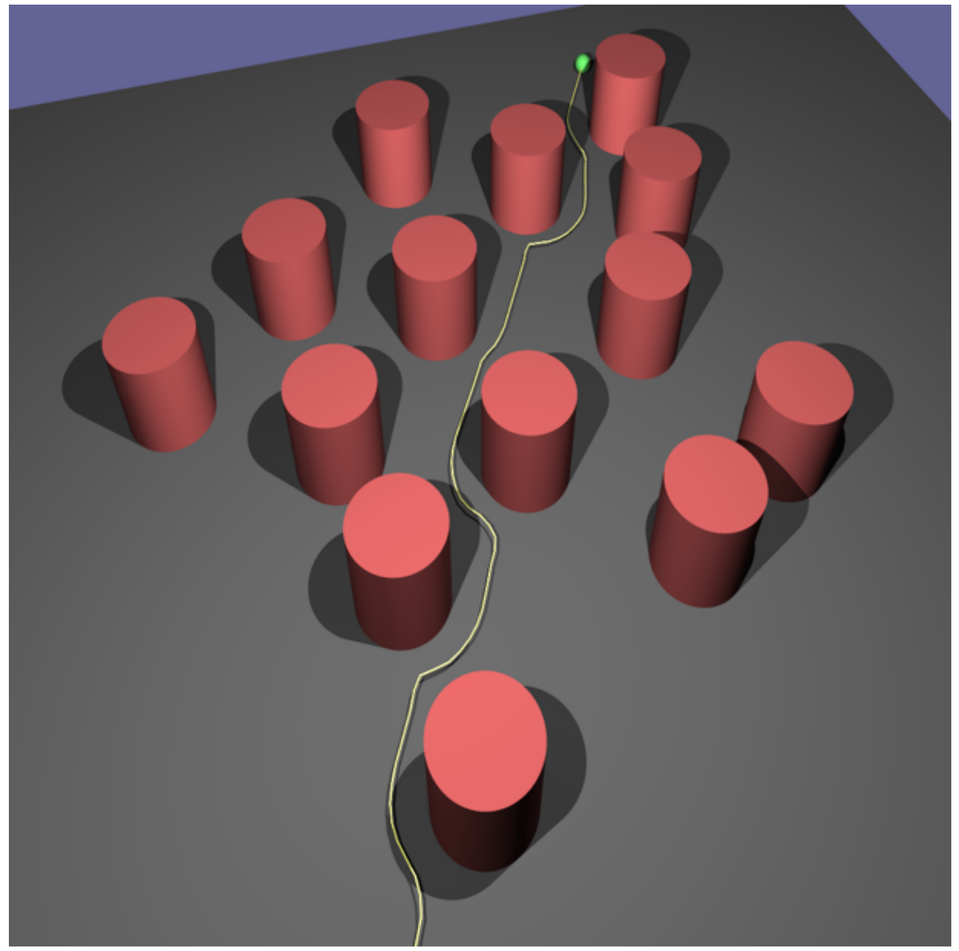
Energy Minimization for Animation

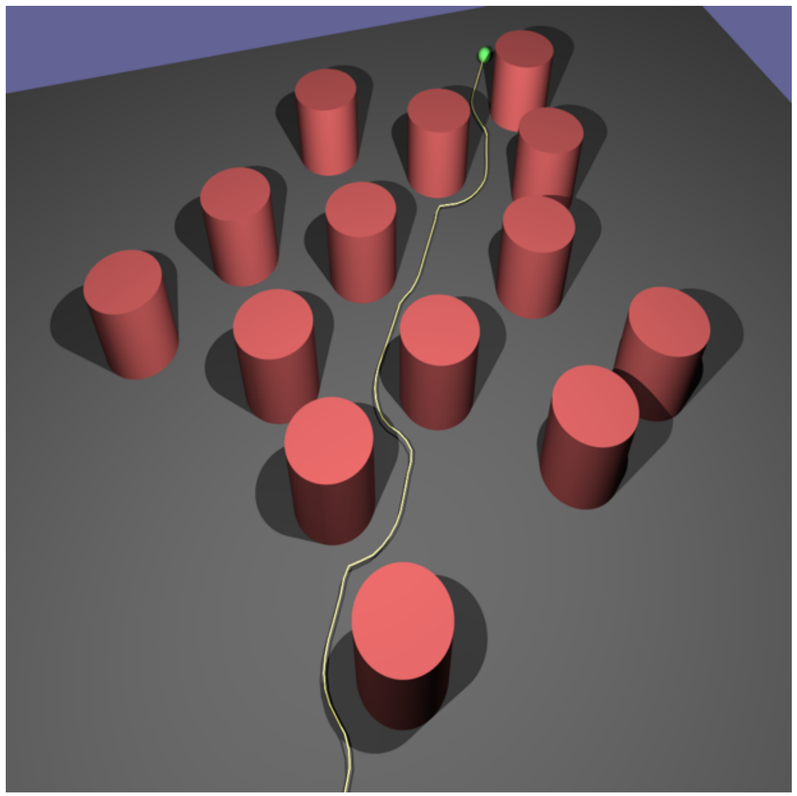
CSE 4280/5280

Animation by minimizing cost functions

- Goal-oriented motion.
- We can add constraints. These constraints change the topography of the cost functions.
- Animation becomes a task of defining a function
