Zdynia 17th-21th September 2024

ON APPLICATIONS OF BIOMOLECULAR COMPUTERS

Sebastian Sakowski[1,2]

[1]Faculty of Mathematics and Computer Science, University of Lodz
Banacha 22, 90-238 Lodz, Poland,
[2]Centre for Data Analysis, Modelling and Computational Sciences, Lodz, Poland
sebastian.sakowski@wmii.uni.lodz.pl

ABSTRACT

In recent years, there has been an increase in interest in the applications of biomolecular computers, for example, to store information using DNA [1] and even using CRISPR to create a molecular digital data storage [2]. Technical solutions based on DNA are particularly suitable for applications in medicine, because nanomachines made of biomolecules are compatible with the cellular environment and biochemical reactions [3]. However, presently these technical solutions are at the initial stage of development and there are no publicly available technical solutions that cover the applications of biomolecular computers. Therefore, detailed theoretical research and practical implementations in this area are necessary, eg, the operation of restriction enzymes, such as endonuclease *Bae*I, that cut double-stranded DNA molecules in both directions (to the left and right) [4].

This report presents new directions for research on biomolecular computers and preliminary scientific results of using biomolecular computers for cancer diagnosis. This research was carried out as part of the National Science Center project, which included two research visits. The first was carried out at the prestigious Duke University (USA, Durham), while the second research stay took place at Justus Liebig University (Germany, Giessen). As part of this research, a new type of biomolecular computer was designed and a new application of biomolecular computers for cancer diagnosis was developed.

ACKNOWLEDGEMENTS

This project is supported by the National Science Centre, Poland, grant number: 2023/07/X/ST6/00078.

REFERENCES

[1] V. Zhirnov, R. M. Zadegan, G. S. Sandhu, G. M. Church, and W. L. Hughes: *Nucleic acid memory*, Nature materials **15(4)** (2016), 366-37.

[2] A. Sadremomtaz, R. F. Glass, J. E. Guerrero, D. R. LaJeunesse, E. A. Josephs, and Zadegan R.: *Digital data storage on DNA tape using CRISPR base editors*, Nature Communications **14(1)** (2023), 6472.

[3] S. Sakowski, J. Waldmajer, I. Majsterek, and T. Poplawski: *DNA Computing: Concepts for Medical Applications*, Applied Sciences **12** (2022), 6928.

[4] S. Sakowski, T. Krasiński, J. Waldmajer, J. Sarnik, J. Blasiak, and T. Poplawski: *Biomolecular computers with multiple restriction enzymes*, Genetics and Molecular Biology **40 (4)** (2017), 860-870.