

Hybrid Raster Analysis workflows based on Spatial Database Technology for Forestry Applications

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Abstract: Numerous environmental research questions deal with the representation of continuous data. The raster data model has proven to be highly suitable for efficient representation of thematic data such as vegetation, temperature, precipitation and elevation. The raster data model also offers functionalities for implementing spatial analysis operations for analysing continuous data. Research has shown that spatial databases management systems (SDBMS) are increasingly supporting spatial data, thus providing functionalities for storage, access, update and analysis of spatial data. They define spatial data types (point, line and region), provide spatial indexing (for 0-n dimensional space) and provide a spatial query language in addition to the functionalities provided by standard relational databases. SDBMS have a special query language for implementation of spatial queries. These queries differ from queries on standard data types in that they compute data that is multidimensional, occupies space and has spatial relationships to other spatial objects.

Demand for in-database spatial analysis in modern day applications cannot be overlooked. It can be seen through development of standards like the Open Geo Consortium (OGC) Specification for simple features access and specification for SQL. Developers of commercial Relational DBMS are following this trend by developing spatial extensions to their DBMS'. Examples of such DBMS' include PostgreSQL, Oracle, Microsoft SQLServer, SQLite and Rasdaman. An evaluation of these DBMS' is done in this research to establish the extent to which each can support hybrid raster analysis.

Availability of spatial functionalities in DBMS' raises questions like: can hybrid spatial analysis workflows be completely implemented within a spatial database? "Hybrid analysis" in this case means integrated computing of raster and vector data. Are spatial databases able to seamlessly handle raster and vector data despite structural differences? Can raster map algebra operations like local, focal, zonal and global operations be implemented using SQL as implemented in GIS applications? This research looks into answering these questions and

additionally evaluating the extent to which commercially available SDBMS' can support hybrid analysis. This research targets to develop a hybrid analysis workflow representing the processes for implementing analyses of raster data within a spatial database. The workflow will further be implemented into a forest analysis application. This workflow can be applied to a vast number of environmental analyses to answer research questions. The most suitable SDBMS found for this implementation is PostgreSQL/PostGIS. PostGIS provides

The forestry application is used in analysis of raster data acquired through LiDAR (Light Detection And Ranging) technology and pre-processed to produce raster data layers with different information. The application is useful to a forestry worker who goes out to the field to perform analysis. The analyst stores a number of raster datasets in a database and analysis functions in a tablet PC. The analyst draws polygons or uses predefined polygons to select an area on which to perform analysis. The analyst selects a function to run on the selected area and initiates the computation. The analysis functions are implemented as stored procedures in the PostgreSQL database and compute the pixel values of the raster data in the database. The results of the analysis are stored and used for further analysis back in the office. This application allows real time analysis to be done on the field using simple open source tools like OpenJUMP.