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Novel Stability Results for Sampled-Data Systems under Aperiodic Sampling

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Introduction

This paper is concerned with the sampling-interval-dependent stability for sample-data systems with aperiodic sampling. A new Lyapunov-like functional is constructed by introducing the double integral of the derivative of the state. When estimating the derivative of the Lyapunov-like functional, superior integral inequalities over Jensen inequality are employed to get a tighter upper bound.

Mathematical Formulas

Considering the following continuous-time linear system

$$\begin{cases} \dot{x}(t) = Ax(t) + B_1\omega(t) + B_2u(t) \\ z(t) = Cx(t) + Du(t) \end{cases}$$

Research Questions

1) A new Lyapunov-like functional is constructed.
2) Superior integral inequalities are employed to get a tighter upper bound.

Methodologies

By the Lyapunov-like functional principle, new stability results are derived.

Table

Table 1. Length of sampling interval

Method	[1]	[2]	[3]	This paper
h	1.113	1.695	1.725	1.729

Conclusion

A new Lyapunov-like functional is constructed by introducing the double integral of the derivative of the state, the double integral of the state, the integral of the state and the cross term of those integral and the sampled state. When estimating the derivative of the Lyapunov-like functional, superior integral inequalities over Jensen inequality are employed to get a tighter upper bound. By the Lyapunov-like functional principle, new stability results are derived. Finally, some examples are listed to show the stability results have less conservatism than some existing ones.