Comments on "Some Conditions on Zeros to Avoid Step-Response Extrema"—Part II

Kang-Bark Park and Ju-Jang Lee

***Abstract*— This paper gives a correct version of Theorem 2 of the above-mentioned paper.**[1]

In Theorem 2 of the above-mentioned paper,[1] relation $\mathbf{R}$ is defined as inequality, and it gives two more conditions. In the theorem, however, relation $\mathbf{R}$ has to be defined as a *one-to-one correspondence* relationship since the theorem deals with finite and infinite zeros. In this case, the number of zeros is the same as that of poles.

Manuscript received October 10, 1995; revised March 12, 1996.

The authors are with the Department of Electrical Engineering, Korea Advanced Institute of Science and Technology, 373-1, Kusong-dong, Yusong-gu, Taejon, 305-701, Korea (jjlee@ee.kaist.ac.kr).

Publisher Item Identifier S 0018-9286(96)08257-8.

[1] A. Rachid, "Some conditions on zeros to avoid step-response extrema," *IEEE Trans. Automat. Contr.*, vol. 40, pp. 1501–1503, Aug. 1995.

Author's Reply

A. Rachid

As pointed out by the first comment, the author was not aware of works [1]–[4]. The paper was submitted for publication to highlight some trivial results which seemed unknown as can be seen from very recent related works [5], [6].

Nevertheless, the author believes that the results in [1]–[4] are given in an ad hoc manner and that, in contrast, Theorem 2 in the paper gives the designer a better insight and a systematic way by means of the system's poles and zeros.

Although the intention should have been clear from the context of the paper, we give a new statement of Theorem 2 in light of the second comment.

Theorem 2: Let $G(s)$ be an irreducible transfer function with n finite and infinite stable zeros $z_{i\{1\leq i\leq n\}}$ and n real stable poles $p_{j\{1\leq j\leq n\}}$. Then the step-response of $G(s)$ has no extremum for $t>0$ if there exists a *one-to-one correpondance* $\mathcal{R}$ satifying the following condition:

$$z_i\mathcal{R}p_j \iff z_i<p_j.$$

Notice that the zeros and the poles are not assumed to be single.

Manuscript received April 23, 1996; revised March 12, 1996.

The author is with the Laboratoire des Systèmes Automatiques, 80000 Amiens, France (e-mail: rachid@lsa.u-picardie.fr).

Publisher Item Identifier S 0018-9286(96)08259-1.

References

[1] S. Jayasuriya and M. A. Franchek, "A class of transfer functions with nonnegative impulse response," *ASME J. Dynamic Syst., Measurement Contr.*, vol. 113, no. 2, pp. 313–315, 1991.

[2] S. Jayasuriya and J.-W. Song, "On the synthesis of compensators for nonovershooting step response," in *Proc. 1992 Amer. Contr. Conf.*, vol. 1, pp. 683–684.

[3] J.-W. Song, "Synthesis of compensators for nonovershooting step responses," Ph.D. dissertation, Dept. Mechanical Engineering, Texas A&M Univ., 1992.

[4] B. A. León de la Barra, "Sufficient conditions for monotonic discrete time step responses," *ASME J. Dynamic Syst., Measurement Contr.*, vol. 116, no. 4, pp. 810–814, 1994.

[5] M. El-Koury, O. D. Crisalle, and R. Longchamp, "Influence of zero locations on the number of step-response extrema," *Automatica*, vol. 29, no. 6, pp. 1571–1574, 1993.

[6] B. A. Léon de la Barra, "On undershoot in SISO systems," *IEEE Trans. Automat. Contr.*, vol. 39, no. 3, Mar. 1994.