RETHINKING MOTION CONTROL FOR ROSIE

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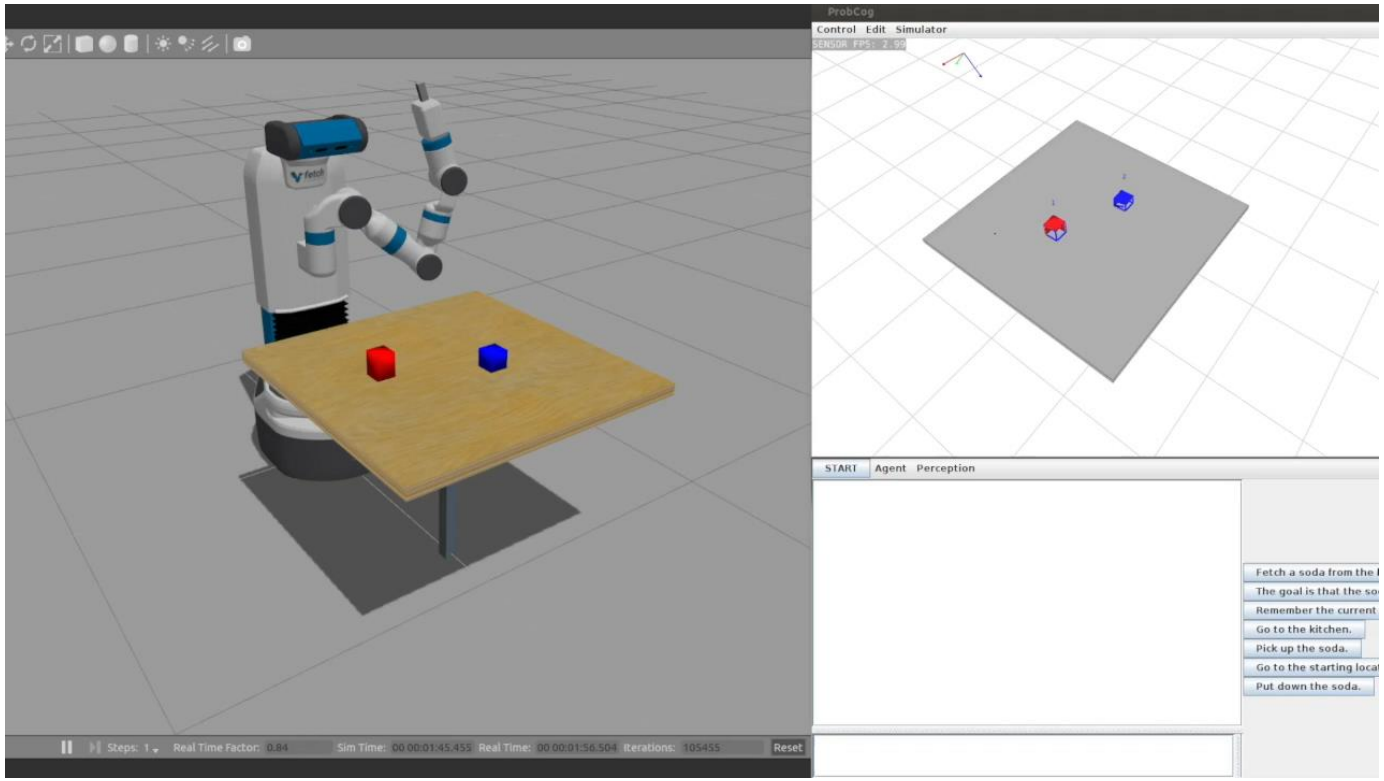
WHAT IS WRONG WITH MOTION CONTROL FOR ROSIE?



WHERE DOES THIS ARTIFACT COME FROM?

