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## **Evolutionary network design for precise oscillations in fluctuating genetic systems**

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Genetic oscillations play important roles in biological functions, such as circadian clocks and segmentations. There, precise oscillations are required although the genetic systems have internal noise originating from small number of protein molecules. Genetic networks in real systems would be evolutionary selected in order to show oscillations that have not only desired period [1,2] but also high precision. Thus, it is important to clarify how a network of genetic interactions should be designed for precise oscillations.

In this study, we employed a genetic network model, which has internal noise and inhibitory interactions, and constructed networks showing precise oscillations using evolutionary optimization algorithms. The obtained networks have the smaller standard deviation of oscillation periods in the presence of the intrinsic noise. Properties of the designed networks will be discussed.

[1] Y. Kobayashi, T. Shibata, Y. Kuramoto, and A.S. Mikhailov: Evolutionary design of oscillatory genetic networks. *Eur. Phys. J. B* 76, 167-178 (2010)

[2] Y. Kobayashi, T. Shibata, Y. Kuramoto, A.S. Mikhailov: Robust network clocks: Design of genetic oscillators as a complex combinatorial optimization problem. *Phys. Rev. E* 83, 060901 (2011)