- A disadvantage is that animator surrenders control over details to the algorithm.



Example 1



$$C_{\text{PathPlan}}(\mathbf{x}) = \|\mathbf{x} - \mathbf{g}\| + \sum_{i=1}^{n} \mathcal{F}(\|\mathbf{x} - \mathbf{o}_i\|)$$

Where:

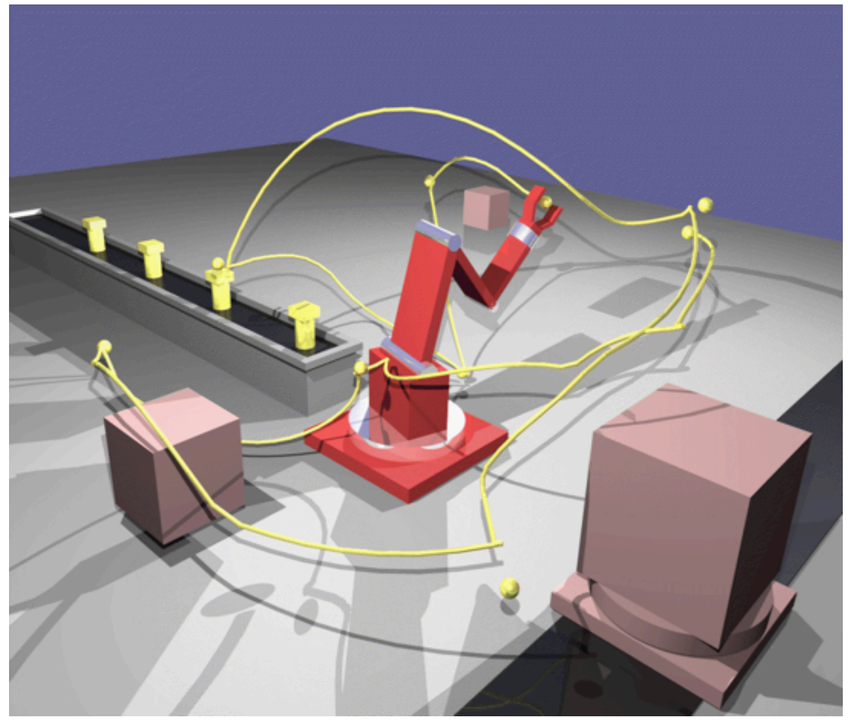
$\mathbf{x}$: Current location of the animated object

