

EXPERT SYSTEMS FOR DTM USE IN MOUNTAINOUS TERRAIN

David G. Goodenough, Jean-Claude Deguise, Michael Robson

ABSTRACT

More than 40% of Canada's marketable timber can be found in the province of British Columbia. Much of this forest resource is on mountainous terrain. In making use of remotely sensed data to update forest geographic information systems, one must take account of topographic relief. Digital Terrain Models (DTMs) are, therefore, essential to the effective integration of remote sensing and geographic information systems in British Columbia. DTMs for portions of the province can be obtained from the Canada Centre for Mapping at 1:50,000 scale and from the B.C. Ministry of Crown Lands at 1:20,000 scale. From our experience with users, we have concluded that many are unfamiliar with the limitations of using digital terrain models, and, as a result, do not use DTMs correctly.

We have created several expert systems written in Prolog to use DTMs. The first problem is to input the Digital Elevation Model (DEM) into the analysis system. If the analysis is going to involve spatial filtering, both the image and the corresponding DEM must be larger than the 1:20,000 map to be updated. If the terrain is sufficiently rugged, then topographic relief corrections must be applied to the imagery. Many users assume incorrectly that the horizontal and vertical accuracy across a DEM are constant. In fact, the accuracies vary as a function of terrain roughness. We estimate terrain roughness by passing a spatial operator over the DEM which estimates the texture of the DTM. To generate a DTM from a DEM, we create slope and aspect features. For most DEMs of British Columbia, these slope and aspect features must have spatial resolutions approximately four times worse than the DEM. It is thus necessary in the analysis to combine, for example, Thematic Mapper imagery resampled to 25 m, with a DTM having elevation samples at 25 m, with a DTM having elevation samples at 25 m positions, and slope and aspect at 100 m resolution. To avoid performing incorrect radiometric corrections at mountain peaks, one must also have the ridge and break lines for the DTM. Accuracy channels are created which reflect the varying accuracy across the DTM. This type of detail is used to create rules and frames for our expert systems which guide the user in properly using DTMs. Examples are given of these DTM rules and their use with forest inventory maps of the B.C. Ministry of Forests.