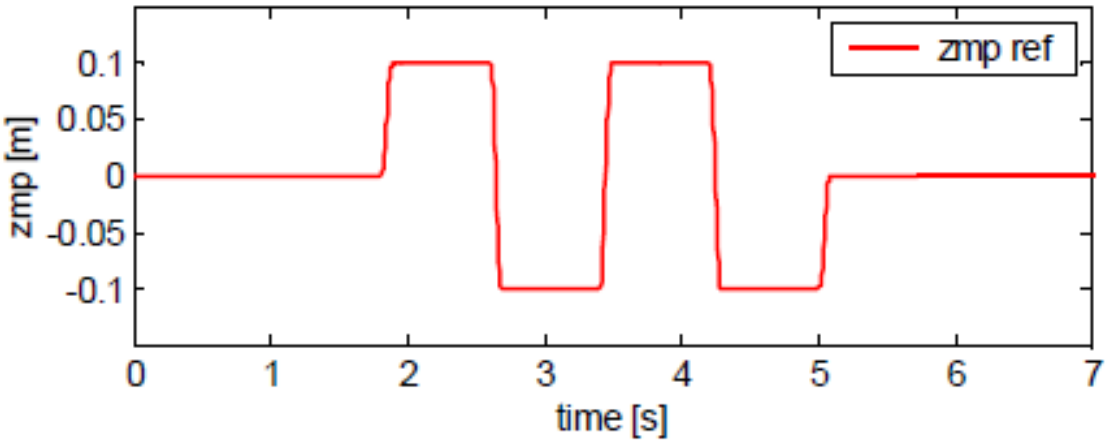


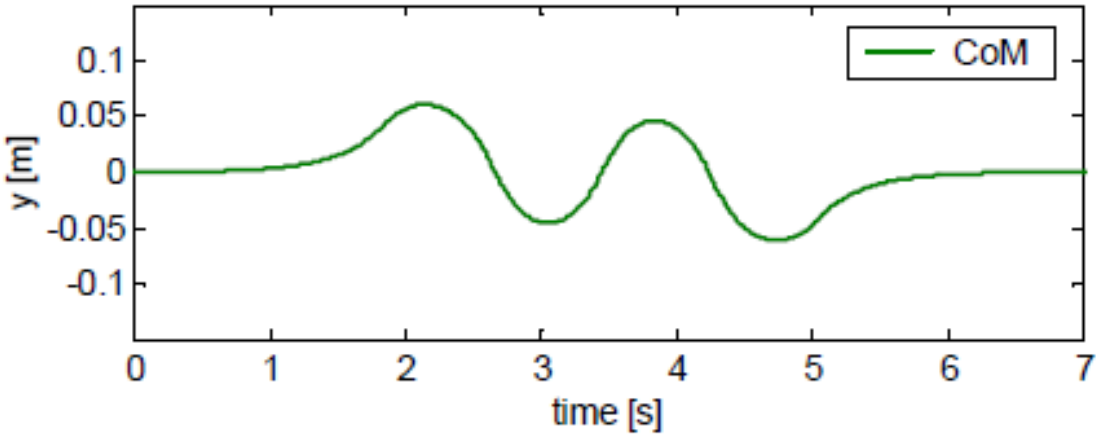
Figure: Linear inverted pendulum

$$p = x - \frac{z\ddot{x}}{g}$$

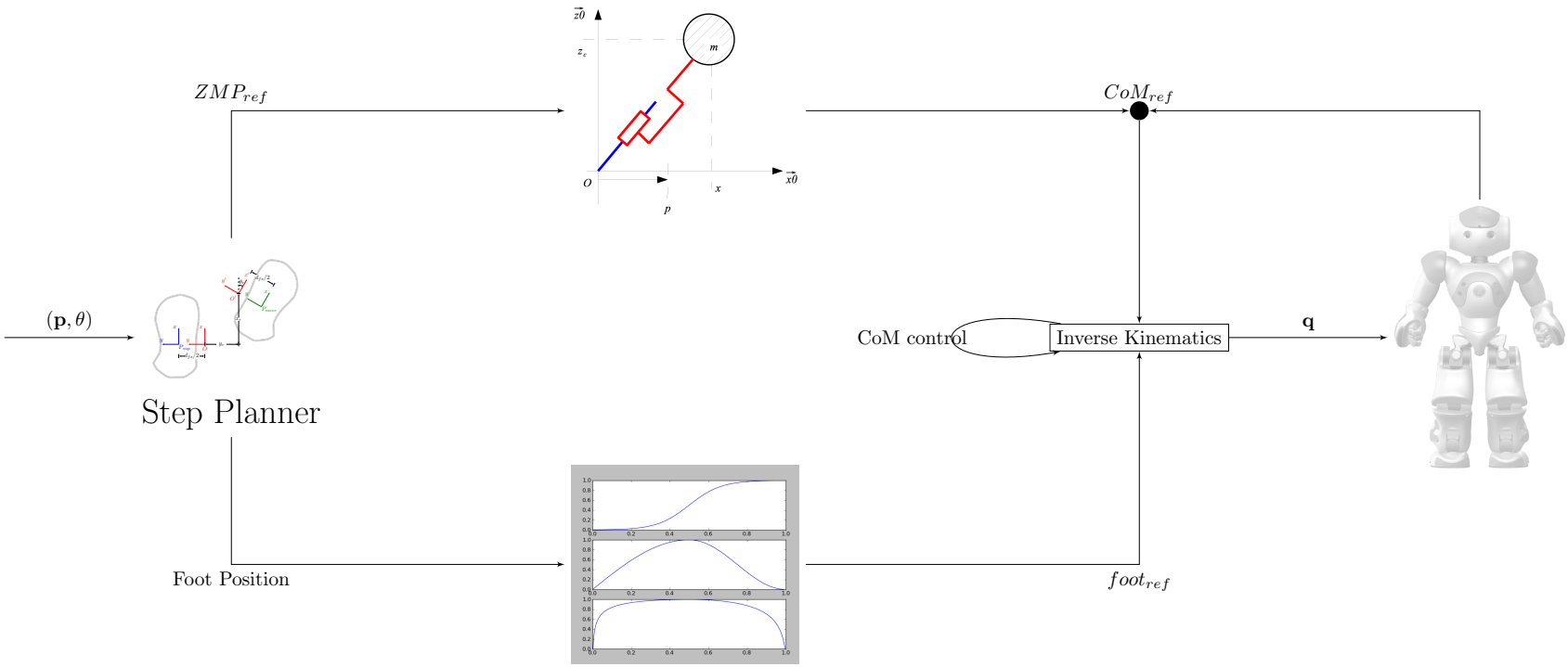
ZMP based pattern generation



