Abstract

The goal of the work presented in this dissertation was to develop new, efficient parallel algorithms for selected problems in hydrological modeling and geographic information systems (GIS). The issues addressed included calculating flow accumulation, delineating watersheds and identifying the longest flow paths. The proposed algorithms were closely evaluated and compared with other existing solutions, both from the literature and commonly used software packages. The results demonstrate significant advantages of the developed algorithms over alternative solutions designed to perform the same tasks. Importantly, the proposed concepts allow for much more efficient use of modern multi-core architectures.

The dissertation consists of three thematically related research publications. Each of them addresses a separate computational problem and presents the solutions developed by the author, assessing their value in relation to the current state of research.

Chapter 1 outlines the background and topics of the research conducted. It specifies the scope and most important objectives, as well as the thesis of this dissertation.

Chapter 2 provides a brief introduction to the area of parallel computing. It covers issues that constitute the common background for all three publications.

Chapter 3 presents selected topics related to hydrological modeling and geographic information systems. The computational issues that were the main focus of this research are outlined here.

Chapter 4 describes the three publications included in the dissertation. It presents the scope of research work, discussing the assumptions, methods and technologies used. The most important results were also highlighted.

Chapter 5 presents a short summary of all the research work carried out, including the most important results and key conclusions. Potential directions for further research were also proposed.

Appendices A, B and C contain the published research papers and therefore present in detail the work carried out within this dissertation.