Optimal Trajectory Generation using Transformers

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Highlights
- Reframe optimal trajectory generation problem as sequence modelling problem.
- Based on Decision Transformer framework developed by Chen et al. [1]
- Can generate effective warm-start trajectories for convex optimization.

Problem Setup
- 2D, Double integrator dynamics
- Cost function
  - Single Agent system
    \[ J = \sum_{t=0}^{T-1} (x_t^T Q x_t + u_t^T R u_t) \]
  - Multi-agent system
    \[ J = \sum_{i=1}^{N_{agents}} \sum_{t=0}^{T-1} (u_t^T R u_t) \]

Methodology and Parameters
- Transformer architecture [2]

Results and capabilities
- \( R_1 = -35 \)
- \( R_1 = -45 \)
- When a higher cost is desired, trajectory takes a longer, sub-optimal path to achieve higher cost.
- Can find a shorter path independent of initial trajectory
- It can patch several single obstacle avoidance trajectories to give a feasible trajectory with multiple obstacles.

Multi-agent system
- Optimal consensus for 3 agents
- Dynamics-in-loop

Training Data

Future Work and References
- Implementation on distributed multi-agent systems.
- Strict implementation of constraint satisfaction.
