Decision Tree Delineating of Prominent Ridgelines in City of Los Angeles

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Objective

- Provide a citywide prominent ridgeline base map for planners
  - To design their policy guidelines for future developments
  - Limit expansion of urban development into ridgeline protection areas
  - Minimize the visual impacts of hillside development & preserve scenic ridgelines.
  - Reasonable care on unstable hillsides
Overview

Input: DEM (USGS 10 m)

Output: Flow Direction
Flow Accumulation
Watershed
Curvature
Topological Positioning Index
Slope

Possible Ridgelines
Prominent Ridgelines
Watershed

• “Watershed” is a catchment basin that conveys all surface and ground water that falls within it & runs through it.
• It is geographically delineated by highest ridgelines.
Ridgelines

A narrow range of mountains.

**Primary Ridgelines**: A Ridgeline which is prominently visible from a substantial land area, or from a major transportation corridor.

**Secondary Ridgelines**: Typically lower, compared with surrounding terrain, and may be visible only to a limited area.
Methodology

1. Derive derivatives of DEM: Watershed, Slope, Curvature, Topological positioning Index (TPI)

2. Use DEM Derivatives in Binary Decision Tree Algorithm
Watershed boundaries
Possible Ridgelines
DEM Derivatives

Slope

Degree of slope = θ

Percent of slope = \( \frac{\text{rise}}{\text{run}} \times 100 \)

\[ \frac{\text{rise}}{\text{run}} = \tan \theta \]
DEM Derivatives

Curvature

\[ Z = Ax^2 y^2 + Bx^2 y + Cxy^2 + Dx^2 + Ey^2 + Fxy + Gx + Hy + I \]

(Source: ARCGIS online help)

Topological Positioning Index (Andrew Weiss, 2001)

\[ TPI = (elevation - focal\_mean(elevation, annulus, irad, orad)) + 0.5 \]

\[ sT = \text{int} \left[ \frac{TPI - \mu}{\sigma} \right] + 0.5 \]
DEM Derivatives

Curvature

TPI \(_{500}\)
- White: (+)ve values; Convex
- Black: (-)ve values; Concave
- Grey: near 0; Valley

TPI \(_{300}\)
Classification of standardized TPI rasters

Class 1: Less than -1 standard deviation
Class 2: Greater than or equal -1 standard deviation, but less than -1 mean value
Class 3: Greater than -1 mean but less than +1 mean
Class 4: Greater than +1 mean, but less than 0.5 standard deviation
Class 5: Greater than 0.5 standard deviation, but less than 1 standard deviation
Class 6: Greater than 1 standard deviation
Binary Decision Tree
A decision support tool that uses a tree-like model of decisions and their possible consequences.
Results
Hollywood Area – Watershed boundaries
Hollywood Area – Ridgelines
After applying Decision Tree Algorithm
City-wide Ridgeline Map
3D Model
Conclusions

- Watershed Delineation process can be used to identify the location of ridgelines.
- Decision tree successfully discriminates ridgeline points from other valley and depression points.
- GIS based 3D Visualization provides sufficient realism for accuracy assessment.
- Automated ridgeline extraction process helps to save significant amount of staff time.
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