

# A model of the RS memory-cell realization in biological systems

**Extended abstract.** In the past eighty years computer structures that represent the basic logic primitives in the construction of computer systems have been based on electronic components. Recently, there has been a strong need noted to have them minimised and to make their response-time faster [1]. To achieve the goal, alternative information-processing platforms are being looked for. Biological systems are certainly one of the possible alternative processing platforms of the future [2]. Dynamics of these circuits is based on the presence (respectively absence) of specific proteins, i.e. transcriptional factors. By manipulating these circuits with genetic engineering (i.e. DNA modifications), their desired behaviour can be achieved. Here we present the basic concepts of these systems on the example of the RS memory-cell for which we developed a mathematical model based on Ordinary Differential Equations (ODEs). We also made a simulation model in the Matlab/Simulink environment (Figures 7 and 8). We simulate the behaviour of our circuit in ideal circumstances (Figure 9) and in those which are an approximation of a real environment (Figure 10). The promising simulation results indicating that realization in a living tissue is possible will be addressed in our future work.

**Key words:** genetic regulatory network, synthetic biology, RS memory-cell, memorizing in biological systems, unconventional computing

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## 1 Uvod

Z veljavnostjo Moorovega zakona, ki napoveduje podvajanje kompleksnosti in s tem podvajanje hitrosti delovanja mikroprocesorjev na približno vsaki dve leti [1], se velikost osnovnih sestavnih delov digitalnih struktur (tranzistorjev) iz leta v leto zmanjšuje. S takšno miniaturizacijo bodo v približno desetih letih tako velikosti tranzistorjev dosegle nanometrsko velikostno raven, v katero spadajo atomi in molekule. Ker je elektronsko pogojeno obvladovanje dinamike entitet na tej ravni težko obvladljivo zaradi vplivov šuma, kvantnih efektov itd., menimo, da bo računalniška tehnologija soočena z iskanjem alternativnih platform procesiranja.

Ena od obetajočih je procesiranje v bioloških sistemih, kjer je temeljni nosilec programiranja dinamike zaporedje DNK. Glavni del DNK-zaporedja je zapis pogojev za proženje generiranja proteinov in