Preface

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The International Conference on DNA Computing and Molecular Programming, held under the auspices of the International Society for Nanoscale Science, Computation, and Engineering (ISNSCE), is the premier conference for research investigating the possibility of programming molecules to carry out computation. The conference features contributed and peer-reviewed talks, poster presentations, and invited talks of leading scientists. The conference attracts a wide range of scientists from many backgrounds such as mathematics, computer science, physics, chemistry, biology, bioengineering, electrical engineering, and nanotechnology.

This special issue of Natural Computing is associated with the 27th International Conference on DNA Computing and Molecular Programming, held September 13–16, 2021. This virtual conference was hosted by the University of Oxford, UK, due to ongoing restrictions imposed by the COVID-19 pandemic. Three papers that had been peer-reviewed and presented in preliminary form at the conference accepted the invitation to the special issue. Each was subjected to a thorough review independent of the DNA 27 reviewing process. This issue contains the final, full versions of those three papers.

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The paper "Parallel Pairwise Operations on Data Stored in DNA: Sorting, Shifting and Searching", by Tonglin Chen, Arnav Solanki and Marc Riedel, harnesses the massive parallelism inherent in molecular computation to carry out highly parallel operations on data stored encoded in DNA. The authors demonstrate the implementation of three key operations fundamental to computer science: sorting, shifting, and searching, using strand displacement reactions.

The paper "Reactamole: Functional Reactive Molecular Programming", by Titus Klinge, James Lathrop, Peter-Michael Osera, and Allison Rogers, introduces a novel mechanism for synthesis of chemical reaction network designs based on a correspondence with functional reactive programming, a declarative programming technique from computer science. The authors show that functional reactive programs can be compiled into corresponding chemical reaction networks and thus provide a powerful high-level specification language for molecular programming.

The paper "Self-Replication via Tile Self-Assembly", by Matthew Patitz, Daniel Hader, and Andrew Alseth, extends the signal-passing tile assembly model into 3D to produces a new model of flexible tile assembly called STAM*. The authors show that this model is capable of self-replicating behavior in which initial seed configurations can encode a target shape to be built. This work sheds new light on the minimal requirements for self-assembly processes capable of shape self-replication.

The guest editors thank the authors of papers from DNA 27 who contributed papers as well as the referees who agreed to review the submissions, all of whom made helpful suggestions that significantly improved the quality of the papers. The guest editors also thank Joost Kok, Grzegorz Rozenberg, and the staff of Natural Computing for their effort in assembling this special issue. Finally, the guest editors are grateful to the conference organizers, authors of track A, B, and C submissions, and attendees at the DNA 27 virtual conference, which was an excellent gathering during a difficult time.

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