Gait Planning for Walk & Roll Robot

Katie Strausser

ME 236 Project Presentation

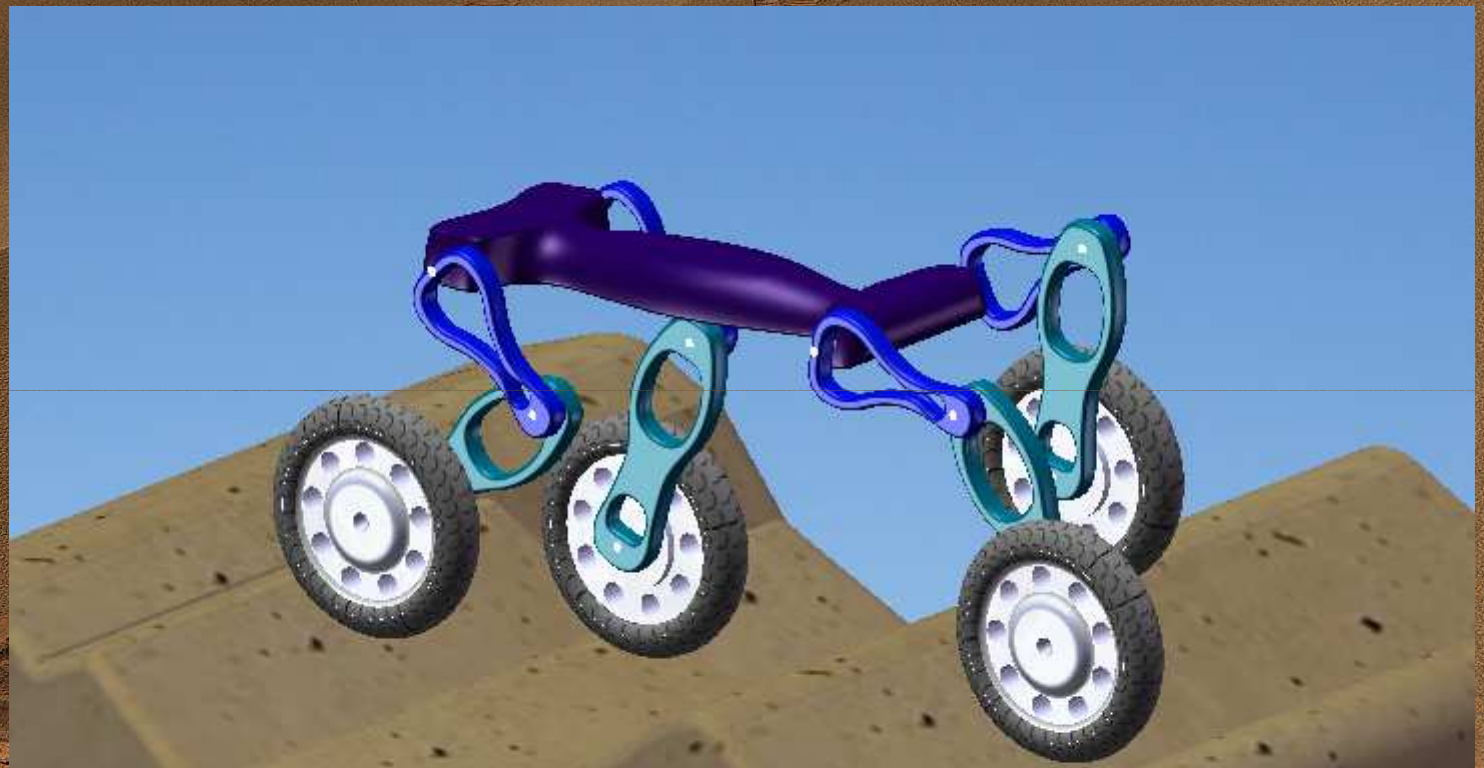
December 6, 2007

UC Berkeley

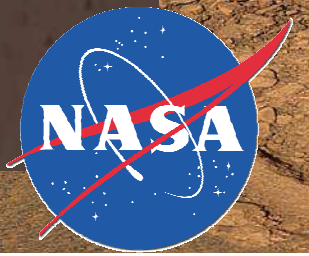
Outline

- Walk and Roll Robot
- Modeling
- Reachability using the Hamilton Jacobi Equation
- Conclusion & Future Work

