Abstract

Cellular automata have a widespread use in the description of complex phenomena in disciplines as disparate as, for example, physics and economics. A cellular automaton is a lattice of cells, and the cells can be in a finite number of states. By using simple local rules the states of the cells are updated in parallel at discrete time steps. In short, a cellular automaton can be characterised by the three words—simple, local, and parallel. These three words are one of the reasons for the attractiveness of cellular automata. They are simple to implement and they are well suited for parallel computers (computations). Another reason for using cellular automata are for their spatio-temporal properties. The lattice may represent space and the updating of the cells gives a dimension of time.

In spite of the simplicity of cellular automata they may give rise to a complex macroscopic behaviour. This is illustrated, in this thesis, by an hydrodynamic example, namely the creation of vortices in flow behind a cylinder.

Although cellular automata have the ability to describe complex phenomena it is sometimes hard to find the proper rules for a given macroscopic behaviour. One approach which has been successfully employed is to let cellular automata rules evolve (for example, through genetic algorithms) when finding the desired properties. In this thesis this will be demonstrated for two-dimensional cellular automata with two possible states of the cells. A genetic algorithm is used to find rules that evolve a given initial configuration of the cells to another given configuration.