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Authors' Reply to "Comments on 'Robust iterative learning control design is straightforward for uncertain LTI systems satisfying the robust performance condition'"

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***Index Terms*—Iterative learning control (ILC), robust performance, uncertain linear time-invariant (LTI) systems.**

The authors appreciate Dr. Doh's comment [2], which basically states that the condition in [5, Th. 1] is not just sufficient but is also necessary.

First of all, we would like to point out that the proof presented in [2] [with actually an error in (4), where a factor $1/(2\pi)$ is missing] is not new; it has been already used *verbatim* in [3].

We agree with [2] that the condition in [5, Th. 1] is necessary in the case where the trial-time is of infinite length and we disagree with it in the case where the trial-time is finite. Of course, a finite trial-time is a more realistic scenario, since, in practice, iterative learning control (ILC) algorithms are applied for systems performing the same task repeatedly over a finite time interval.

In fact, our result stated in [5, Th. 1] holds for the infinite-time case (since the robust performance condition is evaluated for all frequencies), and therefore holds for the finite-time case by the truncation argument.

It is worth noting that the finite-time case does not require to satisfy the convergence condition for all frequencies, but only for $\omega \rightarrow \infty$ (see [1]). Consequently, the robust performance condition used in [5, Th. 1] is too strong and is not necessary for the finite-time case. On the other hand, over a finite-time interval, even though the closed-loop system is unstable, the tracking error remains bounded and the iterative process may converge.

Finally, we would like to highlight the fact that our result, stated in [5, Th. 1], has been introduced in [4]. We would like also to point out that we were not aware of [3] at the time we submitted our paper for publication. Nevertheless, our design approach is different from the one proposed in [3]. In fact, it is assumed in [3] that the feedback controller C is available and satisfies the robust stability condition (see [3, Ass. A3]), and the weighting function W_1 is designed in order to satisfy

$$\left\| \frac{W_1 S}{1 + \Delta W_2 T e^{-j\omega\hat{\theta}}} \right\|_\infty < 1. \quad (1)$$

In our approach, we set W_1 as close as possible to 1 and design the feedback controller C to satisfy the robust performance condition

$$\| \, |W_1 S| + |W_2 T| \, \|_\infty < 1. \quad (2)$$

Moreover, in order to guarantee that the least upper bound of the $\mathcal{L}_2$-norm of the final tracking error is less than the least upper bound of the $\mathcal{L}_2$-norm of the initial tracking error, we propose to design the feedback controller C satisfying a modified robust performance condition as stated in [5, Th. 2].

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Correction to "Quadratic Stability of a Class of Switched Nonlinear Systems"

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The correct affiliation of the first author in [1] should read as follows: J. Zhao is with the School of Information Science and Engineering, Northeastern University, Shenyang 110004, China.

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