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Outer synchronization and parameter identification approach to the resilient recovery of supply network with uncertainty

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Highlights:

1 Outer synchronization is applied to the resilient recovery of supply network with uncertainty.

2 Definition and measurement of the resilient recovery based on outer synchronization are proposed.

3 A supply network model with uncertain parameters, time delay and structural variation in disruption is established.

4 An impulsive pinning control is designed, and the identification laws of uncertain parameters are determined.

Abstract: The resilient recovery is of great necessity and importance to supply network with uncertainty. Outer synchronization helps the supply network restores the scheduled status. Also it has absorptive and adaptive capacity. This paper proposes a resilient recovery method based on outer synchronization. Different from previous schemes, a research on supply networks with time delay, unknown parameters and structural variation has been conducted. A dynamic model of the supply network is established, in which each node is represented as a Lorenz system. Based on the Lyapunov stability theory, an impulsive pinning controller is designed for resilient recovery. Numerical simulations and related case study are used to verify the validity of the proposed model and the resilient recovery method. Experimental results show that, the proposed method can realize the parameter identification and effective recovery with various uncertain environments.

Keywords: Outer synchronization; Resilient recovery; Supply network; Parameter identification; Impulsive pinning control;

1. Introduction

Supply network is a type of complex network with uncertainty. With the economic globalization, the supply network has become increasingly vulnerable. How to deal with disturbance or disruption of supply network is an important issue. Supply network resilience is a new conception of tolerating disturbance or disruption, which has received considerable attention in recent years [1]. For example, Kamalahmadi et al. defined the supply network resilience as: "The adaptive capability to reduce the probability of facing sudden disturbances, resist the spread of disturbances by maintaining control over structures and functions, and recover and respond by immediate and effective reactive plans to transcend the disturbance and restore the supply network to a robust status of operations" [2]. Although there has been some research on supply network resilience, and there is little research has been done on resilient recovery.