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Systematic approach to Escherichia coli cell population control using a genetic lysis circuit

Chih-Yuan Hsu 1,2, Tsu-Chun Yu 1, Ling-Jiun Lin 2, Rei-Hsing Hu 2 and Bor-Sen Chen 1,2

1 Lab of Control and Systems Biology, Department of Electrical Engineering, National Tsing Hua University, Taiwan

2 Lab of Genetic Circuit Design, Department of Electrical Engineering, National Tsing Hua University, Taiwan

Abstract

Background

Cell population control allows for the maintenance of a specific cell population density. In this study, we use lysis gene BBa_K117000 from the Registry of Standard Biological Parts, formed by MIT, to lyse *Escherichia coli* (*E. coli*). The lysis gene is regulated by a synthetic genetic lysis circuit, using an inducer-regulated promoter-RBS component. To make the design more easily, it is necessary to provide a systematic approach for a genetic lysis circuit to achieve control of cell population density.

Results

Firstly, the lytic ability of the constructed genetic lysis circuit is described by the relationship between the promoter-RBS components and inducer concentration in a steady state model. Then, three types of promoter-RBS libraries are established. Finally, according to design specifications, a systematic design approach is proposed to provide synthetic biologists with a prescribed I/O response by selecting proper promoter-RBS component set in combination with suitable inducer concentrations, within a feasible range.

Conclusion

This study provides an important systematic design method for the development of next-generation synthetic gene circuits, from component library construction to genetic circuit assembly. In future, when libraries are more complete, more precise cell density control can be achieved.