C-5-33

Automatic Design with Frequency Characteristics for Synthetic Gene Oscillators

Takafumi Hayashi[1] t_hayashi@es.dis.titech.ac.jp
Masayuki Yamamura[1] my@dis.titech.ac.jp

[1] Department of Computational Intelligence and Systems Science, Tokyo Institute of Technology, Kanagawa 226-8503, Japan

Keywords: synthetic gene circuit, oscillator, design automation

Oscillation is an essential phenomenon in biological systems. Many activities and life maintenance of organisms are supported by that phenomenon. For this reason, a deeper understanding about oscillation in biological system is important in biology. In synthetic biology, synthetic gene circuit is used as a tool to understand the biological system [1]. In order to get a deeper understanding of biological systems, the more complex and larger gene circuits are required. As increasing the number of components, however, difficulty of design becomes higher exponentially. It is difficult to design in human trial and error or ad-hockery. Therefore, Automatic design approaches are important [2].

We propose an automatic design method for synthetic gene oscillators. In previous research related to automation of design, an evaluation is calculated by error of protein concentration in only time domain. However, that evaluation function might make inadequate landscape to optimize an oscillate solution because it' sensitivity for a shift of phase is too strong. The proposed method is also to use the frequency characteristic in the evaluation function. That function can make more appropriate landscape to search oscillators. Moreover we propose two-stage design method. In the first stage, it optimizes the network structure by frequency characteristics. In the second stage, it optimizes parameters by error in time domain. As a result of performance examinations, it was shown that the probability to find an optimal solution by proposed method is higher than previous methods.

[1] Elowitz, M. Lim, W.A., Build life to understand it, Nature, 2010.
[2] Macdonald J.T., Barnes C., Kitney R.I., Freemont P.S., Stan G.B., Computational design approaches and tools for synthetic biology, Integrative Biology, 2011.