DIGITAL TERRAIN ANALYSIS FOR HYDROLOGICAL MODELING PURPOSES: INTRODUCING AND COMPARISON OF DIFFERENT TECHNIQUES

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Increasing broad availability of Digital Elevation Models (DEMs) as an interesting and complex source of information about catchment requires adequate development and applicability testing of Digital Terrain Analysis (DTA) techniques. There have been developed a lot of procedures processing DEMs for hydrological modeling purposes since 1980's, including those which are focused on deriving some specific topographic indices (e.g. the well known TOPMODEL wetness topographic index, Quinn *et al.*, 1991, 1995; Sorensen *et al.*, 2006), extraction of channel (or drainage) network (Tarboton *et al.*, 1991, Soille *et al.*, 2003) or watershed delineation and sub-catchment partitioning (Jenson et Domingue, 1988). Though there exists a number of such procedures and algorithms, in commonly used GIS-based modelling software (like ArcGIS, TOPAZ or GRASS) often merely one (and often the simplest, but not the best one) is implemented, so modelers dependent on this kind of software (probably the majority of modelers...) are constrained by this impossibility of choosing the right method, corresponding to their problem.

The presented poster is aimed to introduce a number of DTA methods, which have been developed by different researchers over the last app. 25 years. For comparison of chosen methods there have been create a new software application (DEMIURG, with GUI), which allows to use and to combine many different algorithms in solving the same problem (for example sinks removing or flats treatment), and then to compare the results and to choose the better one. The main tasks which the presented application is able to resolved are: removing of spurious sinks (often called depressions or pits), treatment of flat areas (where, as in the case of sinks, the problem with drainage direction assignment arises), computing of slopes, curvature, flow (or drainage) direction assignment, flow accumulation computing (e.g. well known contributing area values), wetness index computing, drainage delineation and, at recent stage of development, only a few of basic channel network extraction methods. The implementations of these procedures are predominantly based on priority queue data structures and their complexity is therefore in most cases $O(n\log n)$, where n is a number of cells in DEM, so they are able to process relatively large DEMs in sufficient time.

The presented application is a result of two years of work on author's diploma project, and further work will be focused on more detailed comparison of DTA procedures (including their application in some hydrological modeling examples) and implementation of some of them into some commonly used GIS software, for example open source GRASS modeling system.

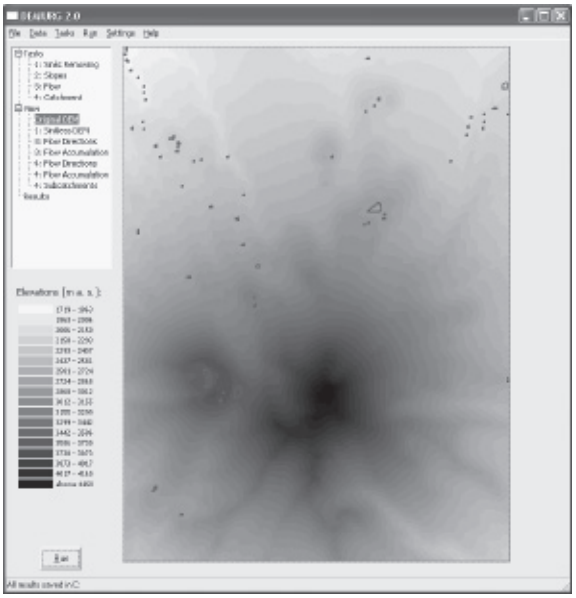

Figure 1. The DEMIURG GUI (USGS DEM of Mount Shasta, California. The sinks are in red, the flat areas are green)

