Correction to the paper “A robust IDA-PBC approach for handling uncertainties in underactuated mechanical systems”

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Abstract—In this note, it is shown that the results claimed in the paper [1]—as well as the examples presented there—are, unfortunately, incorrect.

Index Terms—Passivity-based control, underactuated mechanical systems, robust IDA-PBC.

Notation. \( I_n \) is the \( n \times n \) identity matrix and \( 0_{n \times n} \) is an \( n \times n \) matrix of zeros, \( 0_n \) is an \( n \)-dimensional column vector of zeros. For \( x \in \mathbb{R}^n \), \( S \in \mathbb{R}^{n \times n} \), \( S = S^\top > 0 \), we denote the Euclidean norm \( |x|^2 := x^\top x \), and the weighted-norm \( |x|_S^2 := x^\top S x \). We use the notation \([\#]\) to refer to the equation number \((\#)\) in \([1]\). To simplify the notation, the arguments of the various mappings are indicated only the first time they are defined.

I. BACKGROUND

To set-up the notation we briefly review in this section the interconnection and damping assignment passivity-based control (IDA-PBC) method proposed in [5] for underactuated mechanical systems, which are described in port-Hamiltonian (pH) form by

\[
\begin{bmatrix}
\dot{q} \\
\dot{p}
\end{bmatrix} =
\begin{bmatrix}
0_{n \times n} & I_n \\
-I_n & 0_{n \times n}
\end{bmatrix}
\nabla H(q,p) +
\begin{bmatrix}
0_{n \times m} \\
G(q)
\end{bmatrix} u,
\tag{1}
\]

where \( q, p \in \mathbb{R}^n \) are the generalized position and momenta, respectively, \( u \in \mathbb{R}^m \), \( m < n \) is the control, \( G : \mathbb{R}^n \rightarrow \mathbb{R}^{n \times m} \), with \( \text{rank}(G) = m \). The function \( H : \mathbb{R}^n \times \mathbb{R}^n \rightarrow \mathbb{R} \)

\[
H(q,p) := \frac{1}{2} p^\top M^{-1}(q)p + V(q)
\]

is the total energy with \( M : \mathbb{R}^n \rightarrow \mathbb{R}^{n \times n} \), the positive definite mass matrix and \( V : \mathbb{R}^n \rightarrow \mathbb{R} \) the potential energy.

The control objective is to design a static, state-feedback controller that assigns to the closed loop a desired stable equilibrium \((q^*,0_n)\), \( q^* \in \mathbb{R}^n \). This is achieved in IDA-PBC by assigning to the closed loop the pH target dynamics

\[
\begin{bmatrix}
\dot{q} \\
\dot{p}
\end{bmatrix} = F_d(q,p) \nabla H_d(q,p),
\tag{2}
\]

\[
F_d(q,p) :=
\begin{bmatrix}
0_{n \times n} & M^{-1}(q)M_d(q) \\
-M_d(q)M^{-1}(q) & J_2(q,p) - G(q) K_p G^\top(q)
\end{bmatrix},
\]

with new total energy function \( H_d : \mathbb{R}^n \times \mathbb{R}^n \rightarrow \mathbb{R} \)

\[
H_d(q,p) := \frac{1}{2} p^\top M_d^{-1}(q)p + V_d(q),
\tag{3}
\]

where the desired mass matrix \( M_d : \mathbb{R}^n \rightarrow \mathbb{R}^{n \times n} \) is positive definite, the desired potential energy \( V_d : \mathbb{R}^n \rightarrow \mathbb{R} \) verifies

\[
q^* = \text{arg min}_q V_d(q),
\]

and \( K_p \in \mathbb{R}^{m \times m} \) is a free positive definite matrix. The matrix \( J_2 : \mathbb{R}^n \times \mathbb{R}^n \rightarrow \mathbb{R}^{n \times n} \) is free to the designer and fulfills the skew-symmetry condition

\[
J_2(q,p) = -J_2^\top(q,p).
\]

The pH target dynamics of the closed loop \((\ref{eq:2})\) ensures the following properties \([5]\):

\[\text{S1} \]

The closed-loop system \((\ref{eq:2})\) has a stable equilibrium point at \((q^*,0)\) with Lyapunov function \( H_d \), which verifies

\[
\dot{H}_d = -\|G^\top M_d^{-1}p\|^2_{K_p} \leq 0.
\]

\[\text{S2} \]

The equilibrium is asymptotically stable provided that the output

\[
y_d := G^\top M_d^{-1}p
\]

is detectable with respect to the dynamics \((\ref{eq:2})\).

