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ERROR-TOLERANT MINIMUM FINDING WITH DNA COMPUTING

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Abstract. *In the past decade, DNA computing has become one of the powerful approaches to solve a class of intractable computational problems such as Hamiltonian path problem and SAT problem. The power of DNA computing comes from the fact that it has great potential of massive data storage and processing computation over data in parallel. In this paper, an algorithm for solving the minimum finding problem is proposed in theory with a randomized scheme – the broadcasting scheme on the broadcast communication model. Our method is a novel strategy for optimization in DNA computing, since it can tolerate some chemistry reaction and experiment errors. The less errors are, the less the number of required iterations is. A series of computer simulations are also performed and analyzed to demonstrate the feasibility of the algorithm and the designed experiment.*

Keywords: Molecular computing, DNA computing, Minimum finding, Chemistry experiment error

1. **Introduction.** DNA computing uses DNA strands to encode input and output data and handles the strands with biochemical operations for solving hard problems in the domain of algorithms [2, 8, 11, 12, 13, 14, 16, 17, 25]. Compared to the traditional silicon-based computing system, there are two advantages in DNA computers – high capacity of data storage and massive parallelism in computing. For instance, there are about 6×10^{17} DNA molecules in 1 μmol, and if one bit is encoded with one nucleotide, 1 μmol DNA molecules hold 6×10^{17} bits of information, which is much more than the most massive scale 10^{12} bits (Tera bits) of the storage in a computer nowadays. In DNA computing, different data can be encoded into DNA strands, which can be processed with the biomolecular operations such as primer extension, PCR, restriction enzyme digestion, and gel electrophoresis [4, 10, 18, 21, 23]. If these operations in the tube can be regarded as logical and arithmetic processes of the traditional computer system, the interactions of DNA strands in the tube will be similar to the logical and arithmetic processing in a traditional computer. Moreover, because the interactions take place in the tube simultaneously, DNA computing can be regarded as multiple processors to execute the same instructions in a parallel computer. Consequently, instead of treating data one by one,