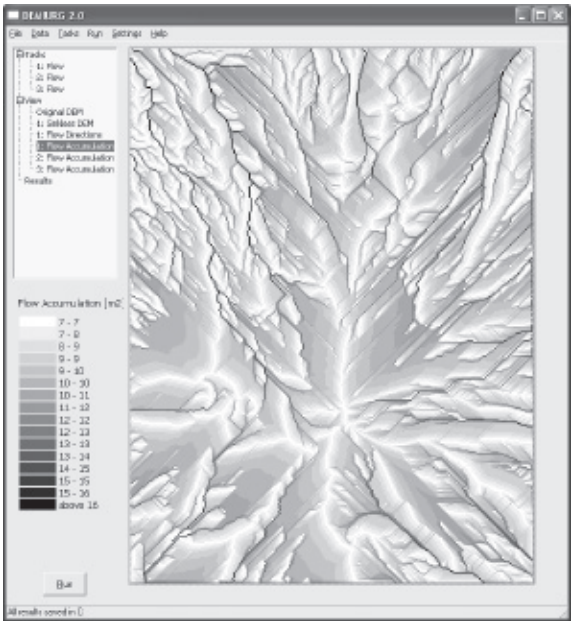

Figure 2. Result of the well known and commonly used D8 algorithm (O'Callaghan and Mark, 1984) for flow direction assignment (logarithmic values of flow accumulation, Mount Shasta DEM)

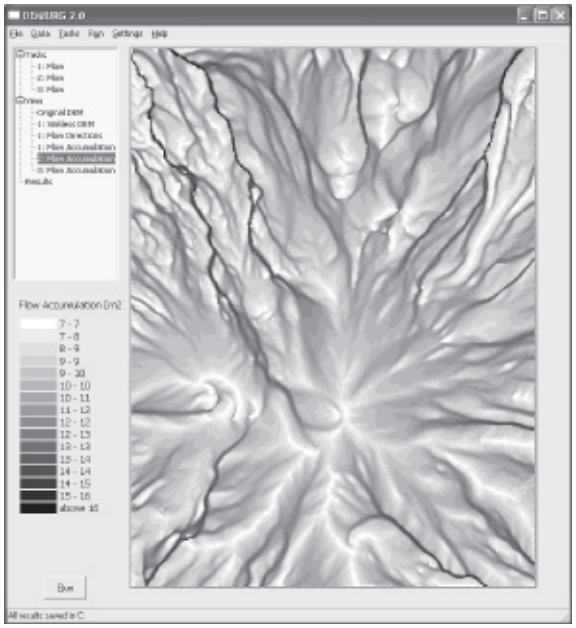

Figure 3. Result of the Quinn's multiple flow direction algorithm (Quinn *et al.*, 1991, 1995, logarithmic values of flow accumulation, Mount Shasta DEM)

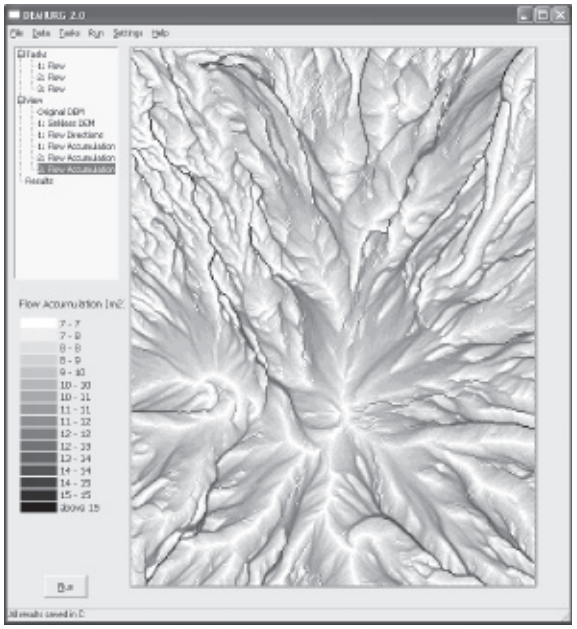

Figure 4. Result of the Tarboton's multiple flow direction algorithm (Tarboton, 1997, logarithmic values of flow accumulation, Mount Shasta DEM)

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