

Errata: Joint Input Shaping and Feedforward for Point-to-Point Motion: Automated Tuning for an Industrial Nanopositioning System

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The paper [1] contains two errors. First, in Theorem 1 (Section 3.3. Optimization Algorithm) the expression

$$\Phi = \Psi C^{-1} \begin{bmatrix} y^j \\ u^j \end{bmatrix} \in \mathbb{R}^{N \times (n_a + n_b)}.$$

should be

$$\Phi = \Psi C^{-1} \begin{bmatrix} y^j \\ -u^j \end{bmatrix} \in \mathbb{R}^{N \times (n_a + n_b)}.$$

Note that the proof is correct.

Second, in the simulation example presented in Section 4, the feedforward filters C_y and C_{ff} and corresponding initial parameters are interchanged compared to Theorem 1. That is, the statement:

The input shaper C_y and feedforward controller C_{ff} are parametrized as 4th order filters given by

$$\begin{aligned} C_y(q^{-1}, \theta) &= 1 + \psi_1 \theta_1 + \psi_2 \theta_2 + \psi_3 \theta_3 + \psi_4 \theta_4, \\ C_{ff}(q^{-1}, \theta) &= \psi_5 \theta_5 + \psi_6 \theta_6 + \psi_7 \theta_7, \end{aligned}$$

with basis functions

$$\begin{aligned} \psi_1(q^{-1}) &= \frac{1 - q^{-1}}{T_s}, \\ \psi_2(q^{-1}) = \psi_5(q^{-1}) &= \frac{1 - 2q^{-1} + q^{-2}}{T_s^2}, \\ \psi_3(q^{-1}) = \psi_6(q^{-1}) &= \frac{1 - 3q^{-1} + 3q^{-2} - q^{-3}}{T_s^3}, \\ \psi_4(q^{-1}) = \psi_7(q^{-1}) &= \frac{1 - 4q^{-1} + 6q^{-2} - 4q^{-3} + q^{-4}}{T_s^4}. \end{aligned}$$

The initial values of the parameters θ yield

$$\theta^{\text{init}} = [0, 0, 0, 0, 9 \times 10^{-1}, 0, 0]^T,$$

should be

The input shaper C_y and feedforward controller C_{ff} are parametrized as 4th order filters given by

$$\begin{aligned} C_{ff}(q^{-1}, \theta) &= \psi_1 \theta_1 + \psi_2 \theta_2 + \psi_3 \theta_3, \\ C_y(q^{-1}, \theta) &= 1 + \psi_4 \theta_4 + \psi_5 \theta_5 + \psi_6 \theta_6 + \psi_7 \theta_7, \end{aligned}$$

with basis functions

$$\begin{aligned} \psi_4(q^{-1}) &= \frac{1 - q^{-1}}{T_s}, \\ \psi_1(q^{-1}) = \psi_5(q^{-1}) &= \frac{1 - 2q^{-1} + q^{-2}}{T_s^2}, \\ \psi_2(q^{-1}) = \psi_6(q^{-1}) &= \frac{1 - 3q^{-1} + 3q^{-2} - q^{-3}}{T_s^3}, \\ \psi_3(q^{-1}) = \psi_7(q^{-1}) &= \frac{1 - 4q^{-1} + 6q^{-2} - 4q^{-3} + q^{-4}}{T_s^4}. \end{aligned}$$

The initial values of the parameters θ yield

$$\theta^{\text{init}} = [9 \times 10^{-1}, 0, 0, 0, 0, 0, 0]^T,$$

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References

- [1] Boeren F, Bruijnen D, van Dijk N, Oomen T. Joint input shaping and feedforward control for point-to-point motion: Automatic tuning for an industrial nanopositioning system. *Mechatronics* 2014;24(6):572–81.

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