Synchronization of Discrete-Time Fractional Complex Networks with Time Delays via Event-Triggered Strategy

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Abstract. This paper is devoted to the synchronization problem of discrete-time fractional complex networks (DTFCNs) with time delays via an event-triggered strategy. First, based on the nabla-like Riemann-Liouville difference, the DTFCNs are established. And then, the pinning event-triggered controlled networks are given. Furthermore, to reduce the frequency of communications, a novel event-triggered control mechanism that only relies on the information at the trigger time is proposed. Next, some sufficient conditions are proposed for achieving synchronization. By using Lyapunov technology, it is shown that the synchronization of the DTFCNs can be achieved via the proposed event-triggered strategy.

Introduction

In recent years, complex networks exist in various fields such as ecosystems, power grids, telecommunication networks, neural networks, Internet networks, and so on. Generally, according to different principles, complex networks are divided into small-world networks [1] and scale-free networks [2]. In the theory of complex networks, the behaviours of the network dynamics are a hot research topic. Notice that in nature and technical fields, there are a large number of fractional dimensions and self-similarity between whole and part. Therefore, fractional calculus as the basis of fractal geometry and fractional dimension has been applied to many fields, such as oscillation, and random diffusion, etc. In practice applications, the event-triggered control approach was proposed for the purpose of reducing the frequency of controller updates. On the other hand, notice that many of the existing control strategies are designed per discrete-time models in the real world with the adoption of digital computers. However, the synchronization problem of DTFCNs with time delays and event-triggered strategy remains an open problem. This paper aims to fill in the aforementioned gaps.

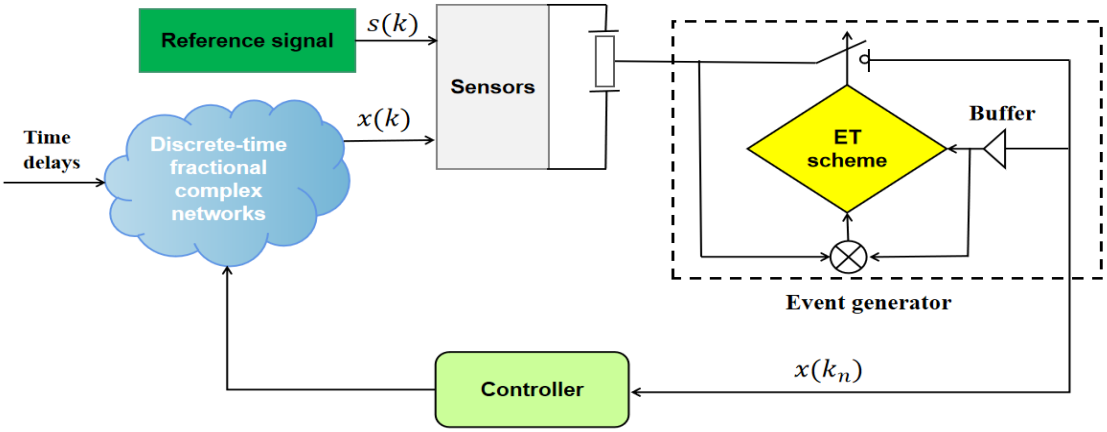

Figure 1: Event-triggered control mechanism.

Results and discussion

In this paper, consider the following DTFCNs with time delays:

$$\nabla_0^{\alpha} x_i(k) = f(x_i(k), k) + c\sum_{j=1}^{N} g_{ij}\Gamma x_j\big(k-\tau_j\big), \qquad i = 1,2,\dots,N,$$

$$x_i(k) = x_{i0} \in R^n, \quad \underline{\tau} \le k \le 0.$$

A novel event-triggered control mechanism of the following form is proposed:

$$\bar{h}_i\big(z_i(k), \varepsilon_i(k)\big) = |\varepsilon_i(k)|^2 - 2\xi(\delta_i - 1)\vartheta|z_i(k)|^2, i = 1,2,\dots,N.$$

Then, some sufficient conditions are given. By using Lyapunov technology, it is shown that the synchronization of the DTFCNs can be achieved via the proposed event-triggered strategy. The event-triggered control mechanism is depicted in Figure 1.

References

[1] Watts, D.J., Strogatz, S.H. (1998) Collective dynamics of `small-world' networks. *Nature* **393**, 440-442.

[2] Barabasi, A.L., Albert, R. (1999) Emergence of scaling in random networks. *Science* **286**, 509-512.