Meta-Reinforcement Learning and Causality for Multi-tasking in Robots with Redundant Kinematics

1st Year Update

Joel Baptista

11/04/2024

Table of Contents

Focus

Meta-Reinforcement Learning and Causality for Multi-tasking in Robots with Redundant Kinematics

Focus

Meta-Reinforcement Learning and Causality for Multi-tasking in Robots with Redundant Kinematics

Translation: Explore different learning methodologies to create intelligent agents that can control robots in difficult tasks

Focus

Meta-Reinforcement Learning and Causality for Multi-tasking in Robots with Redundant Kinematics

Translation: Explore different learning methodologies to create intelligent agents that can control robots in difficult tasks

Motivation

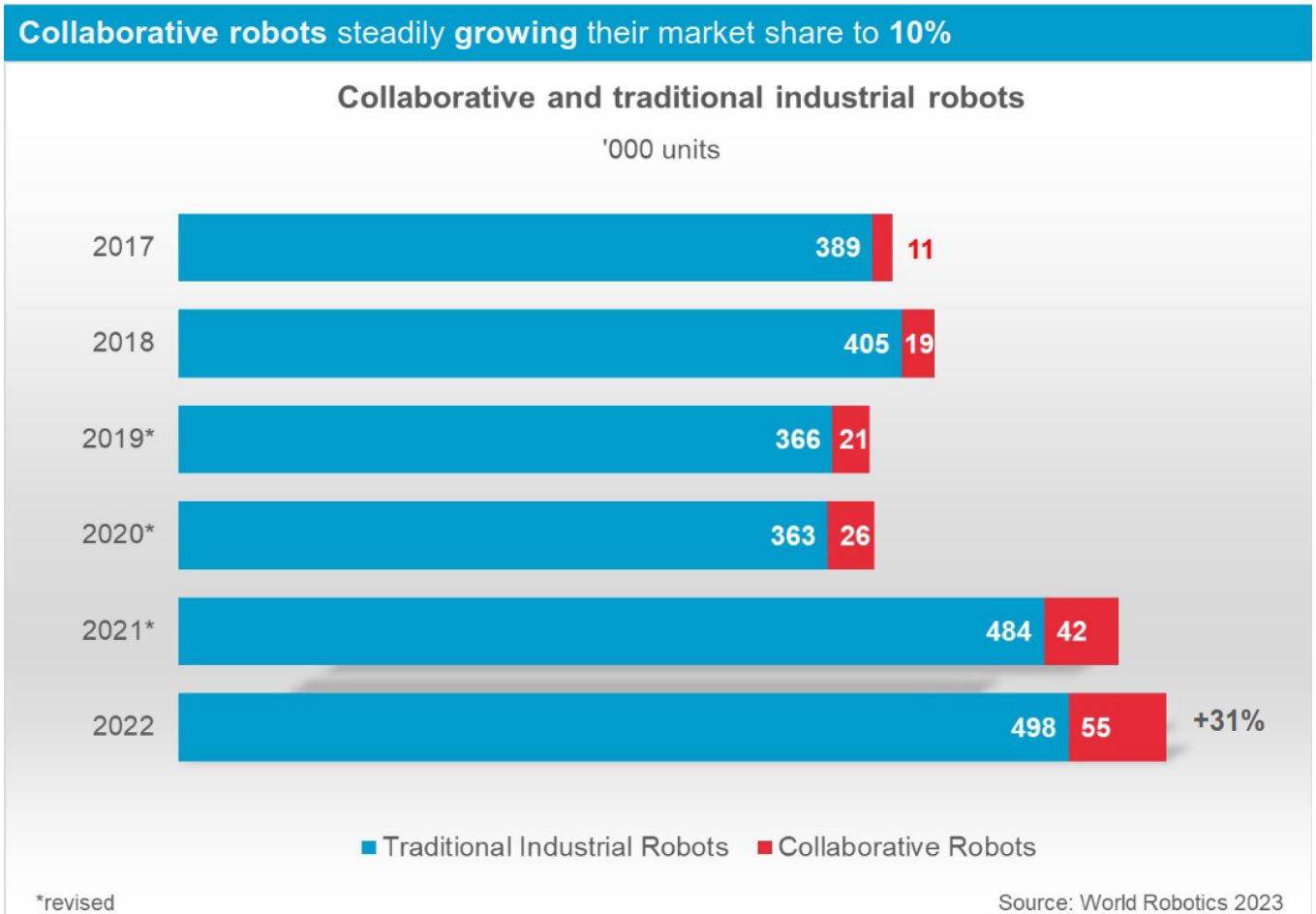
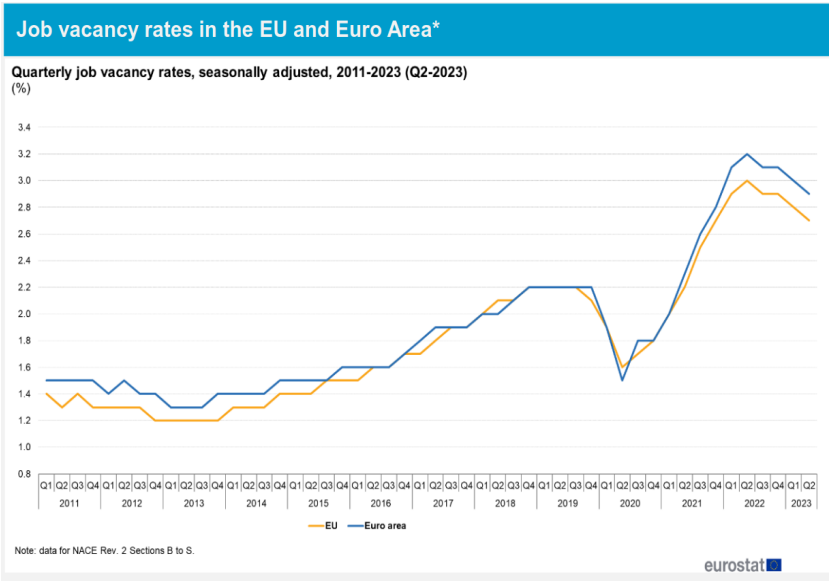


