

Synthetic gene network is a rapidly advancing technology for constructing applied biological systems to exhibit desired behaviors. But their progress faces obstruction from internal and external variability. This book introduces several robust design methods for constructing synthetic gene networks to specification, allowing them to tolerate intrinsic parameter fluctuations and attenuate environmental disturbances. To start, a synthetic gene network is described as having random parameter perturbations and external disturbances in the host cell. Robust design essentially depends on the appropriateness of design parameters to achieve design specifications despite uncertain parameter variations, external disturbances, and variations of regulatory functions; this is achieved through the H_2 optimal tracking and H_∞ disturbance filtering methodology. When synthetic gene networks become complex and their design procedure becomes complicated, network evolutionary methods based on GA and EA algorithms can also be introduced to simplify the process. Also described is the design of robust synthetic gene networks based on library-search methods, in which the promoter libraries or the promoter-RBS libraries are assembled completely. Examples of robust design for synthetic biological filters and transistors based on promoter-RBS libraries serve as case studies to illustrate the feasibility of the design procedure and to confirm its high performance.

In the integrated circuit industry, system design and system implementation companies cooperate to produce very-large-scale integration (VLSI) circuits of high complexity through division of labor. Similarly, system designers should collaborate with synthetic biologists to engineer complex synthetic gene networks. The synthetic design tools in this book will be crucial for ensuring efficient collaboration and advancing future synthetic biology.

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