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# Control and observation of gene regulatory networks by minimal number of molecules

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## Abstract

In modern biology, many complex biological networks have been determined by experiments. These networks describe regulations between a large number of species of molecules. Our goal is to understand the dynamics of these networks and to clarify the origin of biological functions. However, there is an obstacle: it is very difficult by the current technology to observe many molecules simultaneously with sufficient time resolution. Therefore, we cannot obtain sufficient data to describe the system as a concrete ODE system.

The Linkage Logic proposed by Mochizuki et al. and Fiedler et al. may give a solution to this problem. This theory enables us to identify the long-term dynamics of the system by observing only a subset of molecules called feedback vertex set (FVS) which is determined from the regulatory linkage alone. We will show that, as an example, cell differentiation in the development of *Ciona intestinalis* is identified or controlled by the activity of only five genes. We will also show that there is a classification of genes in the FVS: the genes related to intracellular dynamics and intercellular dynamics. We consider that the latter genes have an important role to make difference in differentiation between each cells.

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