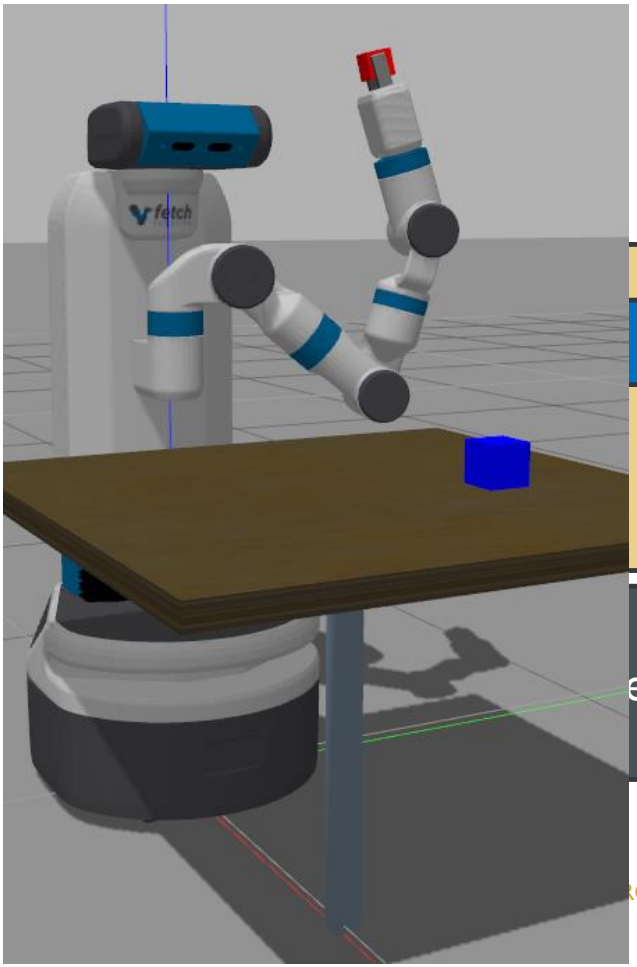
Action Selection / Symbolic Planning

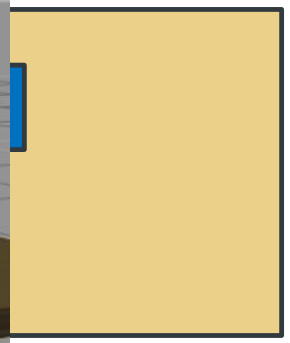
- Rosie has a fixed number of action primitives
  - Put down (object) at (a target position)
- Which action should the agent request, and with what parameters?
- Typically decided by
  - Search (when solving puzzles)
  - Known or learned task ordering
- SVS provides target parameter

Motion Planning

- Assume as givens
  - Robot arm's starting joint positions
  - Goal joint positions or end-effector pose
- Find collision-free path through robot's joint space from start to goal
- Typical algorithms used
  - Sampling-based planners (**RRT**, PRM)
  - Path optimizers (CHOMP, TrajOpt)

ROSIE MOTION PIPELINE TODAY





erception

6

2

Soar

yes/no

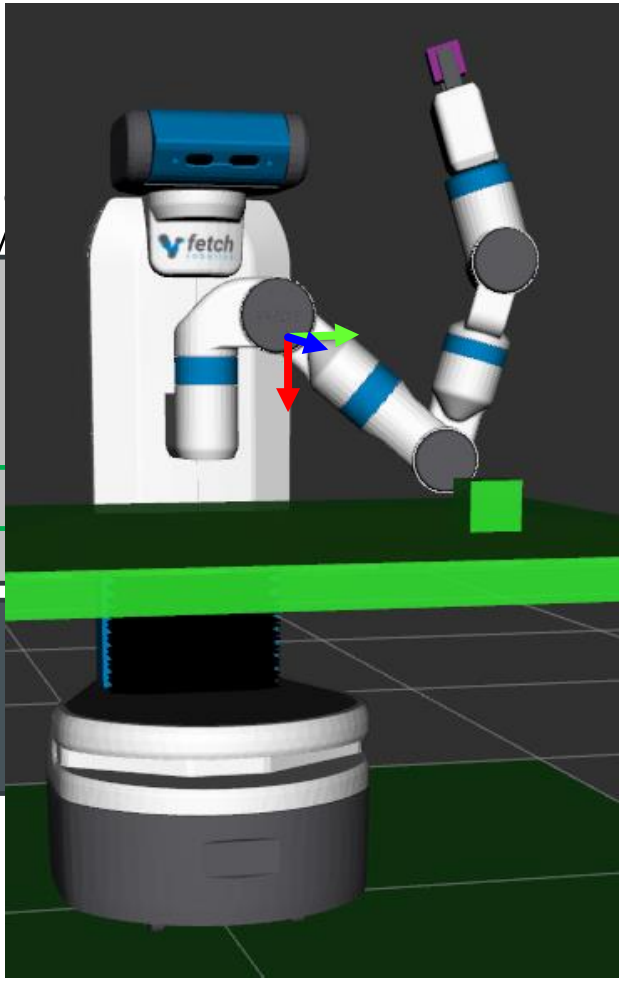
geometry,
visual features

target

geometry

robot's

Motion

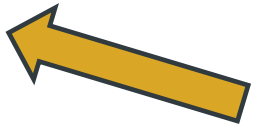


ROL FOR ROSIE

DOWNSIDES OF REQUEST-RESPONSE MOTION

Rosie is not always responsive and may execute (very) suboptimal motions

1. Motion planning problem needs to be solved at the time of the request
2. Does not leverage inherent flexibility in Rosie goals
3. Agent requests are uninformed about trajectory quality:
   - amount of joint motion or execution time
   - amount of hand motion
   - obstacle clearance…

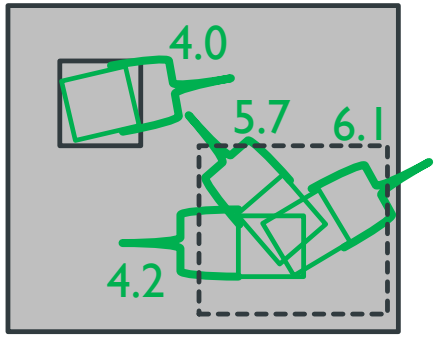


If Rosie had access to this statistic, it could have avoided the egregious arm dance!