By equating the right-hand sides of \((\ref{eq:1})\) and \((\ref{eq:2})\) one obtains the so-called matching equations, which are two partial differential equations (PDEs) that identify the assignable \( M_d \) and \( V_d \), and gives an explicit expression for the (static state-feedback) control signal \( u \).

II. FORMULATION OF THE ROBUST IDA-PBC PROBLEM IN [1]

The authors of [1] consider that the system \([1]\) is in closed loop with an IDA-PBC yielding the closed-loop dynamics \([2]\). Moreover, it is assumed—i.e., Assumption 3.1 of [1]—that the equilibrium \((q,p) = (q^*,0_n)\) of \([2]\) is asymptotically stable. The control objective in [1] is to

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robustify the IDA-PBC with respect to the presence of additive disturbances.

We summarise here the problem formulation in \[1\].

**Problem formulation.** Given the dynamics

\[
\begin{bmatrix}
\dot{q} \\
\dot{p}
\end{bmatrix} = \mathcal{F}_d\nabla H_d + \begin{bmatrix}
0_{n\times m} \\
G
\end{bmatrix} v + \begin{bmatrix}
d_1 \\
d_2
\end{bmatrix},
\]

verifying Assumption 3.1 of \[1\], where \(d_1 \in \mathbb{R}^n\) and \(d_2 \in \mathbb{R}^n\) are said to be the “unmatched” and “matched” disturbances, respectively. Find a control law of the form

\[
\dot{x}_v = F(q, p, x_v) \\
v = \beta(q, p, x_v),
\]

where \(x_v \in \mathbb{R}^n\), that ensures the following objectives:

**O1.** asymptotic stability of the equilibrium \((q, p, x_v) = (q^*, 0, 0_v)\) when \(d_1 = d_2 = 0\):

**O2.** integral-input-to-state stability (iISS) or input-to-state stability (ISS) with respect to the disturbances of the closed-loop.

**Remark 1:** The controller proposed in \[1\] is called an integral control even though the right hand side of the dynamic extension \(\dot{x}_v\) is clearly a function of \(x_v\).

**Remark 2:** The qualification of \(d_1\) and \(d_2\) as unmatched and matched disturbances is arbitrary and has no relation with the null space or image of the input matrix \(G\).

## III. MAIN CLAIMS IN [1] AND THEIR REBUTTAL

The main claims of \[1\] are contained in Proposition 4.1, Section V.A and Proposition 5.1 of \[1\]. Unfortunately, as shown below, the proofs are not correct and thus the claims are invalid.

**A. Proposition 4.1 of [1]**

The claims in this proposition, which refer to the dynamics of the system \(\mathcal{H}\) with \(d_1 = 0\) and \(d_2 = 0\), in closed-loop with the control law \(\mathcal{H}(15)\), are the following.

**C1.** The closed-loop system can be written in the pH form \(\mathcal{H}(20)\), which is described in the new coordinates defined in \(\mathcal{H}(17)\).

**C2.** The control objective \(O1\) is verified.

Both claims are, unfortunately, incorrect for the following reasons.

**R1.** The dynamics of the closed-loop using control law \(\mathcal{H}(15)\) does not have the form \(\mathcal{H}(20)\) without further assumptions on the mechanical system. The matching of the open and closed-loop dynamics results in \(\mathcal{H}(22)\), which has the form

\[

\begin{align*}
Gv &= (J_2 - R_d)M_d^{-1}Kx_v - KK^\top M^{-1}\nabla_q V_d + \\
&\quad + \frac{1}{2}M_dM^{-1}\nabla_q (p^\top M_d^{-1}p) - \frac{1}{2}M_dM^{-1}\nabla_q \\
&\quad \times \left[(p + Kx_v)^\top M_d^{-1}(p + Kx_v)\right],
\end{align*}

