# A Parallel Neural Computing Method for Solving Two-Dimension Shallow Water Equations

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**Abstract:** This paper proposes a parallel computing method for solving two-dimension shallow water equations using cellular neural network (CNN). Two-dimension shallow water equations are used to model the motion of water on the lake or on the sea and to calculate water level of the tide on an area of the sea. This problem requires a huge computing time on digital computers so that it usually doesnt satisfy the demand for fast computing in forecasting and controlling the dam break flow or tidal flows in estuary etc.

Due to parallel processing, cellular neural network is capable to compute flow data in real-time and it will give a good method to solve 2D, 3D shallow water equations in very short time.

The shallow water equations are usually described by a set of partial differential equations as follow:

$$\frac{\partial h}{\partial t} + \frac{\partial (uh)}{\partial x} + \frac{\partial (vh)}{\partial y} = 0$$

$$\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} + g\frac{\partial h}{\partial x} = -\frac{gu(u^2+v^2)^{1/2}}{K_x^2 h^{4/3}} + gS_{ox}$$

$$\frac{\partial v}{\partial t} + u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} + g\frac{\partial h}{\partial y} = -\frac{gv(u^2+v^2)^{1/2}}{K_y^2 h^{4/3}} + gS_{oy}$$

Here, $h$ is the water level; $u, v$ are the average velocities of water in $x, y$ directions; $g$ is the acceleration of gravity; $K_x, K_y$ are the friction diffusion factors; $S_{ox}, S_{oy}$ are the slop of the bottom of the sea. The set of those equations has been solved by numerical methods on digital computers. However, solving by CNN is quite different with the advantages of the parallel and real time processing.

This paper is organized in 5 parts. In the 1st part, two-dimension CNN is introduced. The problems of the 2D shallow water equations are described in part 2. Part 3 proposes a method to solve the 2D shallow water equations by multi layer CNN. Some illustrative simulation results are presented in part 4. Finally, we consider some concluding remarks.

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