OTHER EXISTING SOLUTIONS

- **Combined task and motion planning**, or fully plan out every motion during task planning
  - Takes longer to find high-level plan and get going
  - Costly planning based on a hypothetical future environment is risky
- **Closed-loop control**, or forget the motion planning problem entirely!
  - Does not handle obstacles well
- **Plan to a region**, or adapt the definition of the motion planning problem
  - Still only have one trajectory option

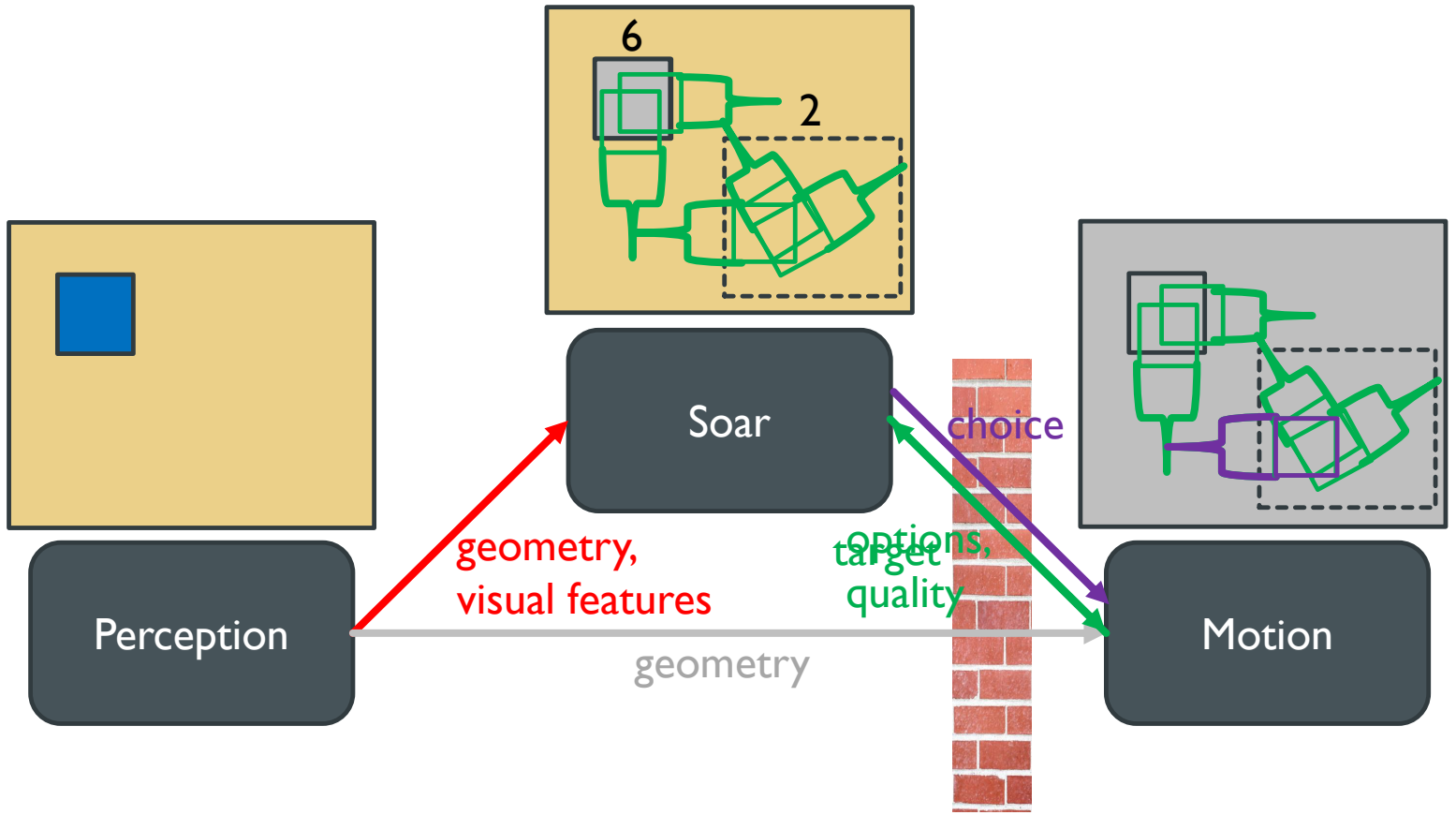
PROPOSED ALTERNATIVE



lengths in joint space (rad), shorter is better

- With some direction from Soar, motion system makes lots of plans
- When agent needs to act, Soar chooses one of the existing plans

ROSIE MOTION PIPELINE TOMORROW (OR IN A FEW YEARS…)



DOES THIS HAVE ANY MEASURABLE ADVANTAGES?

- Short answer: **we don't know**
- How we're going to find out:
  1. Choose target areas and compute lots of plans slightly different targets within each one
  2. Measure **plan quality** (potential advantage) and amount of **time** this takes (definite cost)
  3. If there is an advantage, see if we can reduce time cost through **parallelism** and "**plan prefetching**"

NUGGETS

- Cool?
- Ready to collect the necessary data
- Could result in serious improvement

COAL

- Seems like someone should have tried this
- Don't have the necessary data yet
- Still completely hypothetical

Thanks!