Motion Planning for Recycling Robotics: Progress Report

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Intro

- We are building a simulated robot to manipulate objects on a conveyor belt
- We were motivated by the desire to improve recycling efficiency

Review: Last Semester's Work

- First we researched the robot dynamics for a SCARA arm.
- Next we formulated our optimization problem:

$$\min \; T$$

$$\text{s.t.} \; \frac{d\tilde{x}(\tau)}{d\tau} = Tf(\tilde{x}(\tau), \tilde{u}(\tau)) \qquad \tau \in [0,1]$$

$$- M \le \tilde{u}_j(\tau) \le M \qquad 1 \le j \le 3$$

$$\tilde{x}(0) = x_0$$

$$\tilde{x}(1) = x_T$$

Outline of current and future work
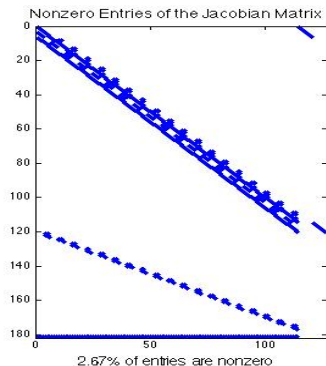
Current work:

- Custom Jacobian
- 3D robot animation

Future work:

- Online optimal path finding
- Temporal goal planning

Custom Jacobian

Reminder: Our dynamics can be written in the following form:

$$b = \frac{x_{i+1} - x_i}{d\tau} - Tf(x_i, u_i) = 0$$

Nonzero Entries of the Jacobian Matrix

2.67% of entries are nonzero

3-D Robot Animation

Here is a video of our current simulation

- A key component is efficiently generating an initial guess
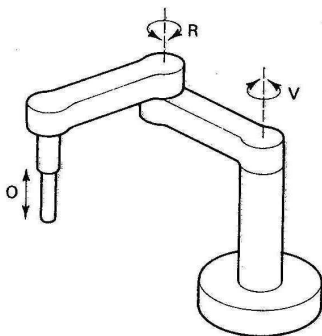- We may consider pre-computing optimal paths

FIGURE 11.8 SCARA body-and-arm assembly (VRO).

Temporal Goal Planning

- Currently, our system finds an optimal path, grabs and moves an object, then repeats.
- With temporal goal planning, we can search several steps in advance for a more globally optimal solution