Project 1 Phase 2 Optimization-Based Minimum Snap Trajectory Generation

状态 ELEC 5660

proj1phase2.zip

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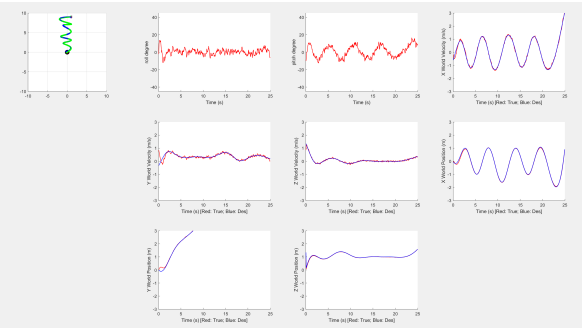
This project uses **quadratic programming (QP)** to create smooth robot paths by minimizing "snap" (the 4th derivative of position)

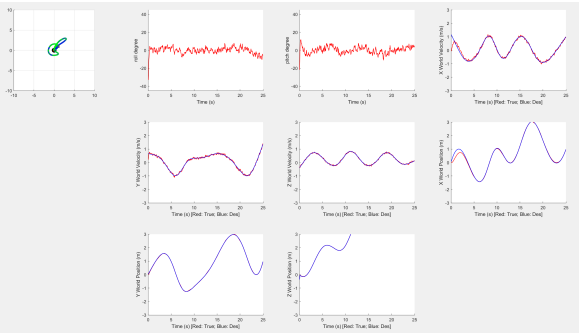
Methodology

1. **Goal**: Minimize snap across trajectory segments while ensuring waypoints are met.
2. **Constraints**:
   - Waypoints must align (position continuity).
   - Velocity/acceleration continuity improves smoothness.
3. **Solver**: MATLAB's `quadprog` was used to solve the QP problem.

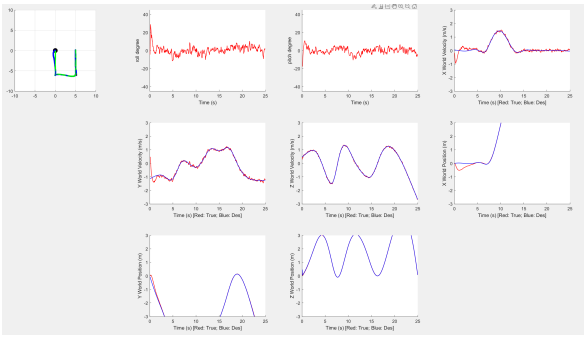
Results & Analysis



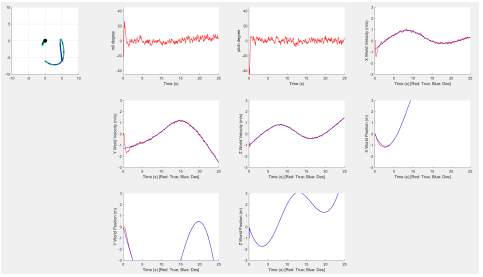
path 1



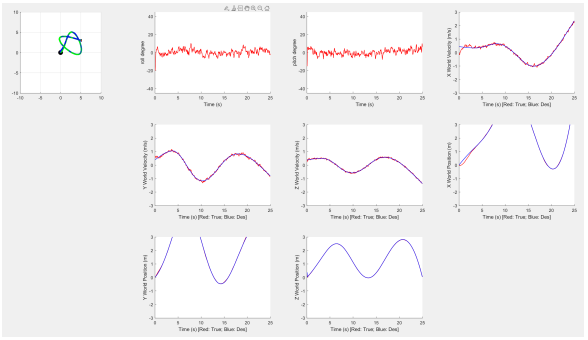
path 2



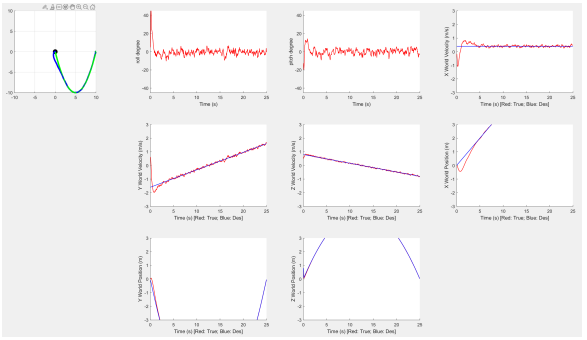
path 3
Figure U with 12 points



path 4
Figure U with 5 points



path 5
Figure A with 6 points



path 6
Figure V with 3 points

Trajectory Smoothness Metrics

	path 1	path 2	path 3 Figure U with 12 points	path 4 Figure U with 5 points	path 5 Figure A with 6 points	path 6 Figure V with 3 points
RMSE Position(m)	0.048489	0.060332	0.089376	0.055922	0.041884	0.12563
RMSE Velocity(m/s)	0.099429	0.087944	0.13083	0.12132	0.067342	0.17402
RMSE Yaw(deg)	2.844	3.3837	2.4143	2.6306	3.2048	2.2512

Future Improvements

- **Time optimization**: Adjust segment timing dynamically for better efficiency.
- **Faster solvers**: Use lightweight tools like OSQP for real-time applications
- **Obstacle avoidance**: Add constraints for real-world safety.