Simulating Shuffle–Exchange Networks with P Systems

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Abstract. We present in this paper a simulation with P systems of the parallel architecture known as *shuffle–exchange network*. This will lead us to consider a new version of P systems with communication, for which the communication graphs are not fixed, but have a dynamic evolution, and for which different communication rules can be associated to different communication graphs. The simulation of the shuffle–exchange network provides a first, simple example, of such a system.

1 Introduction

Any computer, whether sequential or parallel, operates by executing instructions on data. An algorithm (*stream instructions*) tells the machine what to do at each moment, and the input of an algorithm (*stream data*) is affected by the instructions of the algorithm.

A parallel machine consists of a large number of processors (each one have an arithmetic logic unit with registers and a private memory) that be able to solve problems in a cooperative way; that is, that machine is capable of executing several instructions at the same time unit. Basically there are two different kinds of parallel machines according to the possibility to execute, simultaneously, either the same instruction of different data sets (**SIMD**) or different instructions on different data sets (**MIMD**).

In [1] deals with some sorting parallel algorithms, based on a comparison network model of computation, which incorporates features of parallelism, and a simulation of these algorithms through P systems with communication is presented.

In this paper we study the perfect shuffle **SIMD** computer where the processors interconection is based on the *shuffle* and *exchange* functions (that is, by a *shuffle–exchange network*), and we analyze the possibility to simulate this parallel architecture by a cellular computing with membranes.

The paper is organized as follows. In Section 2 we first give some preliminary notions on the perfect shuffle **SIMD** architecture, and some interesting properties of this parallel model are presented. In Section 3 we introduce a variant of P systems with communication modelling perfect shuffle machines. Section 4 and Section 5 illustrate the above simulation with parallel algorithms to sum integer numbers and to find the maximum of a finite numbers of integer numbers. In the last section some conclusions and remarks of our study are presented.

References

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