$$p = x - \frac{z\ddot{x}}{g}$$



Closed loop Walk



Problem and Future work

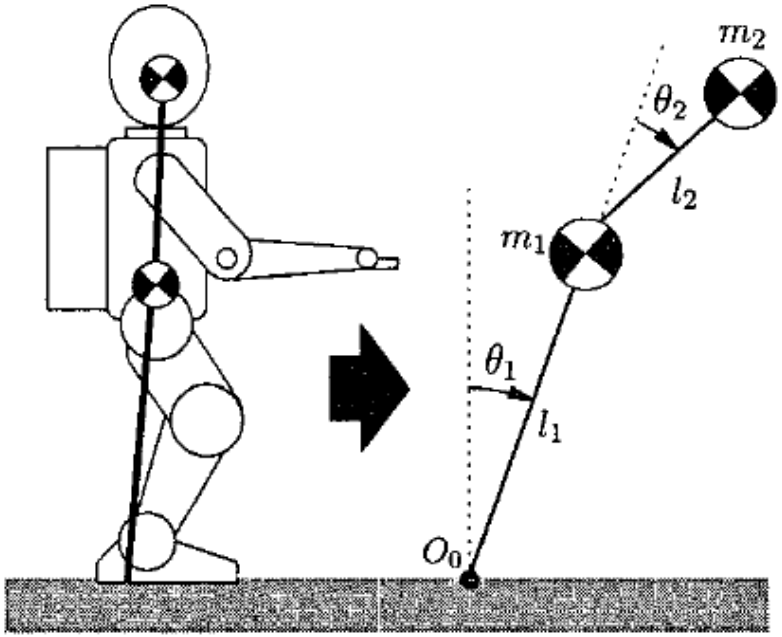


Figure: Two masses model

- low level control (un-smooth movement)
- stabilizer
- foot compensation
- better model