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Synthetic Gene Networks: *De novo constructs* – *in numero* descriptions

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Uncovering the structure and function of gene regulatory networks has become one of the central challenges of the post-genomic era. Theoretical models of protein-DNA feedback loops and gene regulatory networks have long been proposed, and recently, certain qualitative features of such models have been experimentally corroborated. This talk will focus on model and experimental results that demonstrate how a naturally occurring gene network can be used as a "parts list" for synthetic network design. The model formulation leads to computational and analytical approaches relevant to nonlinear dynamics and statistical physics, and the utility of such a formulation will be demonstrated through the consideration of specific design criteria for several novel genetic devices. Fluctuations originating from small molecule-number effects will be discussed in the context of model predictions, and the experimental validation of these stochastic effects underscores the importance of internal noise in gene expression. The underlying methodology highlights the utility of engineering-based methods in the design of synthetic gene regulatory networks.