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# Impulsive Scaled Consensus of Multi-Agent Systems with Stochastic Perturbation

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## Introduction

In recent years, the consensus of multi-agent systems has been an active research field because of its wide applications in various fields. Compared to continuous control methods, the impulsive control protocol can reduce control costs and improve system robustness. Different from the traditional consensus, the scaled consensus means that states of MASs tend to the proportional value rather than a common value.

## Research Questions

The scaled consensus of problem of multi-agent systems considered in this paper has a wider range of applications than traditional consensus problem. The stochastic perturbation considered in this paper can make the method in this paper more practicable.

## Methodologies

Consider the model of follower agent as

$$dx_i(t) = \big(Ax_i(t) + u_i(t)\big)dt + \vartheta_i(t, \delta_i(t))d\omega(t)$$

Consider the model of leader node as

$$\dot{x}_0(t) = Ax_0(t)$$

**Definition.** The scaled consensus error is

$$\delta_i(t) = \gamma_i x_i(t) - x_0(t),$$

The distributed impulsive control input is

$$u_i(t) = \sum_{k=1}^{\infty} b_k \sum_{j\in N_i} (a_{ij}(\gamma_i x_i(t) - \gamma_j x_j(t))$$

$$+c_i(\gamma_i x_i(t) - x_0(t)))\delta^*(t - t_k)$$

The control objective is to design the impulsive controller to realize the scaled consensus in mean-squared sense, such that

$$\lim_{t\to\infty} E\|\delta(t)\| = 0.$$

## Mathematical Formulas

**Theorem 1.** Suppose Assumptions 1 and 2 hold, if

$$(\lambda_A + \lambda_\Sigma)(\tau_p^r - \tau_{p-1}^r) + \ln(\lambda_k \xi) \le 0,$$

then the scaled consensus of multi-agent systems with stochastic perturbation is achieved in mean-squared sense.

## Figures

The topology is shown in Figure 1, which satisfies Assumption 1. Figure 2 shows the scaled consensus error, and it is obvious that the impulsive protocol can realize the scaled consensus of multi-agent systems.

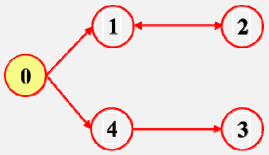


Figure 1. The topology of multi-agent systems

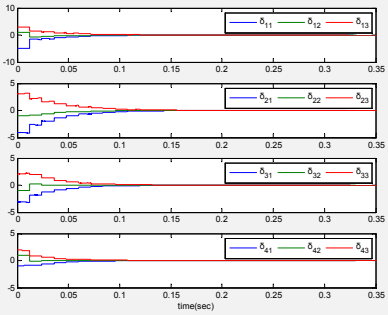


Figure 2. The scaled consensus error

## Conclusion

The paper studies the scaled consensus of multi-agent systems with stochastic perturbation via impulsive control. A sufficient consensus condition with impulsive control is derived and one numerical simulation is shown to prove the correctness of the proposed method.