Letters

Addendum to "Systematic Control of a Class of Nonlinear Systems With Application to Electrohydraulic Cylinder Pressure Control"

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***Index Terms*—Passivity, strict feedback form systems.**

In [1], some potentially confusing verbiage was used to explain the results of the analysis in Theorem 3.1 and Theorem A.1. This letter seeks to clarify the explanation.

At the end of Theorems 3.1 and A.1, the authors point out how a chain of systems that are individually state-strictly-passive would be convergent to zero if they were forced by an exponentially decaying signal. However, the misleading claim is made that "the serial interconnections of strictly passive elements is also strictly passive." The intended statement would be as follows for Theorem 3.1 and a similar exposition would apply for the boundedness argument in Theorem A.1.

From Case 1 and Case 2 in Theorem 3.1, the relationship between $|e_i|$ and $|e_{i+1}|$ is state-strictly-passive and hence bounded input–bounded output (BIBO) stable for any $i \in [1, r-1]$. In fact, since the relationship is state-strictly-passive, $|e_i|$ is asymptotically stable in the absence of $|e_{i+1}|$ [2]. The serial interconnection of BIBO systems is also BIBO stable. This implies that the relationship between $|e_i|$ and $|e_r|$ is therefore BIBO stable $\forall i \in [1, r-1]$. From the rth error dynamics equation

$$\dot{e}_r = -k_r e_r. \tag{1}$$

Since $k_r > 0$, the error e_r converges exponentially to zero with convergence rate k_r. Therefore, $|e_i| \to 0$ as $t \to \infty\ \forall i \in [1, r-1]$ since the input forcing function (e_r) to the chain of error dynamics

$$\dot{e}_i = -k_i e_i + g_i e_{i+1}, \quad i \in [1, r-1] \tag{2}$$

decays exponentially to zero. Each individual set of e_i error dynamics is asymptotically stable in the absence of e_{i+1} forcing as well as being BIBO stable. Therefore, all errors remain bounded during the sequential convergence of $e_i \to e_{i+1} \ldots \to e_{r-1} \to e_r \to 0$. Hence, the output tracking error, $e_1 = y - y_{\text{desired}}$, converges to zero as $t \to \infty$.

References

[1] A. Alleyne and R. Liu, "Systematic control of a class of nonlinear systems with application to electrohydraulic cylinder pressure control," *IEEE Trans. Contr. Syst. Technol.*, vol. 8, pp. 623–634, July 2000.

[2] H. Khalil, *Nonlinear Systems*. Upper Saddle River, NJ: Prentice-Hall, 1996.

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