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博士论坛

# EPA网络控制系统时延特性分析

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摘要 EPA（Ethernet for Plant Automation）通过微网段划分和确定性调度策略解决了以太网的非确定性问题，实现了信息的实时传输。作为一种实时网络控制系统，网络时延特性是影响EPA控制性能的关键因素。在分析EPA信息结构和信息传输规律的基础上，研究了EPA微网段中信息传输网络时延的构成和各部分子时延的特性。通过分析确定性调度策略，对网络时延各部分中最重要的通信调度管理实体排队时延部分进行了重点研究，推导了周期报文和非周期报文排队时延的数学表达式，还建立了确定周期报文发送时间片和非周期报文发送时间片的数学模型。最后通过一个实例对相关分析进行了验证，找到了制约EPA网络时延特性的关键因素并提出了解决方案。

关键词 工业以太网 网络控制系统 网络时延
分类号

# Analysis on network delay in NCS based on EPA

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**Abstract**
EPA（Ethernet for Plant Automation）resolves the nondeterministic problem of Ethernet and accomplishes real-time communication through micro-segment topology and deterministic scheduling mechanism.As a type of NCS，network delay is a very important factor that influences the performance of EPA system.On the basis of the analysis on the constitution of EPA messages and the information transmission regularity in a sub-segment，the components of EPA information network delay are studied.The queue delay at EPA-CSME（EPA Communication Schedule Management Entity） that is the most important component of EPA information network delay is studied through analyzing EPA deterministic scheduling mechanism.The formulas for the queue delay of periodic messages and nonperiodic messages are presented and the formulas for the configuration about the time slice for periodic messages and nonperiodic messages are given.At last，an example is presented to validate the analysis on the queue delay of EPA system and the deterministic scheduling mechanism.According to the analysis in this paper，the methods to reduce EPA network delay are proposed.

**Key words** Ethernet for Plant Automation（EPA） system Networked Control System（NCS） network delay

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