\]

with \(K(q) := G(q)K\), \(K_i > 0\). The control law, proposed in the first equation of \(\mathcal{H}(15)\), is given by

\[
v = (G^\top G)^{-1}G^\top \left\{ (J_2 - R_d)M_d^{-1}Kx_v - KK^\top M^{-1}\nabla_q V_d + \\
\quad + \frac{1}{2}M_dM^{-1}\nabla_q (p^\top M_d^{-1}p) - \frac{1}{2}M_dM^{-1}\nabla_q \\
\quad \times \left[(p + Kx_v)^\top M_d^{-1}(p + Kx_v)\right]\right\}.
\]

However, to ensure that the matching is satisfied, one should verify that

\[

\begin{align*}
G^\top \left\{ (J_2 - R_d)M_d^{-1}Kx_v - KK^\top M^{-1}\nabla_q V_d + \\
\quad + \frac{1}{2}M_dM^{-1}\nabla_q (p^\top M_d^{-1}p) - \frac{1}{2}M_dM^{-1}\nabla_q \\
\quad \times \left[(p + Kx_v)^\top M_d^{-1}(p + Kx_v)\right]\right\} = 0
\end{align*}

\]

is satisfied. The condition \(\mathcal{H}(23)\) is not verified for general underactuated mechanical systems and the claim \(C1\) is false.

**R2.** Asymptotic stability is not ensured from Assumption 3.1.

As indicated in Section \(\mathcal{H}\) Assumption 3.1 of \(\mathcal{H}\) is that the equilibrium \(\mathcal{H}(22)\) is asymptotically stable. It is argued in \(\mathcal{H}\) that the control objective \(O1\) “is concluded using the arguments used in Assumption 3.1\(^{\text{H1}}\), but it is not clear at all to which arguments the authors are referring to. In a rambling text in the paragraph where Assumption 3.1 is enunciated and the one below, reference is made to Proposition 1 in \(\mathcal{H}\). This proposition simply quotes the statement \(s2\) of Section \(\mathcal{H}\) where it is important to underscore that the detectability property refers to the system \(\mathcal{H}\). Even assuming that the bound \(\mathcal{H}(21)\) is correct, which it is not because—as proven in \(R1\)—the closed-loop dynamics is not given by \(\mathcal{H}(20)\)—it is erroneous to assume that the aforementioned detectability property with respect to \(\mathcal{H}\) implies detectability with respect to \(\mathcal{H}(20)\). The discussion that is given in the remaining lines of the paragraph below \(\mathcal{H}(21)\) have no connection with the asymptotic stability claim \(C2\).

**Remark 3:** The mistake made in Claim \(C1\) stems from the following elementary linear algebra fact. The equation \(Az = b\), with \(A \in \mathbb{R}^{n \times m}\) a full-rank, tall matrix and \(b \in \mathbb{R}^n\) admits the solution \(z = (A^\top A)^{-1}A^\top b\) if and only if \(A^\top A\) is a full-rank left-annihilator of \(A\). It is rather surprising that the authors of \(\mathcal{H}\) made such a mistake given that the need of the “\(A^\top\) condition” is explicitly stated in \(\mathcal{H}(6)\) for the basic IDA-PBC.

**Remark 4:** Sufficient conditions for \(\mathcal{H}\) to hold are (i) \(M_d\) is a constant matrix, and (ii) \(G^2 + J_2M_d^{-1}G = 0\). These are the assumptions made in \(\mathcal{H}\), which characterize the class of underactuated mechanical system for which the claim \(C1\) holds.

**B. iISS property in Section V.A of [1]**

In Section V.A of \(\mathcal{H}\) it is claimed the following.
C3. The system \( [3] \), with \( d_1 = 0 \), in closed-loop with the control law \([1, (19)]\) is iISS with respect to the disturbance \( d_2 \).

This claim is, unfortunately, incorrect for the following reasons.

R3. To establish the claim an upper bound on the time derivative of the desired energy function \( \dot{H} (x_q, x_p, x_v) \) given in \([1, (16)]\) is computed in \([1, (25)]\) as follows

\[
\dot{H} \leq -||G^T M_d^{-1} x_p||^2_{K_v} + (M_d^{-1} x_p)^\top d_2.
\]  

(6)

Then, the authors claim that the bound

\[
-||G^T M_d^{-1} x_p||^2_{K_v} + (M_d^{-1} x_p)^\top d_2 \\
-\frac{1}{2} \lambda_{\text{min}}(K_v) |G^T M_d^{-1} x_p|^2 + \frac{1}{2 \lambda_{\text{min}}(K_v)} |d_2|^2
\]

is not square—the right hand side of \([3] \) is not in the form \( c_1|y|^2 + c_2|y| |z| \), with constants \( c_1 \) and \( c_2 \).

