

SPECIAL ISSUE

## SYSTEMS AND SYNTHETIC BIOLOGY

*Edited by M. H. Khammash and J. Stelling*

### 523 The Hallmarks of Mathematical Oncology

*By J. A. Bull and H. M. Byrne*

**| INVITED PAPER |** This article reviews classes of mathematical models used to understand and treat cancer, with the perspective of upcoming validated and clinically applicable cancer models.

### 541 Metabolic Networks, Microbial Consortia, and Analogies to Smart Grids

*By A. Theorell and J. Stelling*

**| INVITED PAPER |** This tutorial article introduces approaches to predict fluxes in chemical reaction networks inside living cells, with an emphasis on similarities to (smart) electrical grids.

### 557 Machine Learning Approaches to Single-Cell Data Integration and Translation

*By C. Uhler and G. V. Shivashankar*

**| INVITED PAPER |** This article describes how problems arising in the analysis of individual biological cells and of cell-to-cell variability have inspired foundational developments in machine learning.

### 577 Spiking Control Systems

*By R. Sepulchre*

**| INVITED PAPER |** From control and circuit theory perspectives, this article reviews efforts toward developing a control theory of natural and engineered spiking (mixed discrete and continuous) systems.

### 590 Learning Outside the Brain: Integrating Cognitive Science and Systems Biology

*By J. Gunawardena*

**| INVITED PAPER |** This article uses concepts ranging from cognitive science to control theory to discuss how learning in biological systems is possible outside of, or even without, a brain.

### 613 Synthetic Gene Circuits: Design, Implement, and Apply

*By A. Lezia, A. Miano, and J. Hasty*

**| INVITED PAPER |** This article gives a broad overview of the field of synthetic biology, focusing on the engineering of genetic circuits.

DEPARTMENTS

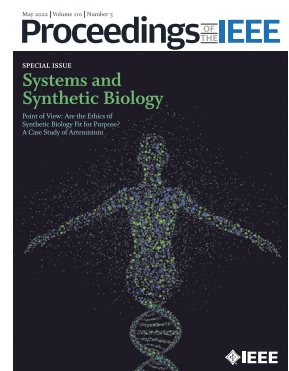
### 511 POINT OF VIEW

Are the Ethics of Synthetic Biology Fit for Purpose? A Case Study of Artemisinin  
*By J. Dalziel and W. Rogers*

### 518 SCANNING THE ISSUE

Systems and Synthetic Biology  
*M. H. Khammash and J. Stelling*

### 708 FUTURE SPECIAL ISSUE/SPECIAL SECTIONS



### On the Cover:

This month's cover is an artist's depiction of the role DNA plays as the design template for all living organisms and its importance in synthetic biology.

[Continued on page 510 ►]

# CONTENTS

CONTINUED FROM PAGE 509

SPECIAL ISSUE: Systems and Synthetic Biology

## 631 **Cybergenerics: Theory and Applications of Genetic Control Systems**

By *M. H. Khammash*

| INVITED PAPER | This expository article presents an introduction to the exciting field of genetic control systems (cybergenerics). It covers the basic theory, implementation, and applications of this nascent field.

## 659 **Advances in the Computational Design of Small-Molecule-Controlled Protein-Based Circuits for Synthetic Biology**

By *S. Kretschmer and T. Kortemme*

| INVITED PAPER | This article reviews the field of computational protein design, focusing on the advances in the engineering of synthetic small-molecule-binding protein sensors as well as sensor-actuator proteins.

## 675 **Bayesian and Algebraic Strategies to Design in Synthetic Biology**

By *R. P. Araujo, S. T. Vittadello, and M. P. H. Stumpf*

| INVITED PAPER | This article provides an overview of two complementary approaches (algebraic and Bayesian) for rational design in synthetic biology.

## 688 **Synthetic Morphogenesis: Introducing IEEE Journal Readers to Programming Living Mammalian Cells to Make Structures**

By *J. A. Davies*

| INVITED PAPER | This article shows how complex tissues can develop from a small number of elementary behaviors and proposes ways in which they can be manipulated to yield synthetically designed shapes.

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