

Comparative Analysis of Coupled vs. Decoupled Control Strategies for Spacecraft RVD

The following results present the impact of coupling, decoupling, and cost tuning on spacecraft Rendezvous and Docking performance using Model Predictive Control (MPC) and Linear Quadratic Regulation (LQR). The graphs illustrate how considering coupled dynamics versus decoupled approximations, along with different weighting in the cost function, affects trajectory tracking, alignment, and control effort. MPC demonstrates improved handling of coupled dynamics and optimal trade-offs through cost tuning, whereas LQR and decoupled approaches provide baseline behaviors that may underperform in accurately capturing system interactions.

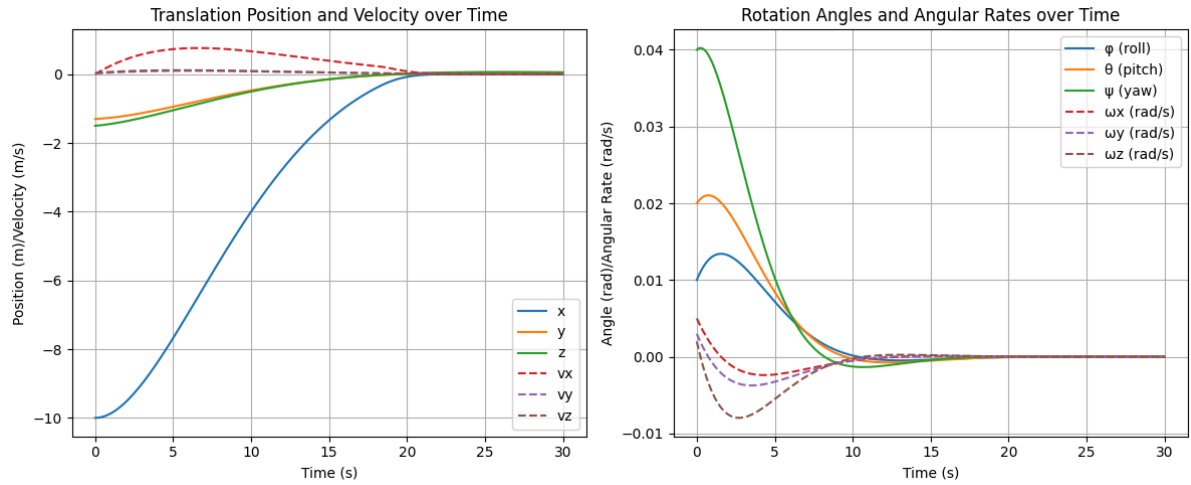


Fig 1: Results of RVD with MPC: no coupling present

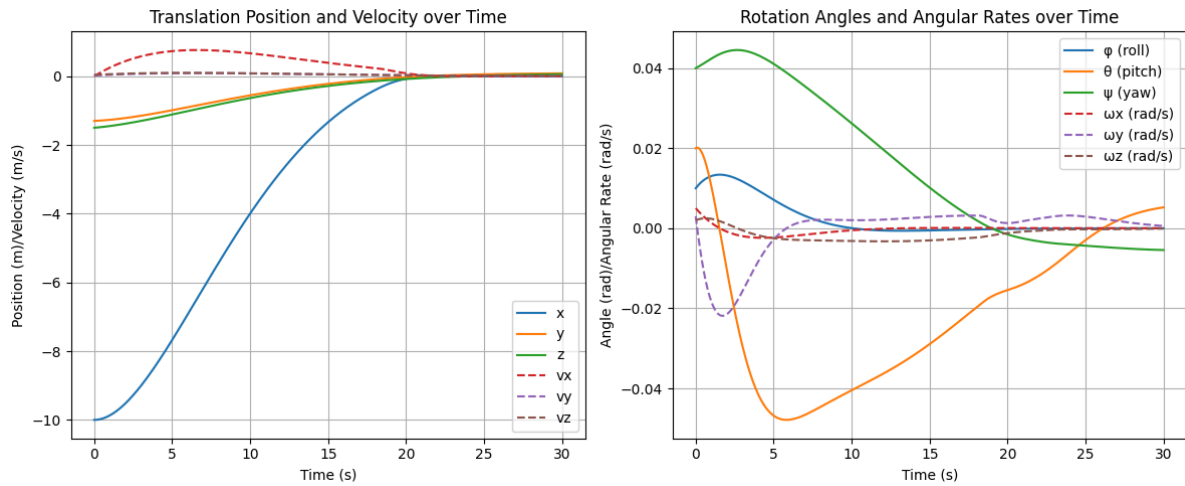


Fig 2 : Results of RVD with MPC: coupled spacecraft dynamics with uncoupled costs tuning