$\mathbf{g}$: Goal location

$\mathbf{o}_i$: Location of object i

$\mathcal{F}$: Penalty field for collision avoidance

Example 2



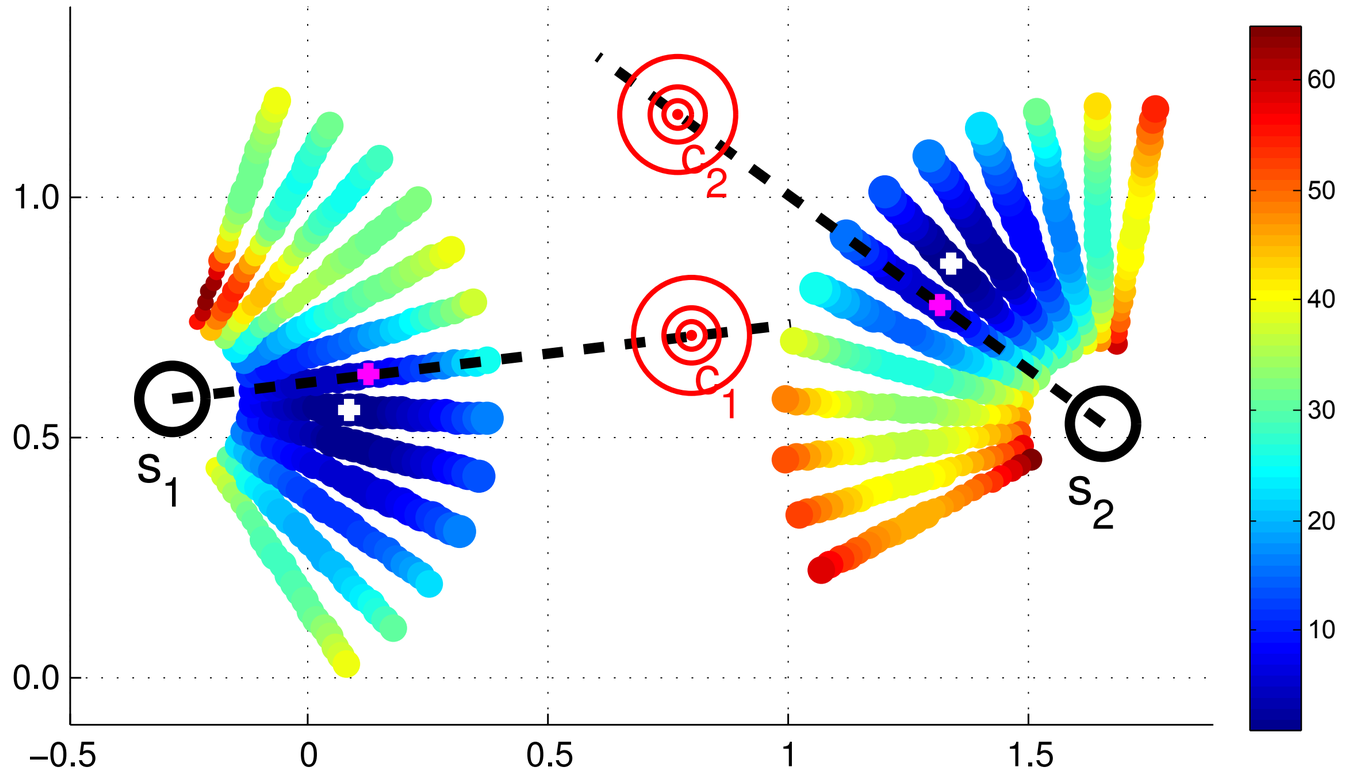
$$C_{\text{Reach}}\left(\phi_0, \phi_1, \phi_2\right) = \left\| P_{\text{tip}}\left(\phi_0, \phi_1, \phi_2\right) - \mathbf{g} \right\| + \sum_{i=1}^{n} \mathcal{F}\left(\left\| P_{\text{tip}}\left(\phi_0, \phi_1, \phi_2\right) - \mathbf{o}_i \right\| \right) + \sum_{i=0}^{2} \text{limit}\left(\phi_j\right).$$

Social-force model

D. Helbing and P. Molnár. Social force model for pedestrian dynamics. *Physical Review E*, 51(5):4282–4286, 1995.

Social-force model

$$d_{ij}^2(t, \tilde{\mathbf{v}}_i) = ||\mathbf{p}_i + t\tilde{\mathbf{v}}_i - \mathbf{p}_j - t\mathbf{v}_j||^2$$



- Colors denote energies for different velocities.
- White dots mark the minima

Reference: http://vision.cse.psu.edu/courses/Tracking/vlpr12/PellegriniNeverWalkAlone.pdf