

Robustness Analysis of Incremental Nonlinear Dynamic Inversion Control

Mike Timmerman / 19th June 2023



Problem Statement

- F-16 Fighting Falcon
- Combat airplane
- Highly agile
- Relaxed static stability
- Nonlinear behavior

Operational Environment:



Dynamic Pressure

- Changes in velocity
- Changes in air density



Center of Gravity

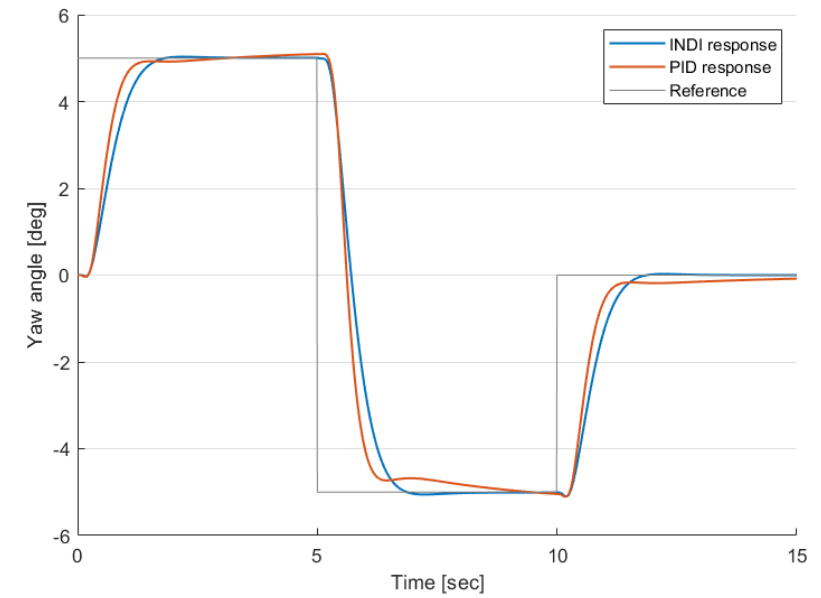
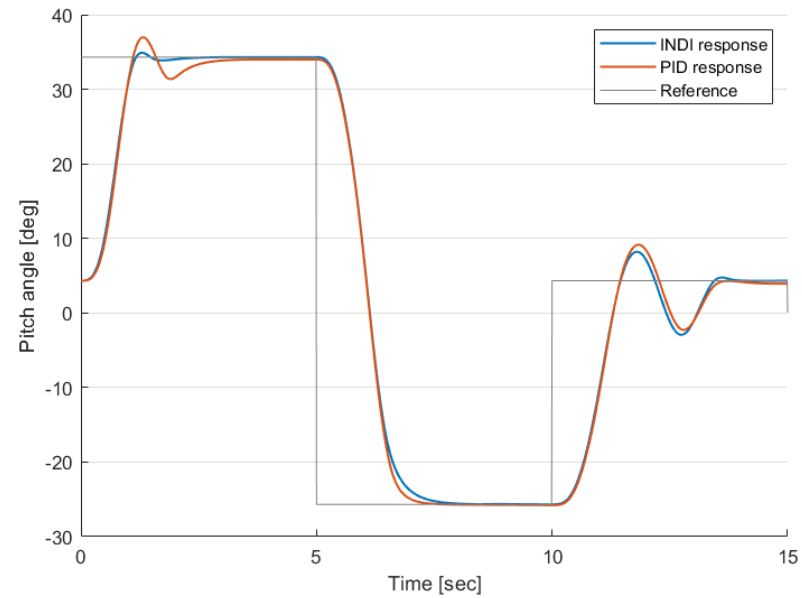
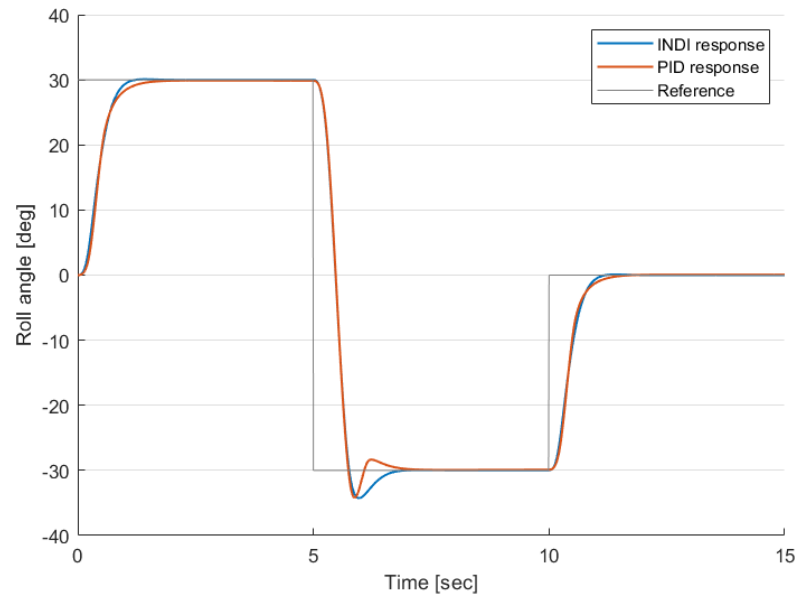
- Shift in center of gravity
- Change in stability characteristics