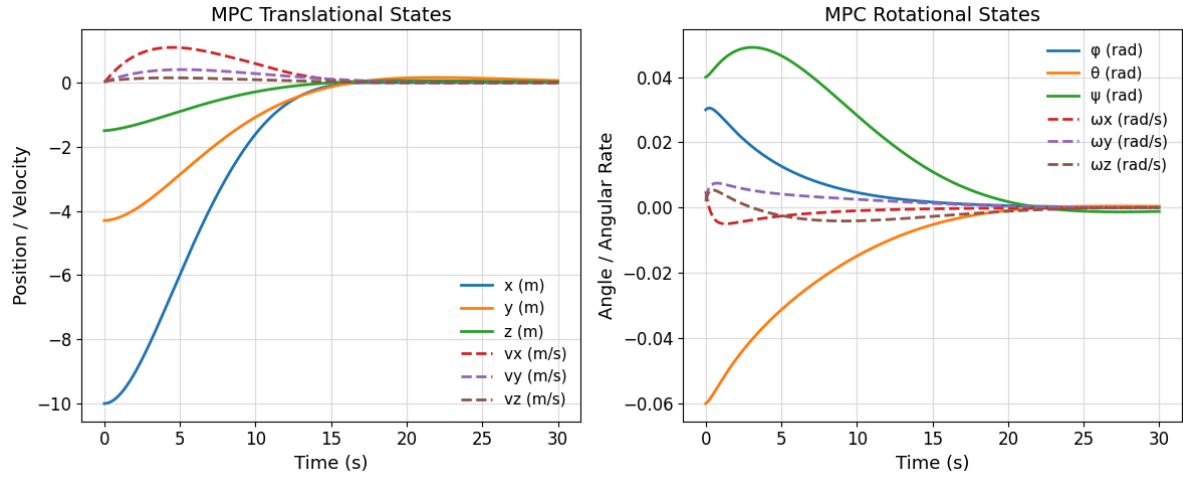


Fig 3: Results of RVD with MPC: coupled spacecraft dynamics with coupled costs tuning

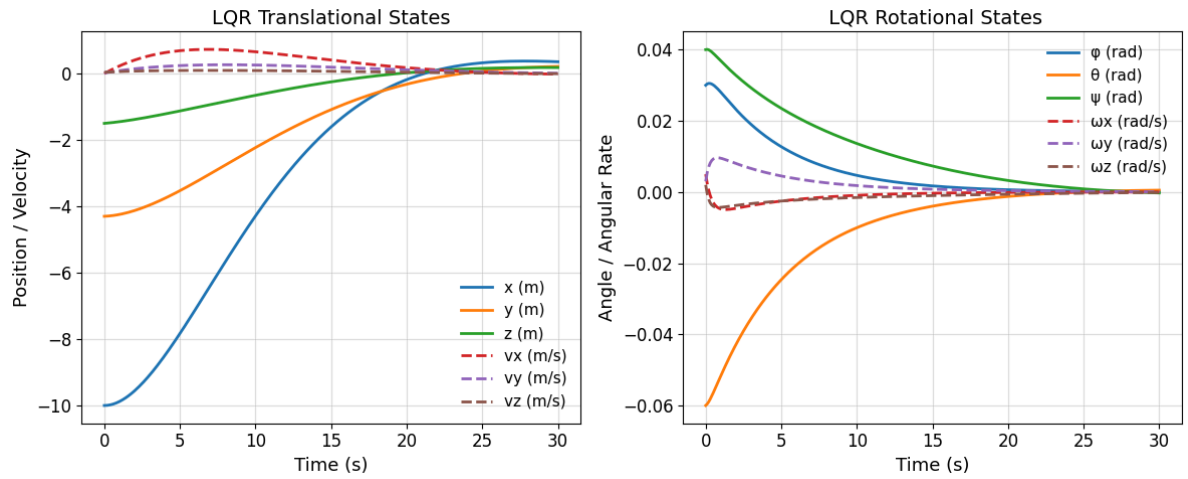


Fig 4: Results of RVD with LQR : for comparison