

Tugas paper sistem pengaturan Berjaringan

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Summary Paper

Title: Delay Scheduled Impulsive Control for Networked Control Systems.

Authors: Chengzhi Yuan (Student Member, IEEE) and Fen Wu.

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The paper presents a novel delay scheduled impulsive control (DSIC) scheme for Networked Control Systems (NCSs) subject to time-varying transmission delays and packet dropouts. The key idea of DSIC is to schedule the control input update and transmission at discrete impulsive instants while taking into account the delay dynamics of NCSs. The authors develop a delay scheduled controller design approach based on Lyapunov-Krasovskii functional (LKF) theory to guarantee the asymptotic stability of the closed-loop system. Furthermore, the proposed DSIC scheme is extended to cope with the uncertainties due to the delay and the packet dropouts by incorporating an adaptive learning mechanism. Finally, the effectiveness of the DSIC method is demonstrated through numerical simulations. The authors propose a novel Delay Scheduled Impulsive Control (DSIC) scheme that not only considers the delay dynamics but also ensures the asymptotic stability of the closed-loop system.

Networked Control Systems are a class of control systems where the sensors, actuators, and controllers are connected through communication networks. NCSs have become increasingly prevalent in various applications, such as robotics, aerospace, and manufacturing systems, due to the benefits of reduced wiring complexity, better scalability, and ease of remote monitoring and control. However, the introduction of communication networks also introduces time-varying transmission delays and packet dropouts, which can negatively impact the system's performance and stability.

The DSIC method aims to tackle these challenges by scheduling the control input update and transmission at discrete impulsive instants, taking into account the delay dynamics in NCSs. To ensure the asymptotic stability of the closed-loop system, the authors develop a delay scheduled controller design approach based on Lyapunov-Krasovskii functional (LKF) theory. The LKF theory is a widely recognized tool for the stability analysis of systems with time-varying delays, providing a robust foundation for the proposed DSIC scheme.

Additionally, the paper extends the DSIC method to handle uncertainties in the delay and packet dropout dynamics by incorporating an adaptive learning mechanism. This mechanism learns from the system's performance and adjusts the control strategy, accordingly, making the DSIC method more flexible and adaptable to real-world scenarios.

However, despite its advantages, the DSIC method also has some limitations. Firstly, the reliance on the LKF theory may lead to conservative stability conditions, which may not be optimal for all situations. Secondly, the adaptive learning mechanism might require more computational resources, making it less suitable for resource-constrained applications or devices. Thirdly, the assumption of a known delay model could negatively impact the DSIC scheme's performance if the real-world delay dynamics differ from the assumed model.

Advantages:

1. DSIC provides a systematic approach to cope with time-varying transmission delays and packet dropouts in NCSs, improving the stability and robustness of the system.
2. By leveraging the LKF theory, the proposed method guarantees the asymptotic stability of the closed-loop NCSs.
3. The adaptive learning mechanism enables the DSIC scheme to handle uncertainties, increasing the flexibility of the method in real-world applications.
4. The paper provides numerical simulations to validate the effectiveness of the proposed DSIC approach, demonstrating its applicability in practice.

Disadvantages:

1. The DSIC approach relies heavily on the LKF theory, which can lead to conservative stability conditions and may not be optimal in all scenarios.
2. The adaptive learning mechanism might require more computational resources, making the method less suitable for resource-constrained applications or devices.
3. The paper assumes a known delay model, which may not be accurate in real-world scenarios, potentially impacting the performance of the DSIC scheme.
4. The simulation results, while encouraging, may not fully capture the complexities of real-world NCSs and their associated challenges.