Walk & Roll Robot

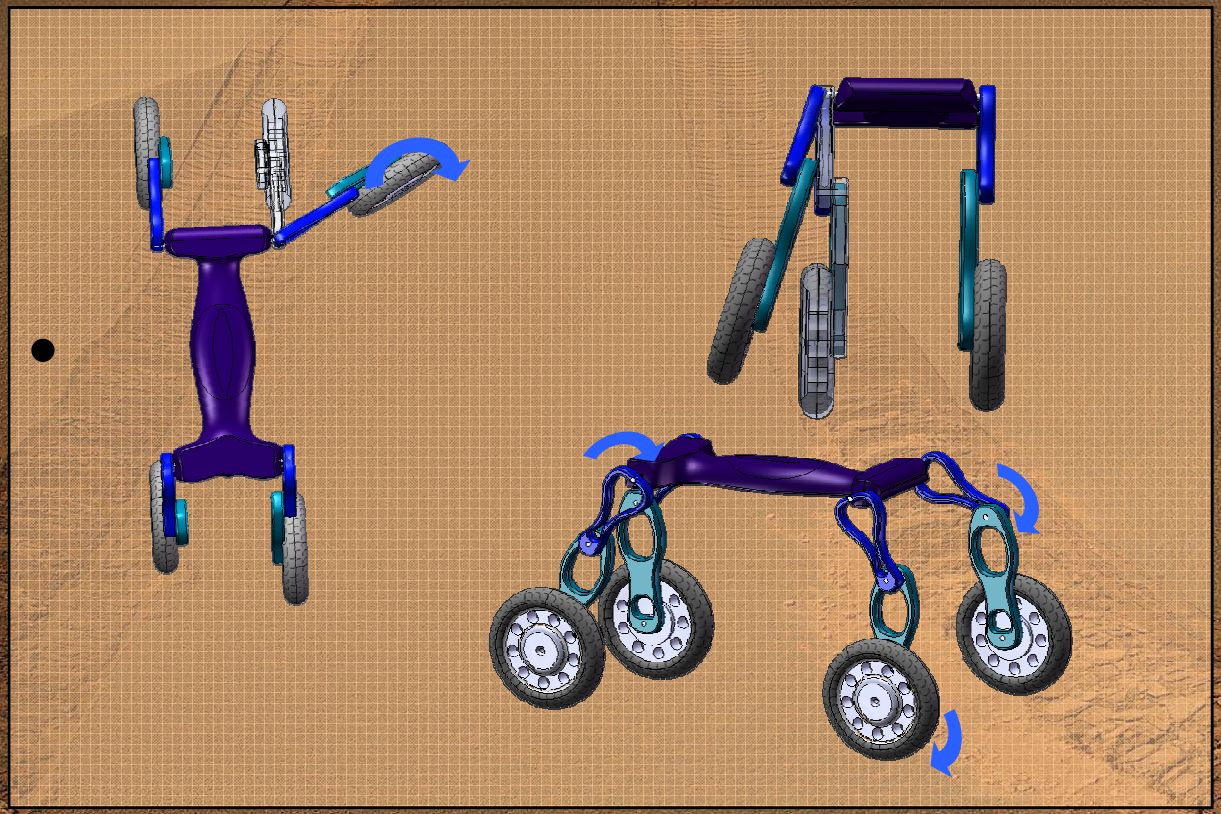


NASA Robotics Academy 2007: Vranish (PI),
Strausser (TL), Punnoose, Wilson, Parikh



Source image NASA/JPL/Caltech/Cornell. Enhancement Aldo Erdic www.marsgeo.com

Walk & Roll Robot



NASA Robotics Academy 2007: Vranish (PI), Strausser (TL), Punnoose, Wilson, Parikh