The issue here is that the disturbance \( d_2 \) is not matched, since it is not in the image of \( G \). Indeed, considering a true matched disturbances \( d_2 = Gd_2 \), \([3] \) becomes

\[
\dot{H} \leq -\left( ||G^T M_d^{-1} x_p||^2_{K_v} + (M_d^{-1} x_p)^\top d_2 \right) G d_2
\]

and Young’s inequality can be applied.

A further mistake is made in the second equation of \([1, (26)]\), where it is claimed that there exists a \( K_{\infty} \) function \( \alpha \) such that

\[
-\frac{1}{2} \lambda_{\text{min}}(K_v) |G^T M_d^{-1} x_p|^2 + \frac{1}{2 \lambda_{\text{min}}(K_v)} |d_2|^2 \leq -\alpha(|x_p|) + \frac{1}{2 \lambda_{\text{min}}(K_v)} |d_2|^2.
\]

(7)

Since \( G \) is not square, \( \alpha \) cannot be an \( K_{\infty} \) function of \( |x_p| \). Therefore, the iISS property with respect to the input \( d_2 \) claimed in Section V.A of \([1]\) does not hold.

\textbf{Remark 5:} Notice that applying Young’s inequality to the correct bound \([7] \)—corresponding to a \textit{bona fide} matched disturbance \( d_2 \)—it follows that

\[
\dot{H} \leq -\frac{1}{2} \lambda_{\text{min}}(K_v) |y_p|^2 + \frac{1}{2 \lambda_{\text{min}}(K_v)} |\hat{d}_2|^2
\]

(8)

with \( y_p := G^T M_d^{-1} x_p \). Then, under an assumption of detectability of \( y_p \) when \( d_2 \equiv 0 \), the closed-loop is iISS with respect to the disturbance \( d_2 \). It is not surprising that pH systems with damping injection enjoy iISS properties with respect to matched disturbances.

C. Proposition 5.1 of \([7]\)

The claims in this proposition are that the system \([1]\) in closed loop with the control law \([1, (27)]\) verifies the following.

C4. The system can be written in the \( pH \) form \([1, (31)]\), which is described in new coordinates defined in \([1, (29)]\).

C5. The system is ISS respect to the disturbances \( d_1 \) and \( d_2 \).

Both claims are, unfortunately, incorrect for the following reasons.

R4. Similarly to the mistake made in the claim C1 above, the “\( G^\perp \) condition"

\[
0 = G^\perp \{ M_d M^{-1} \nabla q H_d - 2(M^{-1} K + M_d M^{-1}) \nabla x_q \hat{H} \}
\]

\[
- (J_2 - R_d) M_d^{-1} (q) p + (J_2 - R_d) M_d^{-1} (x_q) p \\
- M^{-1} p + 2(J_2 - R_d) M_d^{-1} K x_v - 2M_d M^{-1} x_v
\]

(9)

admits the solution \([1, (27)]\). Without this condition, the matching claim is incorrect.

Moreover, the dynamics of \( x_q \) obtained from \([1, (29)]\) is

\[
\dot{x}_q = \hat{q} - \dot{x}_v
\]

\[
= M^{-1} p + d_1 - M^{-1} \nabla x_q \hat{H} - \frac{1}{2} M^{-1} p \\
= -M^{-1} \nabla x_q \hat{H} + \frac{1}{2} M^{-1} p + d_1
\]

\[
= -M^{-1} \nabla x_q \hat{H} + M^{-1} x_q - M^{-1} K x_v + d_1
\]

\[
= -M^{-1} \nabla x_q \hat{H} + M^{-1} M_d M_d^{-1} x_p - M^{-1} K x_v + d_1
\]

\[
= -M^{-1} \nabla x_q \hat{H} + M^{-1} M_d \nabla x_q \hat{H} - M^{-1} \nabla x_q \hat{H} + d_1
\]

which shows that the first row of the desired dynamics in \([1, (31)]\) is not achieved.

