Minimum Spanning Tree in Landscape Mosaic

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Abstract

We approach a problem of building a landscape connectivity model with very limited assumptions and input data. A landscape is provided as a classified patch mosaic in vector-based format. A mobile agent (an entity moving in a landscape, like a species) is characterized by two parameters only: 1) patch resistance – the cost of passing through the patch and 2) transfer resistance – the cost to negotiate between adjacent patches. The former may be tied to patch suitability, size or shape metrics. The latter can be derived from ecological similarity of patch types. We do not demand data nor make assumptions about agent's flow, spatial distribution, dispersal range or population dynamics. Mobility is defined in a symmetric way, so direction of movement is unspecified. Within this restricted framework, we are still able to build a undirected, weighted graph structure and find least-cost paths between a specified set of key patches (e.g. important habitats, protected areas). Next, we build a Minimum Spanning Tree (MST) on reduced graph composed of key patches and l-c paths. Resulting MST is an optimum transportation network for key patch set and may be used as an ecological corridor system. The system maximizes functional connectivity and minimizes resource consumption (number of patches, area).

Our model is implemented as a standalone software package, capable of building graph topology from ordinary shapefile map. MST is presented on the background of the original map, and in listings and statistics. We give examples for artificial mosaics and actual vegetation coverages for north-eastern Poland.

Keywords:

ecological network, graph theory, optimization, landscape connectivity