

Ets sistem pengaturan Berjaringan

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1. The authors tackle the challenges faced by Networked Control Systems (NCSs) due to data packet dropouts and transmission delays. NCSs have become increasingly prevalent in various engineering applications, and as a result, understanding their stability and control is critical for their effective implementation. The authors present a robust control strategy for stabilizing continuous-time NCSs, considering both data packet dropout and transmission delays.

The paper is well-structured and begins with an introduction to the importance of NCSs and the problems posed by data packet dropouts and transmission delays. It provides a clear overview of the relevant literature and positions the authors' work in the context of existing research. The authors effectively communicate the significance of their study and the need for a more efficient control strategy for NCSs.

The main contribution of the paper lies in the development of a novel robust control algorithm that simultaneously considers both data packet dropout and transmission delays. This algorithm is designed for continuous-time NCSs, which have not been as thoroughly explored in the literature as their discrete-time counterparts. The authors derive stability criteria for the proposed control scheme based on Lyapunov theory and provide a step-by-step procedure for constructing the control law. Additionally, the authors introduce a new method to calculate the upper bound of the allowable transmission delay, further enhancing the practicality of their control strategy.

One of the strengths of this paper is the authors' rigorous theoretical analysis. They present a series of lemmas and theorems that provide the foundation for the proposed control algorithm and prove its effectiveness. Each proof is well-structured and detailed, with the authors taking care to explain their thought process throughout.

The paper also includes a simulation study that demonstrates the effectiveness of the proposed control scheme in stabilizing continuous-time NCSs with data packet dropouts and transmission delays. The authors have chosen a suitable benchmark example, and the simulation results are presented clearly and concisely. This section effectively illustrates the practical applicability of the proposed method and serves as a validation of the theoretical results presented earlier in the paper.

In summary, this paper offers an important contribution to networked control systems by tackling data packet dropout and transmission delay issues. The authors create a strong control strategy for continuous-time systems and back it up with thorough analysis. The well-written paper is easy to follow, and the simulation study validates the effectiveness of their approach.

1. Apply smith predictor design block diagram.

The figure above illustrates the effect of delaying in the system, the blue graph is a system without delay while the orange graph is a system with delay. The blue system clearly looks like it can get to set point 1 in a span of 100 seconds, the system with a delay of 1 seconds, the system reach set point in 10 seconds.

Diagram

Description automatically generated

The result for applying smith predictor and bode plot for this system there are.





Chart

Description automatically generated

* Analysis response:

Systems with delay and without delay look different if the system given with delay with magnitude is at -62.3 dB. The phase angle in systems with delay is at -253 deg. The conclusion of the bode plot is that the magnitude of the system with a delay is higher than the system without delay and viewed from the angle of the phase of the system without delay is lower than the phase with delay.

* Analysis for time response and bode plot:

The time response of a control system using the Smith Predictor will be affected by the time delay, the controller gain, and the process dynamics. The Smith Predictor adds an additional delay to the control system, which can cause instability or oscillations if the controller gain is too high. However, if the controller gain is too low, the response time of the control system may be slower than desired. Here controller gain use .

The Bode plot of a control system using the Smith Predictor will show a phase shift at the frequency corresponding to the time delay. This phase shift can cause the system to become unstable if the gain margin and phase margin are not properly designed.

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3. In a Networked Control System (NCS) with a feedback controller, delay and sampling play a significant role in the performance and stability of the system. An event-driven control signal, denoted by in continuous-time systems or in discrete-time systems (where k is an integer time index and are the sampling interval), is generated based on certain triggering conditions, such as when the system state reaches a predefined threshold. The control signal is sent over a communication network, where it is subject to delay and sampling effects.

Delay: In NCSs, delays can occur at various stages, such as in sensor-to-controller or controller-to-actuator communication. These delays can be constant or time-varying, and they can lead to degradation in control performance or even instability. The impact of delay on the event-driven control signal or is that the controller receives outdated information about the system state, which might result in incorrect or late control actions. It is crucial to design feedback controllers that can accommodate and compensate for these delays to ensure stability and performance.

Sampling: In NCSs, the continuous-time system state is typically sampled at discrete time intervals, generating a discrete-time signal. The choice of the sampling interval directly affects the performance of the event-driven control system. If the sampling interval is too large, the controller may not capture the system's dynamics accurately, leading to poor control performance or instability. Conversely, if the sampling interval is too small, it may generate excessive control updates, increasing communication overhead and computational burden on the controller.

1. Topological entropy is a mathematical concept used to measure the complexity or chaos in a dynamical system. It quantifies the exponential growth rate of the number of distinguishable orbits as time progresses. In other words, it measures how sensitive a system is to its initial conditions and how quickly trajectories diverge over time. Higher topological entropy values imply more chaotic behaviour, while lower values suggest more predictable behaviour.

In the context of control systems, topological entropy can serve as a useful characterization tool to understand the system's behaviour and design appropriate control strategies. By quantifying the level of chaos, one can determine the required robustness and adaptiveness of the control algorithm. For example, systems with high topological entropy might necessitate more complex control laws to maintain stability or desired performance, while systems with low entropy might allow for simpler control laws.

Furthermore, topological entropy can be employed in the analysis of secure communication systems. In these systems, a chaotic signal is often used for encryption, providing increased security against unauthorized access. High topological entropy in the encrypted signal makes it more difficult for an eavesdropper to reconstruct the original information.

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