R5. The claim of ISS is incorrect because, on one hand, the closed-loop dynamics is not in the form \([1, (31)]\)—for the reason given above. On the other hand, as in the rebuttal of C3, it is easy to see that Young’s inequality is erroneously used to get the first bound in \([1, (32)]\). Moreover, the claim that the function \( \alpha \), appearing in the second bound, is \( K_{\infty} \) for \( |x_q, x_p, x_v| \) is wrong because \( G \) is not square.

IV. EXAMPLES OF \([1]\)

In this section we prove that the two examples considered in \([1]\) are incorrect.
A. The inertia wheel pendulum

The first example proposed in [1] is the inertia wheel pendulum (IWP). The controller for this example is designed using the result in Proposition 5.1. We will show next that, as shown in Subsection III-C for the general case, the proposed controller for the IWP does not satisfy the matching equation.

Consider the following matrices and functions for the IWP [1]:

\[
M = \begin{bmatrix} k_1 & k_2 \\ k_2 & k_2 \end{bmatrix}, \quad G = \begin{bmatrix} 0 \\ 1 \end{bmatrix}, \quad V = k_3[1 + \cos(q_1)],
\]

\[
M_d = \Delta \begin{bmatrix} m_1 & m_2 \\ m_2 & m_3 \end{bmatrix},
\]

\[
V_d = -k_3\gamma_1 \cos(q_1) + \frac{K_p}{2} [k_1 \gamma_1 q_1 + q_2]^2,
\]

\[
\tilde{V} = -k_3\gamma_1 \cos(q_1) + \frac{1}{2} K_p [k_1 \gamma_1 q_1 + q_2]^2.
\]

From [1], the control law should satisfy

\[
Gv = M_d M^{-1} \nabla_q V_d - 2M^{-1} K \nabla_q \tilde{V} - 2M_d M^{-1} \nabla_q \tilde{V} - M^{-1} p - 2(R_d M_d^{-1} K x_v + M_d M^{-1} x_v), \tag{10}
\]

with \( K = G K_G \) and \( x_q = q - x_v \).

The terms in the right-hand-side of (10) can be computed as follows

\[
M_d M^{-1} \nabla_q V_d = \begin{bmatrix} 1 \\ 1 \end{bmatrix} K_p \epsilon \mathbf{S} (\gamma_1 k_1 q_1 + q_2) + \gamma_1 k_2 k_3 (m_1 - m_2) \sin(q_1) \tag{11}
\]

\[
-2M^{-1} K \nabla_q \tilde{V} = \begin{bmatrix} 2k_2 \\ -2k_1 \end{bmatrix} \frac{K_i K_p}{(k_1 - k_2) k_2} (\epsilon \gamma_1 k_1 q_1 + q_2), \tag{12}
\]

\[
-2M_d M^{-1} \nabla_q \tilde{V} = \begin{bmatrix} 2k_2 \\ -2k_1 \end{bmatrix} \frac{K_i K_p}{(k_1 - k_2) k_2} (\gamma_1 k_1 q_1 + q_2), \tag{13}
\]

\[
-2(R_d M_d^{-1} K x_v + M_d M^{-1} x_v) = -2L \begin{bmatrix} 0 \\ 1 \end{bmatrix} k_1 (k_1 - k_2)(m_1 m_4 - m_2)^2, \tag{14}
\]

\[
M_d M^{-1} \nabla_q \tilde{V} = \begin{bmatrix} 2k_4 m_1 K_v x_v \\ 0 \end{bmatrix}, \tag{15}
\]

with

\[
S := 1 + \gamma_1 k_1 k_2 (m_1 - m_2)
\]

\[
L := \begin{bmatrix} k_2 (m_1 - m_2) x_v + k_1 (m_2 - m_1) x_v \\ k_2 (m_1 - m_2) x_v + k_1 (m_3 - m_1) x_v \end{bmatrix}.
\]

Using (11)-(15) in (10), we obtain that the matching equation (10) has the form

\[
\begin{bmatrix} 0 \\ 1 \end{bmatrix} v = \begin{bmatrix} (*) \\ (**) \end{bmatrix}, \tag{16}
\]

where (*) and (**) are non-zero. From (16) we conclude that the matching equation cannot be satisfied.

B. Rotary inverted pendulum

A controller for the rotary inverted pendulum (RIP) is designed using Proposition 4.1 in [1]. We will shown in this section that the proposed controller does not satisfy the matching equation and therefore the stability claims have no theoretical support.