Figure: Collaborative and traditional industrial robots' growth[1]

[1] Source: World Robotics Report 2023 - Press Conference

Motivation



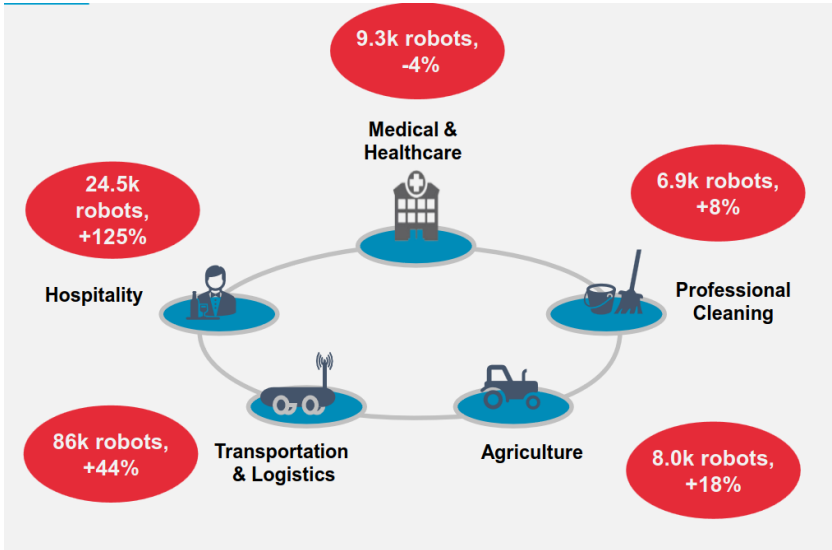


Figure: Job vacancy and service robots' growth[1]

