Artist Robot
With Stroke Imitation

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Outline

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Objectives

Robot imitates hand drawings

- Input: Video with hand drawing
- Online trajectory generation
- Output: 2d graph with different colors on canvas
State Machine

**Stroke generation**

- Standby
  - Load next frame
    - Compare neighboring frames
  - Add to checkpoint queue
    - Generate checkpoint with stroke

**Robot Operation**

- Standby
  - Pop next checkpoint
    - Adjust force/ change color
  - Adjust force
  - Draw (trajectory tracking)
Trajectory Generation
$F = kr$

Difference from two frames
Control Strategies
Open-Loop Force Control + Trajectory Tracking

F = k*r

Open Loop Force Control

Xd += Kf * F
in direction perpendicular to canvas

Operational Space PD control

Inverse Task

Motion Control

Joint Space Null Space Posture Control

Robot & Environment

Forward Kinematics

Gravity, Coriolis Compensation

Simulation

r = F/k
World and Robot Platform
World

Board

Palette

Stroke

pen
Robot Platform

Panda arm + pen

Redis used to transform data:

controller (expected x, y, z, r) -> simulator

simulator (actual force, x, y, z, r) -> controller
Challenge
Challenge

1. Stroke simulation in world:
   ------Create many cylinders on board

2. Steady state error when touch the board
   ------Only decrease depth-direction gain
Video Demo
Art Gallery

Halloween Smile

Name Initials of Members

CS225A

Happy 2021
Future Works

Improve perception module for smoother lines and higher accuracy
Try better force feedback control
Online trajectory tracking and drawing