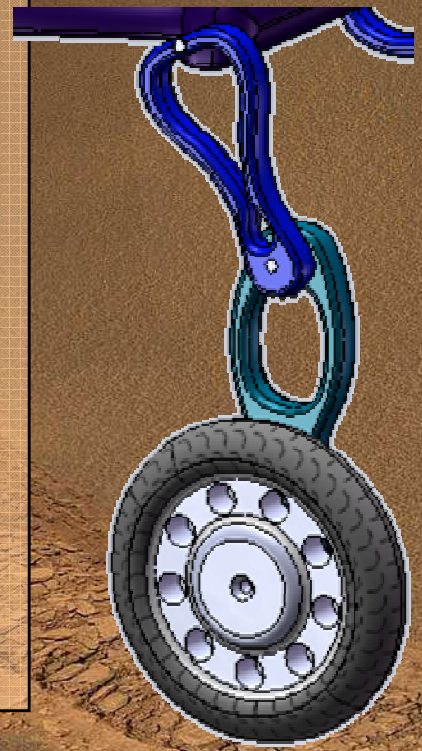
Source image NASA/JPL/Caltech/Cornell. Enhancement Aldo Erdic www.marsgeo.com

Modeling

- Kinematics
  - Easy to compute
  - Fits into Hamilton Jacobi
  - Doesn’t adequately describe the motion of the system

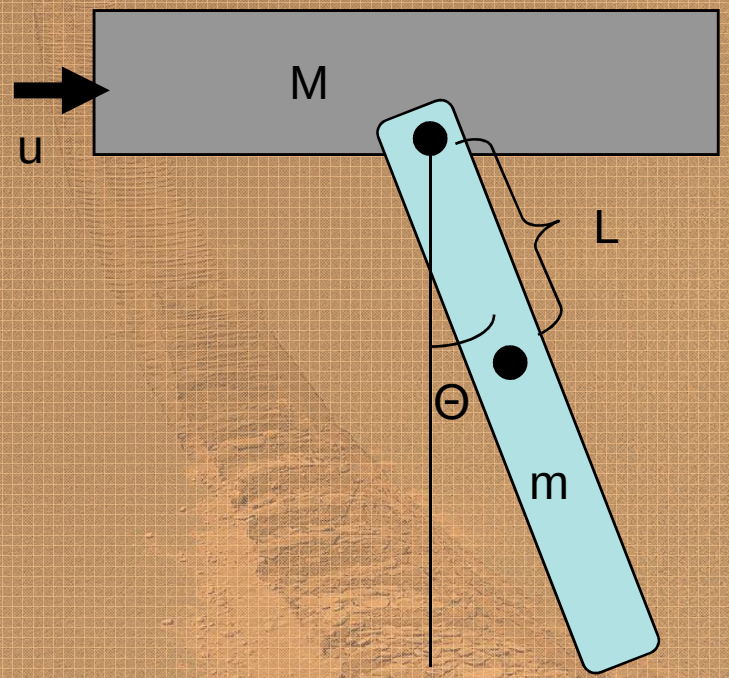
Modeling

- Dynamics
  - Too many Degrees of Freedom (DOFs)
  - Simplify to 1 leg using assumptions of periodicity of gait
  - Eliminate knee joint



Modeling

- Parameters:
  - M = mass of body
  - m = mass of leg
  - (uniform along leg)
  - Θ = angle of leg
  - (wrt vertical)
  - g = gravity
  - u = input force
  - (disturbance)
  - L = length of each half of leg



