BUILDING A PARALLEL DECISION-MAKING SYSTEM BASED ON RULE-BASED CLASSIFIERS IN MOLECULAR ROBOTICS

Wibowo Adi\textsuperscript{1,2} and Kosuke Sekiyama\textsuperscript{1}

\textsuperscript{1}Department Micro-Nano System Engineering, Nagoya University, Nagoya, Japan
\textsuperscript{2}Department of Informatics, Diponegoro University, Semarang, Central Java, Indonesia

Email: wibowo@robo.mein.nagoya-u.ac.jp

Submitted: Feb. 20, 2015  Accepted: Mar. 27, 2015  Published: June 1, 2015

Abstract. Controlled drug delivery based on cellular components can be achieved by exploiting disease-specific properties, but these require a rapid, sensitive, and selective method of detection in a biomolecular system. We propose a parallel decision-making system for disease detection and classification based on the fact that DNA computing along with biomolecular systems can be subjected to massively parallel processing. We designed and programmed a DNA strand displacement reaction to implement rule-based classifiers from a binary tree classification as a decision-making system. In our framework for molecular robot development, the system components of molecular robots and simple classifier rules were used to alleviate the computational burden. The design consists of a basic model that generates rule-based classifier gates in several binary tree and cancer classifications based on micro (mi)RNA expression. Simulation results showed that detection and classification were rapid using this system. Moreover, experiments using the synthetic miRNA hsa-miR-21 demonstrated that our model could be a feasible decision-making system for drug delivery.

Index terms: Molecular robotics, DNA strand displacement, Rule-based classifiers, Binary tree classification.