Discussion on: “H∞ Control for Networked Control Systems”

are a little different when it comes for feedback control and packet dropouts between controller and actuator. As demonstrated by [7], depending on the packet dropout rates and the weights of the optimization variable, better results can be obtained with zero-input or with hold-input schemes. Hence, the design of the mode-dependent filter could be simplified by considering a null input whenever a dropout occurs, but some simulation should be done before deciding what the best strategy for the control input is.

The output feedback control is built based on an internal model state observer interconnected with a state gain. For the mode-dependent $H_2$ control problem, a Separation Principle has been proved by [1], but there is no similar result for the $H_\infty$ control problem, to the best of my knowledge. Therefore, it would make more sense to work with a full-order dynamic output feedback controller, as indicated in [4].

Finally, it seems to me that using a limit for the number of consecutive dropouts in the communication channels, indicated in the article as $l_k$ and $h_k$, has increased too much the complexity of the problem. By considering an upper bound for that variable, the stochastic nature of the dropout is not Bernoulli anymore and the formulas for the expected values should be different. Moreover, most of the complexity on the Lyapunov function used by the authors comes from the fact that their closed loop system is represented as a discrete-time Markov jump system with time-delays.

In summary, the association of a mode-dependent dynamic output feedback controller with the quantization effects and the discussion of when to apply hold-input or zero-input strategies would be a good direction for future work by the authors, given the developments they have achieved in the article under discussion.

References


Final Comments by the Authors

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Firstly, we would like to thank the author for his comments on possible ways to improve the results in our paper.

As pointed out in the above, the Bernoulli process can be seen as a particular case of a two-state Markov chain, and the quantized control problem with dynamic quantization and Bernoulli process dropouts considered in our paper [1] is the first step of our work.

It should be pointed out that the dynamic output feedback $H_\infty$ control problem of networked control systems with packet dropouts is not a convex problem. The quantized control problem with dynamic quantization and Markov chain dropouts using state feedback is currently being prepared for submission [2].

By considering the upper bounds for the two variables, the terms $\delta_kq_{k-\delta_k}(y(k-l_k))$ in (5) of [1] and $\beta_kq_{k-\beta_k}(u(k-h_k))$ in (8) of [1] should be $\bar{\delta}_kq_{2\bar{\delta}_k-\delta_k}(y(k-l_k))$ and $\bar{\beta}_kq_{k-j\bar{\beta}_k}(u(k-h_k))$, respectively, where $\bar{\delta}_k$ is a polynomial term dependent on $l_k$ and $\delta_k$, and $\bar{\beta}_k$ is a polynomial term dependent on $h_k$ and $\beta_k$. Our work [1] keeps $\delta_k$ and $\beta_k$ unchanged, which may introduce some conservativeness into the result. The new forms have been considered in our new work [3].

In addition, our work does not consider the mode-dependent controller and does not discuss the merit of the hold-input or zero-input strategies of dropouts. The association of mode-dependent dynamic output feedback controller with the quantization effects and the discussion of when to apply hold-input or zero-input strategies are certainly a direction for future work.
References

