

# 10<sup>th</sup> Home Project

November 8, 2022

The equation of motion of Duffing Oscillator:

$$\ddot{q} = \alpha q + \delta \dot{q} + \beta q^3 + u \quad (1)$$

Table 1: Model parameters for Duffing Oscillator

| Parameter | Exact | Approx |
|-----------|-------|--------|
| $\alpha$  | 1     | 0.8    |
| $\delta$  | 0.2   | 0.1    |
| $\beta$   | 1     | 0.9    |

The simulation length: 2e4 Cycle time:1e-3

The Nominal trajectory:

$$q^N = A \sin(\omega t) \quad (2)$$

, where  $A = 2$  and  $\omega = 0.5$ .

Create a RFPT controller for Duffing Oscillator, with initial condition  $q(0) = 0$ ,  $\dot{q}(0) = 0$  and an initial condition, which is close to the Nominal trajectory. The computations for "preparation" have to be calculated on paper, then you have to typeset it into the documentation, and have to assign the paper computation to the documentation. (use "PID" type Kinematic Block)

Create the following plots for both cases.

- Nominal and Realized Trajectory
- Tracking Error
- Phase Space
- Control Signal

Explain the plots.

Document everything in L<sup>A</sup>T<sub>E</sub>X.