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LETTERS TO THE EDITOR

To the Editor:

In the article titled "New Approach to Analysis and Design of Smith-Predictor Controllers"by Tan et al. (June 1996, p. 1793), a new approach to the design of Smith-predictor controllers is developed on the basis of an equivalent representation of the Smith-predictor controller given in Figure 2. In the third part of the paper, the authors claim that "... we can actually view the single-loop control system as a particular case of a mismatched Smith system with $L_o = 0$" and that "With this particular representation, every Smith system has an associated 'compensated' process $F(s)$ and all the uncertainty is concentrated in this process. The properties of $F(s)$ will thus directly affect the achievable closed-loop performance of the Smith system." This implies that Figure 1 is always equivalent to Figure 2 and the transfer function from the load disturbance d to the system output y is always $g_p(s)$, even when uncertainty exists. That is impossible. In fact, Figure 1 can be equivalent to Figure 2 only when $g_p(s) = g_{po}(s)$. In addition, why are there two practical processes with different inputs in the equivalent representation of the Smith predictor? If the $g_p(s)$ in $F(s)$ and $C(s)$ is actually the model, then $C(s) = e^{sL_o}$ and $F(s) = g_{ro}(s)$. How can all the uncertainty be concentrated in the $F(s)$ and how can the $F(s)$ affect the achievable closed-loop performance of the Smith system?

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Reply:

Figures 1 and 2 in Tan et al. (1996) are equivalent whether the model is perfect or not. The confusion arises from the use of the notation d for the equivalent disturbance signal in Figure 2, which is not the same as the signal d in Figure 1. Therefore for clarity, we now replace d by $\tilde{d}$ in Figure 2, where

$$\tilde{d} = g_p(1 - g_{yr})d$$

On the question of Zhang and Xu concerning why there are "two practical processes with different inputs in the equivalent representation," we would just like to clarify that the equivalent representation is used only for the purpose of analysis and design of the Smith-predictor controller and in this instance is also used to highlight the possible use of model mismatch to improve control performance.

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