

Towards construction of genetic relaxation oscillators

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Abstract

One of the most significant goals of synthetic biology is construction of controllable systems in a cell. Until today, several synthetic genetic networks have been proposed, for example oscillators^{1,2}, a bistable toggle switch³ and an inter-cellular communication system⁴. Particularly, the networks exhibiting oscillatory behaviours are of interest in terms of biological rhythms. We show novel models of genetic relaxation oscillators. Performances and qualitative characteristics of the models are evaluated by means of computer simulation and nonlinear dynamics such as phase plane and bifurcation analysis. Designs of plasmids to construct the models are also discussed in connection with Registry of Standard Biological Parts (<http://parts.mit.edu>). It is also planned to characterise quantitative properties of “biomolecular parts” of the systems by (1) a parameter estimation method using time-series fluorescence intensity⁵ and (2) free energy calculation using molecular dynamics simulation⁶.

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