

Routing Rivers, Lakes and Portages

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Over three hundred years ago the myriad of rivers and lakes in Northern Canada made up the complex and well connected transportation network of Les Coureurs des Bois, the runners of the forest, those mainly concerned with the fur trade industry. Once the center of North American commerce, this transportation system has been all but forgotten, replaced with human built high speed land systems and air transportation infrastructure. The attention has shifted southward to those regions where few rivers and lakes stand in the way of highway and railway construction. However, in those mainly unexploited lands with enriched water systems, such as the “Little North” (a region that spans from northwestern Ontario and into Manitoba), the waterway is still the best choice for local residents, tourists and those seeking an experience with the land.

For centuries the First Nations have maintained a labyrinth of portage points, connecting river systems and lakes to form a vast system of highly connected routes. Until now there was no systematic record of route information such as the location and length of portage trails, rapids and falls that foil any attempt at transportation planning. With the construction of the “Little North” canoe atlas, years of documented route information is encoded in a GIS, establishing a framework for constructing a transportation network. The challenge lies in synthesizing the rivers and lakes, lines and polygons, to establish a spatial model for route optimization.

We introduce two spatial decomposition algorithms that transform lake or polygon information into linear networks where routing algorithms, such as the shortest path algorithm, can be applied for effective transportation planning. Our first method generates the medial axis framework of lakes and rivers with significant width in order to establish a linear network across them, based on constructing a constrained Delaunay triangulation. Our second method decomposes the lakes and wide rivers (mapped as polygons) by integrating within-lake buffering and constructing a Delaunay triangulation. We perform a shortest path analysis and establish an optimum path between two locations in the “Little North”. We examine the advantages and disadvantages of each method and discuss the uncertainty within the water-based network routing system.

Key words: GIS; route optimization; medial axis; shortest path; Delaunay triangulation; water-based network routing system.