Preface

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Held annually since 1995, the International Conference on DNA Computing and Molecular Programming, now under the auspices of the International Society for Nanoscale Science, Computation, and Engineering, has become the foremost venue for work in biomolecular computing, a growing field at the intersection of computer science, chemistry, biophysics, and molecular biology. The meeting is a unique forum where scientists with widely different backgrounds meet and interact.

This special issue contains a selection of 7 papers presented in preliminary form at DNA 18: the 18th International Conference on DNA Computing and Molecular Programming, held 14–17 August 2012 at Aarhus University, Denmark. The papers are representative of the breadth of topics of the conference: theory, simulations, experimental results, and applications.

“Reachability Bounds for Chemical Reaction Networks and Strand Displacement Systems” by Anne Condon, Bonnie Kirkpatrick, and Jan Manuch tackles the fundamental limits of chemical reaction networks with respect to their ability reliably to implement long computations, showing that if the number of reactants exceeds a certain bound crosstalk is inevitable.

“Deterministic Function Computation with Chemical Reaction Networks” by Ho-Lin Chen, David Doty, and David Soloveichik takes up the question of what functions

(in a unary representation) can be deterministically computed by a chemical reaction network, showing that it is just the semilinear functions.

“Simulating a burnt-bridges DNA motor with a coarse-grained DNA model” by Petr Šulc, Thomas E. Ouldridge, Flavio Romano, Jonathan P. K. Doye, and Ard A. Louis describes a coarse-grained molecular-dynamics simulation of DNA strand displacement for the scenario where a cargo strand can migrate by toehold-based strand exchange between two single-stranded stators attached to a surface, a critical step in a DNA walker design.

“Probabilistic reasoning with a Bayesian DNA device based on strand displacement” by Iñaki Sainz de Murieta and Alfonso Rodríguez-Patón proposes using DNA strand displacement directly to represent a form of Bayesian inference, and thus compute conditional event probabilities.

“Enforcing delays in DNA computing systems” by Nathanaël Aubert, Yannick Rondelez, Teruo Fujii, and Masami Hagiya presents a design and first experimental data on a generic delay gate that can be interfaced with various DNA reaction systems, which can be used to enforce sequential execution of critical operations.

“A DNA Based Molecular Logic Gate Capable of a Variety of Logical Operations” by Anton Kan, Yoko Sakai, Koh-ichiroh Shohda, and Akira Suyama reports simulations and experiments with a set of logic gates that use reverse transcription and DNA polymerization to translate RNA inputs to RNA outputs.

“Modeling Scalable Pattern Generation in DNA Reaction Networks” by Peter B. Allen, Xi Chen, Zack B. Simpson, and Andrew D. Ellington shows a way to build macroscale objects using the logic of DNA reactions to draw programmable, deterministic spatial patterns.

All papers contributed to the special issue were reviewed independently of the conference review process.

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