Job vacancy is rising and the field of service robots is growing in response

[1] Source: World Robotics Report 2023 - Press Conference

Motivation

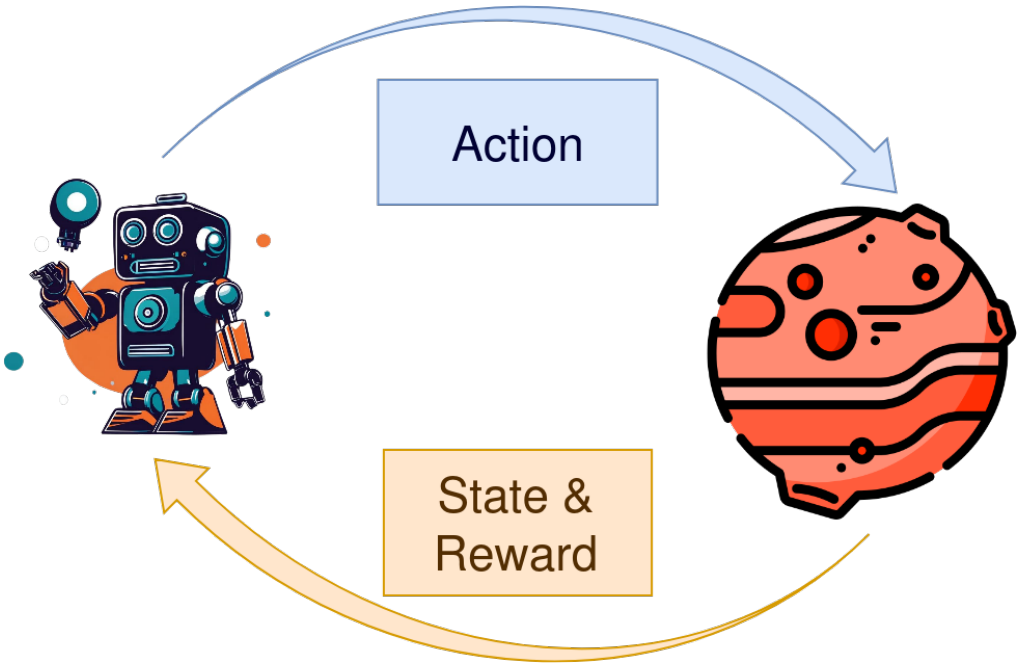
Cobots and Service Robots interact in more complex and uncontrolled environments, ...

Motivation

Cobots and Service Robots interact in more complex and uncontrolled environments, ...
... therefore, they need to be more **flexible and adaptable** to different tasks.

Table of Contents

Reinforcement Learning



Learns to accomplish a goal by **interacting** with an environment, receiving rewards and penalties.