Model Mismatch

- Model of physical system
- Mismatch in model and reality

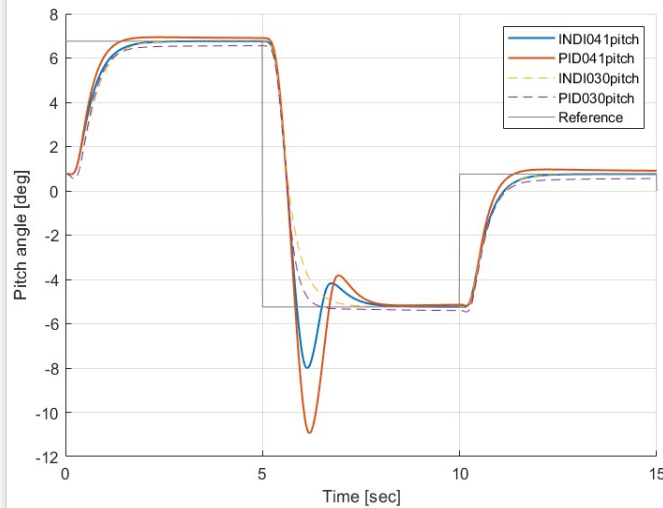
Nominal Performance



Performance Analysis

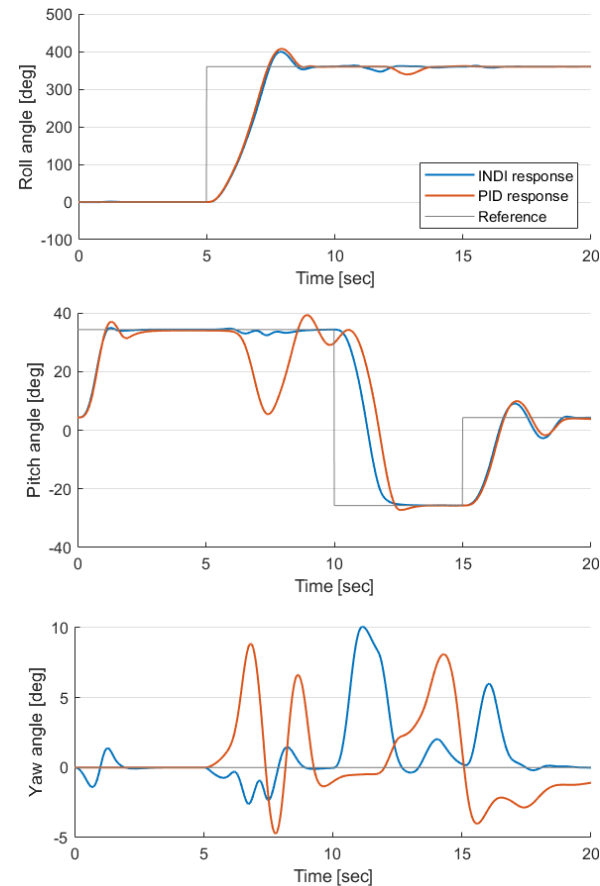
Center of Gravity Shift

- Center of Gravity shifted far aft
- Aircraft is statically unstable
- Less overshoot on the INDI response



