

***Unconventional systems analysis problems in molecular biology:
A case study in gene regulatory network modeling***

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The broad conceptual postulate that systems engineering techniques developed for complex chemical processes may be applicable to complex cell biological processes is very compelling. However, a naïve, "direct" application of systems engineering techniques to biological problems of practical significance may be rendered virtually ineffective by fundamental differences between cell biology and chemical processes. These differences and the problems they pose are illustrated in this paper with an example problem: modeling a gene regulatory network involved in the yeast cell cycle. We demonstrate how the biological essence complicates a straightforward "process modeling/identification" problem and subsequently recommend an alternative approach. The approach—a middle ground between a direct, "off the shelf" application of systems engineering tools and a "one-at-a-time" ad-hoc development—incorporates fundamental knowledge of the mechanisms and constraints intrinsic to biological systems. The principles and implementation details of the approach are illustrated with the case study.