Control of a Walking Biped Using a Combination of Simple Policies

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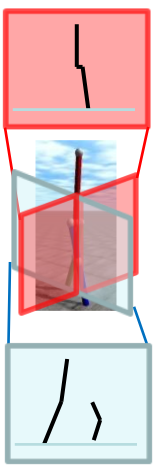
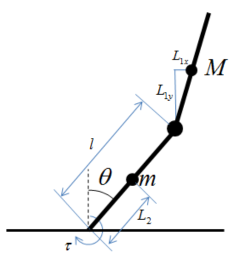
We simplify a high-dimensional controls task by dividing it into multiple lower dimensional problems.



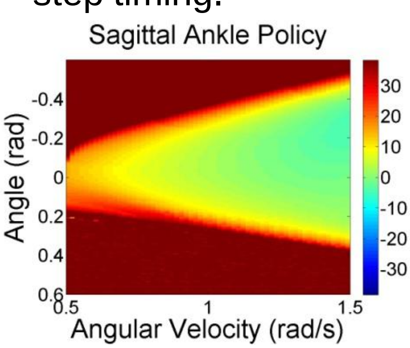
Divide the full system:
- Coronal plane
- Sagittal stance leg/torso
- Sagittal swing leg



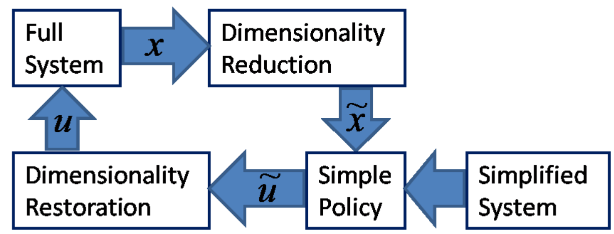
One Degree-of-Freedom sagittal model: A constrained 2-link inverted pendulum

$$L(x,u) = 6000(v - v_{des})^2 + \tau_1^2 + 0.02F_{x,grf}^2$$

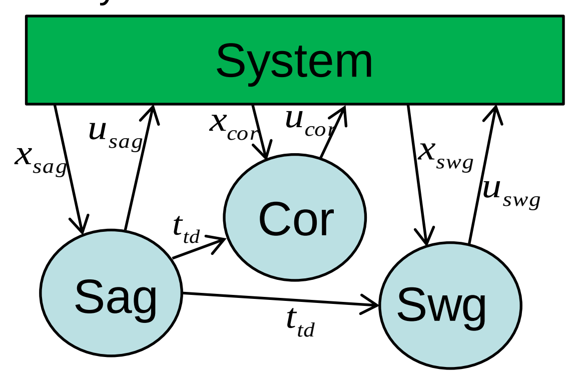
- Use dynamic programming to generate policies for the simple systems
- Simultaneously and globally optimize body motion, foot placement, and step timing.



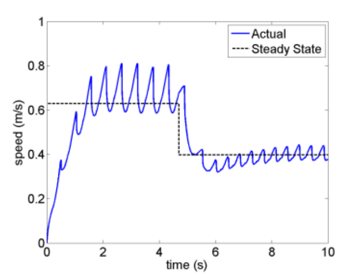
Policy defined for a large region of state space.

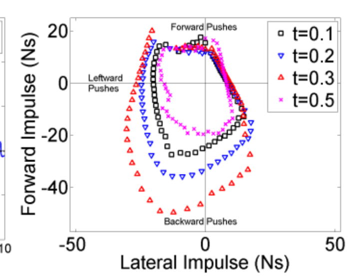


Map the simple systems onto the full system.



Coordinate the policies through time until touchdown.





Simulation Results: Walking speed, and robustness to perturbations.

Conclusion: We can control a complicated system by combining simple policies.

Future Work: Apply this technique to the Sarcos humanoid robot.

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