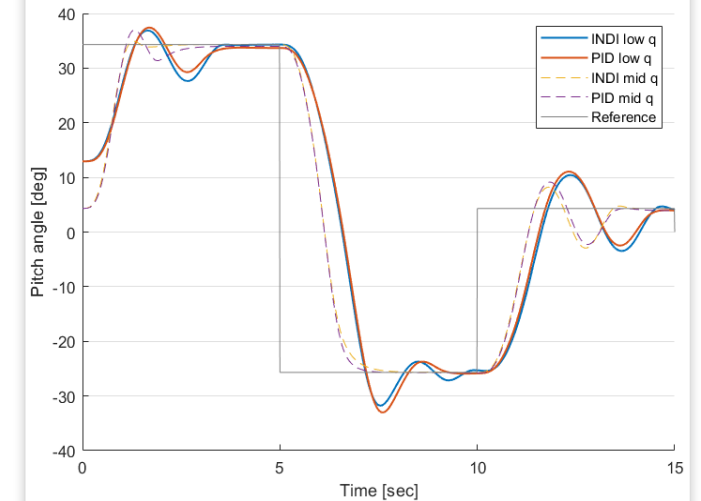
Complex Tracking Maneuver

- Combined pitch and roll maneuver

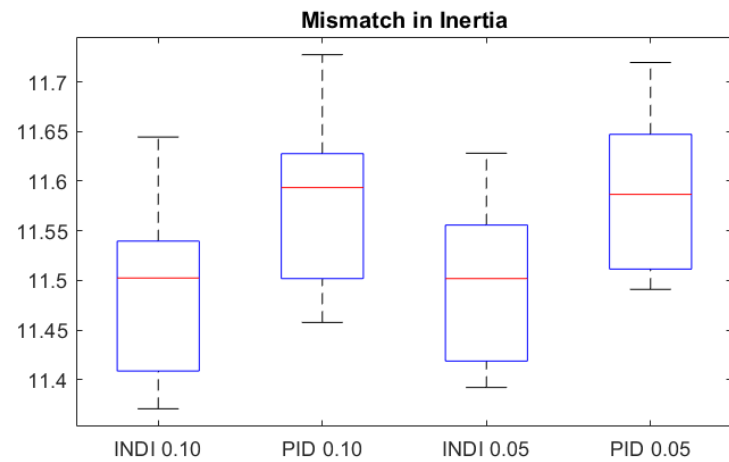
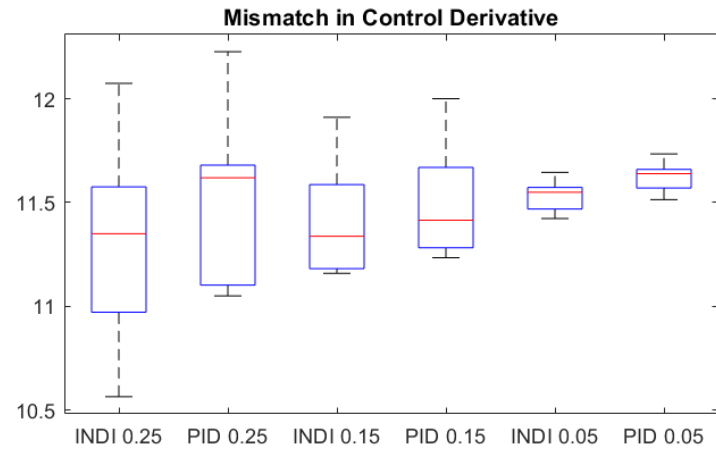


Change in Dynamic Pressure

- Decreased dynamic pressure
- Decreased actuator effectiveness



Model Mismatch



Thank you for your attention

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