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A simulation study of an algorithm for distributing power packets in a network

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Abstract—Power packet dispatching system is an efficient technology for energy saving. To support this system, we propose an algorithm for distributing power packets in a network system. In this study, we consider the consensus dynamics in a network by assuming the state variable at each node as an amount of power. In addition, we assume that network topology changes in time. These assumptions are effective for distributing power packets in power network systems in terms of decentralized control.

1. Introduction

Power packet dispatching systems have been one of promising technologies in the field of power electronics for saving power consumption [1]. Power packets are discrete units of voltage and transmitted with header and footer tags in which an information of the destination node in a power network is retained as the internet packets do. The transmitted power packets are delivered to a destination node by a router assigned at each node. In the power packets routing, there exists several limitations intrinsic to electronic circuits and devices. Therefore, a mathematical study with models is useful so as to consider an efficient algorithm for distributing power packets in a network. Specifically, we focus on consensus dynamics [2] as a simple model of diffusion dynamics in a network, which corresponds to delivering process of power packets in a power network. Then, we propose a simple algorithm for distributing power packets in the network to satisfy target amount of power in each node. That is to say, the amount of power at each node is controlled to a different level of power from the equal amount. Moreover, to diversify distribution patterns of power packets, we consider switching networks in which accessible links change with time [2]. In particular, we focus on the condition that a node in a network can interact with only one randomly selected node in the network.

2. Numerical simulations

Figure 1 shows time series of consensus dynamics at all the nodes in a 4 node network controlled by the algorithm. As shown in the time series, the state of each node is converging to a certain value, which implies that all amount of power is distributed to every node towards targeting level of power. In fact, the error from the controlled state is less than 10 % in Figure 1 .

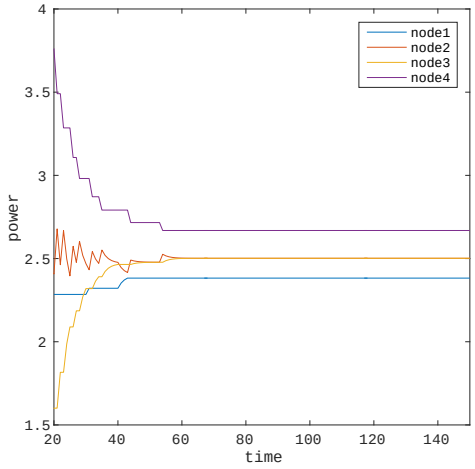

Figure 1: Time series of consensus dynamics for a 4 node network with switching topology.

3. Summary

We have numerically investigated the consensus dynamics with switching topologies of networks controlled by a local demand of power at each node. Our main concern of this study is how a decentralized control can be combined with central one for saving energy and time consumption. This combination should be done in a future work especially as circuits implementation of the proposed algorithm.

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References

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