Modeling

$$(M+m)\ddot{x} + ml\ddot{\theta} = u \tag{4}$$

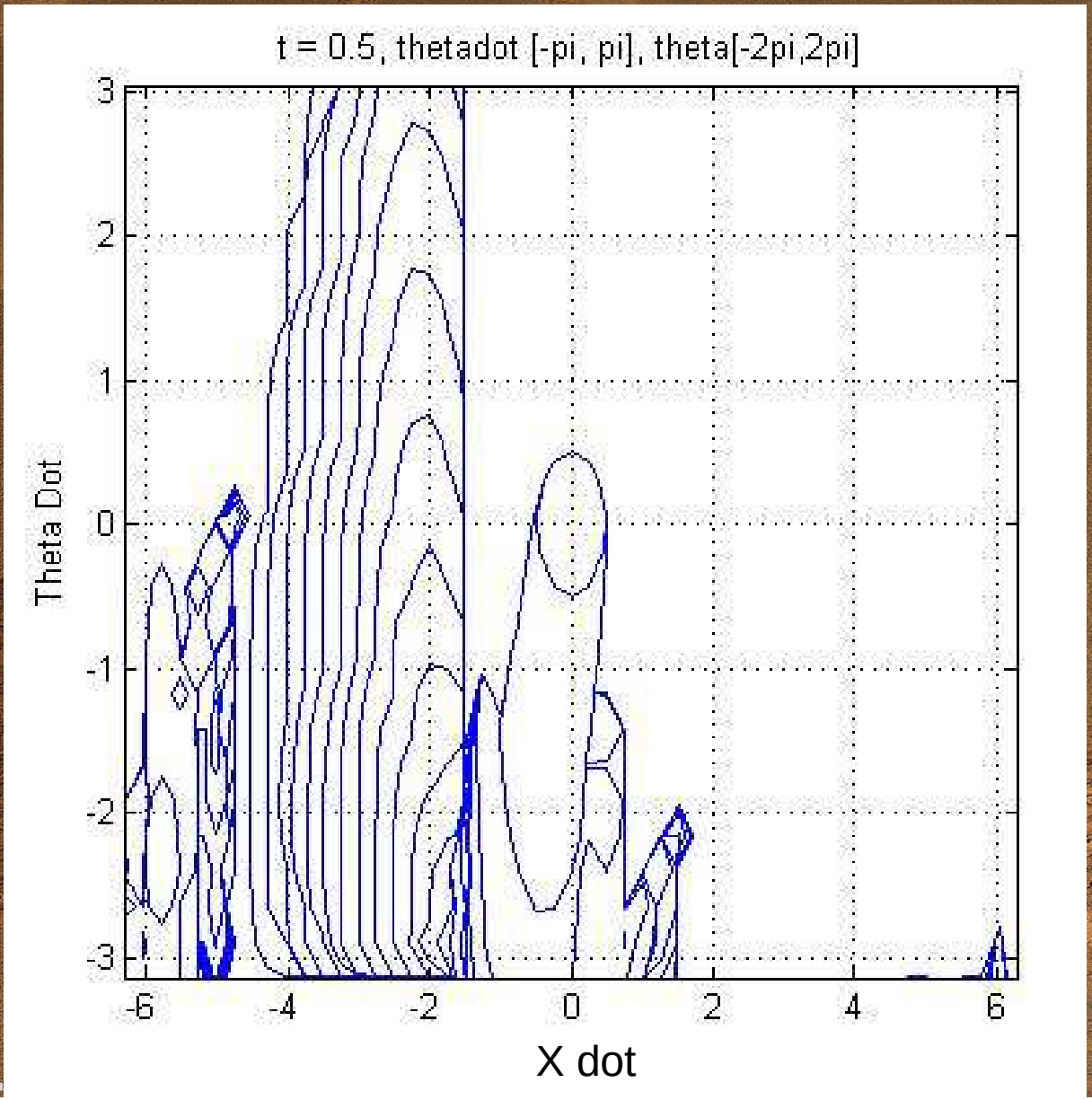
$$ml^2\ddot{\theta} + ml\ddot{x} = mglcos(\theta) \tag{5}$$

$$H = p_1(\frac{mg+2Mg)}{1-(M+m)}\theta) + p_2(\frac{-m(M+m)+2Mg(m+M)\theta}{(2m+M)m} + p_1(\frac{-u}{1-(M+m)} + p_2(\frac{u}{(2m+M)l}) \tag{6}$$

$$\frac{\partial H}{\partial p_1} = \frac{mg+2Mg}{1-(M+m)}\theta \tag{7}$$

$$\frac{\partial H}{\partial p_2} = \frac{-(M+m)}{2m+M} - \frac{2Mg(m+M)}{m(M+2m)}\theta \tag{8}$$

Level Set Toolbox



Conclusions & Future Work

- Model gives values for theta, thetadot
  - Must convert to values of x to find reachable points
- Plot contour
  - Determine efficient path

Questions?

Source image NASA/JPL/Caltech/Cornell. Enhancement Aldo Erdic www.marsgeo.com