REVERSE ENGINEERING AND SYNTHESIS OF BIOMOLECULAR SYSTEMS

GIL ALTEROVITZ

Division of Health Sciences and Technology, Harvard University/Massachusetts Institute of Technology, Cambridge, MA 02139, USA. Children's Hospital Informatics Program, Boston, MA 02115, USA. Department of Electrical Engineering and Computer Science, Cambridge, MA 02139, USA. Partners Healthcare Center for Personalized Genetic Medicine, Harvard Medical School, Boston, MA 02115, USA. gil@mit.edu

SILVIO CAVALCANTI

Department of Bioengineering, University of Bologna, Bologna, Italy.

TARO M. MUSO

Partners Healthcare Center for Personalized Genetic Medicine, Harvard Medical School, Boston, MA 02115, USA.

MARCO F. RAMONI*

Children's Hospital Informatics Program, Boston, MA 02115, USA. Division of Health Sciences and Technology, Harvard University/Massachusetts Institute of Technology, Cambridge, MA 02139, USA. Partners Healthcare Center for Personalized Genetic Medicine, Harvard Medical School, Boston, MA 02115, USA.

MAY WANG

Department of Biomedical Engineering, Georgia Institute of Technology, Atlanta, GA 30332, USA.

1. Introduction

Synthetic biology is the new frontier of biological engineering. Instead of incrementally altering living organisms, synthetic biologists propose to use biological knowledge, modular biological parts, and computer-aided design to quickly develop systems capable of unprecedented biochemical feats. Synthetic biology therefore promises dramatic improvements in green chemistry [1], alternative energy [2], drug manufacture [3,4], and therapeutirs [5].

There have been numerous recent advancements in synthetic biology. The need for accuracy at the design and simulation stage have inspired dialogue on how to add functional characterizations to parts documentation in the Registry of Standard Biological parts [6,7]. In addition, a design strategy -- constructing networks from quantitatively characterized libraries of diversified components -- has been proposed [8]. A synthetic network must be integrated into an engineering chassis. To this end the development of evolved ribosome-mRNA pairs may be the first step towards an orthogonal cellular network [9 10 11 12].

Although scientists have made significant progress in synthetic biology, the field must still overcome a number of challenges. To this end, this session offers novel methodologies in three general areas: namely, in designing synthetic systems, in developing novel biological parts, and in analyzing complex networks.

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2. Session Papers

Design principles and development strategies from other engineering disciplines must be adjusted to the peculiarities of biological systems. **Kharam *et al***. propose a rate independent scheme to implement binary counting using chemical reactions. **McDermott *et al***. develop enhanced network models to determine biological dependencies that help predict behavior of a system. **Senum *et al***. present a collection of computational modules implemented with chemical reactions, independent of exact reaction rates. **Uhlendorf *et al***. have proposed and developed a system towards in vivo control of gene expression using an experimental platform combining micro-fluidic device, an epi-flouresence microscope and software approaches. **Verdicchio *et al***. have demonstrated how logic minimization of the collections of state in Boolean network basins of attraction can help identify targets for intervention.

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