The control law for the RIP is obtained from [1] (15) using the following matrices:

\[
M_d^{-1} = \begin{bmatrix} \frac{\Delta m_3}{\Delta \gamma} \\ \frac{\Delta \sigma (q_1) (\cos(q_1) + \epsilon)}{\Delta \gamma} \end{bmatrix},
\]

\[
\nabla_q M_d^{-1} = \begin{bmatrix} B_1 & B_2 \\ B_2 & B_3 \end{bmatrix},
\]

where all the functions and parameters are defined in Section VII of [1].

From [1] (22), the controller should satisfy

\[
Gv = \frac{1}{2} M_d M^{-1} \sum e_i p^T \nabla_q M_d^{-1} p + (J_2 - R_d) M_d^{-1} K x_v
\]

\[
- \frac{1}{2} M_d M^{-1} \sum e_i x_v^T \nabla_q M_d^{-1} x_v - K \dot{x}_v. \tag{17}
\]

with \( x_p = p + K x_v \).

The terms on right-hand-side of (17) can be computed as follows

\[
\frac{1}{2} M_d M^{-1} \sum e_i x_v^T \nabla_q M_d^{-1} x_v = \begin{bmatrix} 2B_1 p_1^2 + B_2 p_1 p_2 + \frac{1}{2} B_2 p_2^2 \\ 0 \end{bmatrix}, \tag{18}
\]

\[
J_2 - R_d \frac{1}{2} M_d M^{-1} x_v = Q x_v = 2B_1 p_1^2 + B_2 p_1 p_2 + \frac{1}{2} B_2 p_2^2 \tag{19}
\]

\[
\frac{1}{2} M_d M^{-1} \sum e_i p^T \nabla_q M_d^{-1} p = \begin{bmatrix} p \\ 0 \end{bmatrix}, \tag{20}
\]

\[
- \frac{1}{2} M_d M^{-1} \sum e_i x_v^T \nabla_q M_d^{-1} x_v = -K x_v, \tag{21}
\]

where we defined

\[
Q := \frac{1}{2} B_1 p_1^2 + B_2 p_1 p_2 + \frac{1}{2} B_2 p_2^2 \tag{22}
\]

\[
P := \begin{bmatrix} \frac{1}{2} \sigma (q_1) (\cos(q_1) + \epsilon) \\ \frac{1}{2} \sigma (q_1) (\cos(q_1) + \epsilon) - k_v (\cos(q_1) + \epsilon) \end{bmatrix}, \tag{23}
\]

Using (18)-(21) in (17), we show that the matching equation (17) has the form

\[
\begin{bmatrix} 0 \\ 1 \end{bmatrix} v = \begin{bmatrix} (*) \\ (**) \end{bmatrix}, \tag{24}
\]

where (*) and (**) are non-zero. Indeed,

\[
(*) = \frac{1}{2} B_1 p_1^2 + B_2 p_1 p_2 + \frac{1}{2} B_2 p_2^2 + \frac{1}{2} \sigma (q_1) (\cos(q_1) + \epsilon) x_v \tag{25}
\]

\[
- B_2 p_1 (p_2 + x_v) - \frac{1}{2} B_2 p_2 x_v^2 - \frac{1}{2} B_1 p_1^2 \tag{26}
\]

\[
= j_2 \frac{1}{2} \sigma (q_1) (\cos(q_1) + \epsilon) x_v - B_2 p_1 x_v - B_2 p_2 x_v^2 - \frac{1}{2} B_2 x_v^2 \tag{27}
\]

which clearly shows, together with (22), that the matching equation cannot be satisfied.

Also, notice that the terms (18) and (20) are conspicuous by their absence in the controller computed in [1] (48)].
V. Conclusions

We have shown that the claims made in Proposition 4.1, Section V.A of [1] and Proposition 5.1, as well as both examples presented there, are wrong. There are many other examples in the literature, e.g., [3], [4], [6] where PBC has been erroneously applied. This situation is not critical in application-oriented publications, where the main emphasis is not in mathematical correctness but on the fact that the proposed design yields a satisfactory performance, validated by experiments. It is however critical in the present case, where the publication is made in a theoretical journal, where mathematical rigor is of prime importance. Moreover, it is very harmful to the control community, to allow the publication of a paper that claims to extend a well-established method. Particularly considering that there are already several schemes that achieve this objective, which are cited in [1], that is [7], [3], [5], [2].

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