RL vs Traditional Control

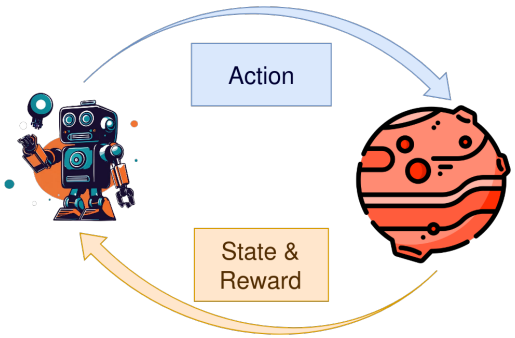


Figure: Reinforcement Learning Cycle

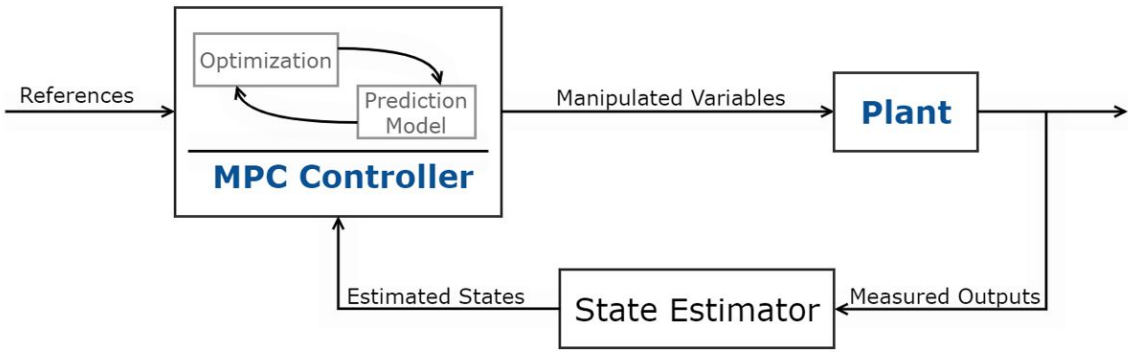


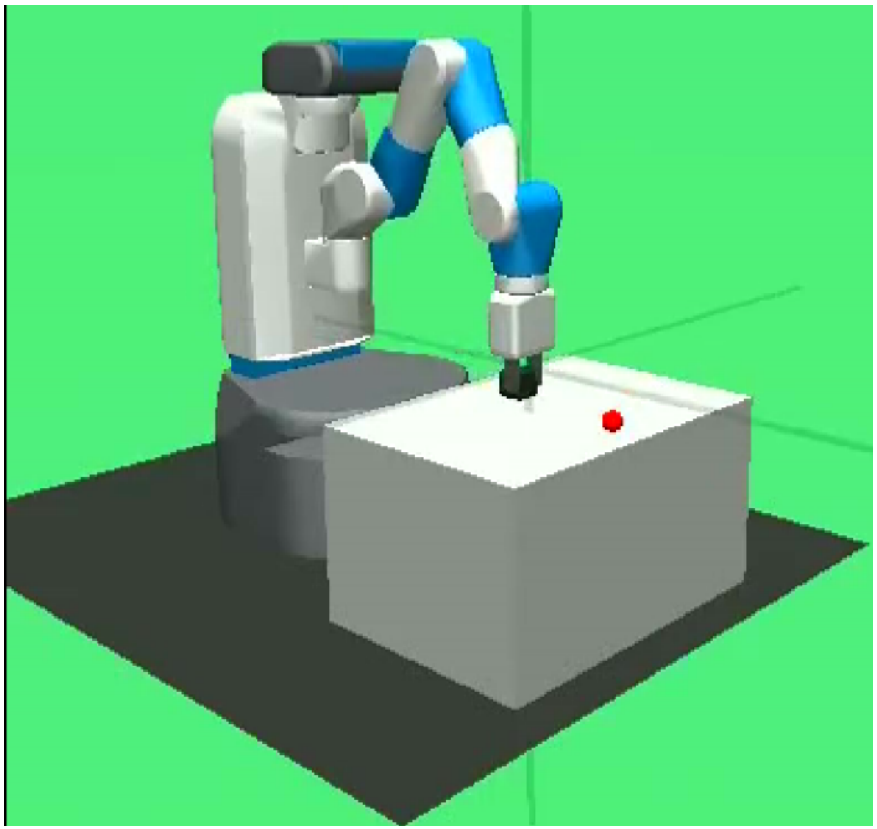
Figure: Model Predictive Control Cycle

Just to mention that there are other methods to control robots, such as MDP, but they are not as flexible as RL.

RL vs Traditional Control

[2]Source: Robotics Systems Lab: Legged Robotics at ETH Zurich

RL vs Traditional Control



RL vs Optimal Control

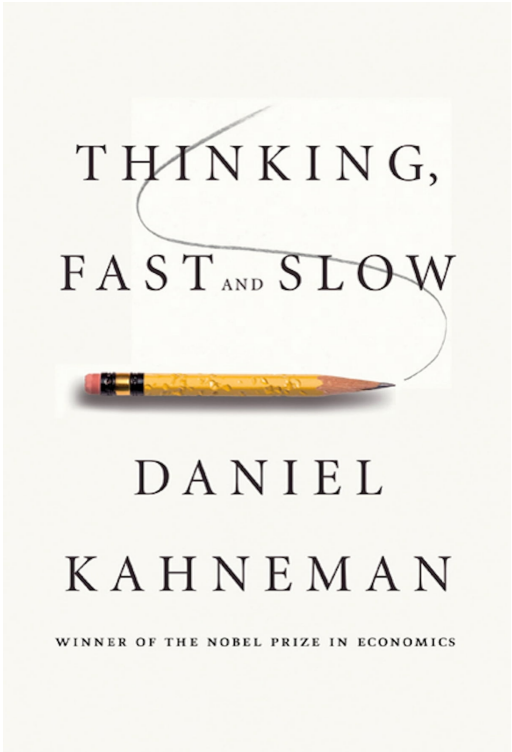
- Traditional Control: Robust and predictable, but not scalable.
- Reinforcement Learning: Scalable and flexible, but not robust.

RL vs Optimal Control

- Traditional Control: Robust and predictable, but not scalable.
- Reinforcement Learning: Scalable and flexible, but not robust.

Table of Contents

Intuition



- **Fast Thinking**: Correlation, pattern recognition, subconscious, ...
- **Slow Thinking**: Logical (causal), calculating, conscious, ...

Many researchers believe that AI can only utilize "fast thinking" (System I). They propose causality to reach "slow thinking" (System II).

Intuition