Development of a Model for Pedestrian Route Selection on the Colby Campus

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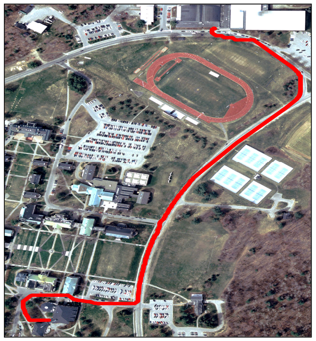
Abstract

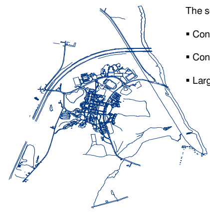
Millions of unconscious calculations are made daily by pedestrians walking through the Colby College campus. I used ArcGIS to make a predictive spatial model that chose paths similar to those that are actually used by people on a regular basis. To make a viable model of how most travelers choose their way I considered both the distance required and the type of traveling surface. I used an iterative process to develop a scheme for weighting travel costs which resulted in accurate least-cost paths to be predicted by ArcMap. The accuracy was confirmed when the calculated routes were compared to satellite photography and were found to overlap well-worn "shortcuts" taken between the paved paths throughout campus.

Introduction

Human traffic is a large field of study, with applications ranging from marketing and advertising to civil engineering and policy-making. With 1,800 students and 700 staff making their daily commutes around campus, the paved walkways and roads and grass quads receive a lot of foot traffic. No one knows how much, where, or most importantly, why. The first step for making any analysis of campus pedestrian traffic is to find out why people choose to walk where they do. They don't walk in straight line paths from building to building: they stick to paved pathways to certain destinations, and take short cuts to other places. This complicated set of behaviors can be modeled by a simple underlying set of rules. I used GIS to make a model which weighted different surface types with a "travel cost"; a subconscious attribute people assign to grass or pavement. Once these costs were set for all of campus, I calculated least-cost paths for certain destinations on campus.



A very inefficient initial calculation from Cotter Union's arch to the Alfond Athletic Center



The source layer was obtained from PPD as a CAD dataset

- Converted to a GIS formatted line file
- Contained class information such as pathway or building
- Larger extent than the intended study area

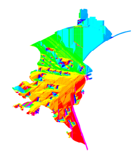
Prepared for conversion to a raster layer

- All "open" areas closed off
- Converted from polyline to polygons
- Re-classed into surface categories
- Clipped to appropriate size

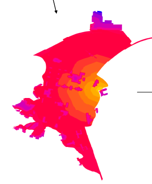
Surface	Travel Cost	Color
Barriers	500	Brown
Buildings	500	Brown
Stairways	14	Grey
Pathways	17	Grey
Roads	18	Dark Grey
Grass	19	Green

Raster creation

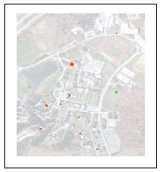
- Turned from polygons into a grid of .5m x .5m squares
- Each square has an associated "travel cost" derived from its surface type



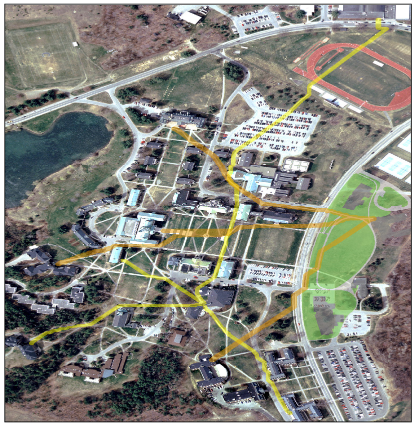
Cost Back Link Grid shows in which direction lies the least cost adjacent square



Cost Distance Grid shows accumulated costs of travel in any direction.
This one originates from the Alumni Center



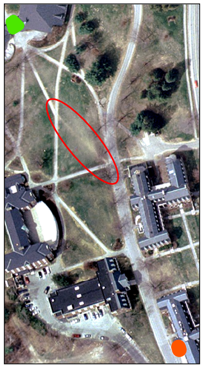
Source points (green) and destinations (orange) are the last input required to find routes

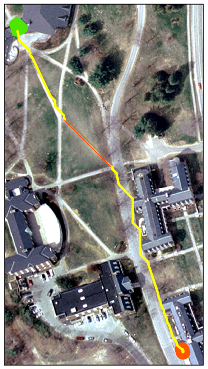


The yellow paths are from Cotter to various destinations on campus requiring a shortcut, and this was used to fine tune the model.
The orange paths are from the new Alumni Center to various popular spots on campus. Time will tell if the paths are correctly predicted.

Methods

I started with a CAD map of campus which I converted into an ArcMap polyline layer. This required closing off all of the "open" polygons so they would all be recognized as finite shapes, and converting the layer from a CAD file format into a polyline file. I grouped all of the polygons into 1 of 6 classes (paths, stairways, buildings, impassable, grass, and roads) and assigned a travel cost value. Then I converted polygons into a raster layer, then into two components necessary for least-cost path analysis: the cost distance and cost back link layers. With these created, I added some starting sources and destinations which in practice utilize shortcuts, and then ran least-cost analyses. The actual travel costs needed considerable editing, as initial paths calculated were very far from the realities which exist on campus.





Can the GIS model imitate real life choices? The model successfully determined the easiest route from green to orange to include the well worn path in front of Cotter (indicated in red).

Discussion

Through trial and error, I made a model which estimated real path selection through campus, estimated from well worn paths in the grass. This is a sufficient model for gross estimates, but for finer scale calculations more factors would need to be taken into consideration, including weather, snow cover, view shed from a given area, knowledge of campus, and the slope of the terrain. This would make a more subtle model which could accurately predict traffic density for a given area, especially if buildings were weighted for the number of people entering and exiting. The data could be used for paving new paths in the best areas when new buildings are constructed, placing new emergency call boxes, or putting up informational signs. In the end though, people won't always follow perfect logic. Sunday strolls, campus golf, and slack lining will always be confounding variables.