Automating Pen and Ink Landscape Renderings

Jim Mower
Geography and Planning
University at Albany
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Classic Block Diagrams

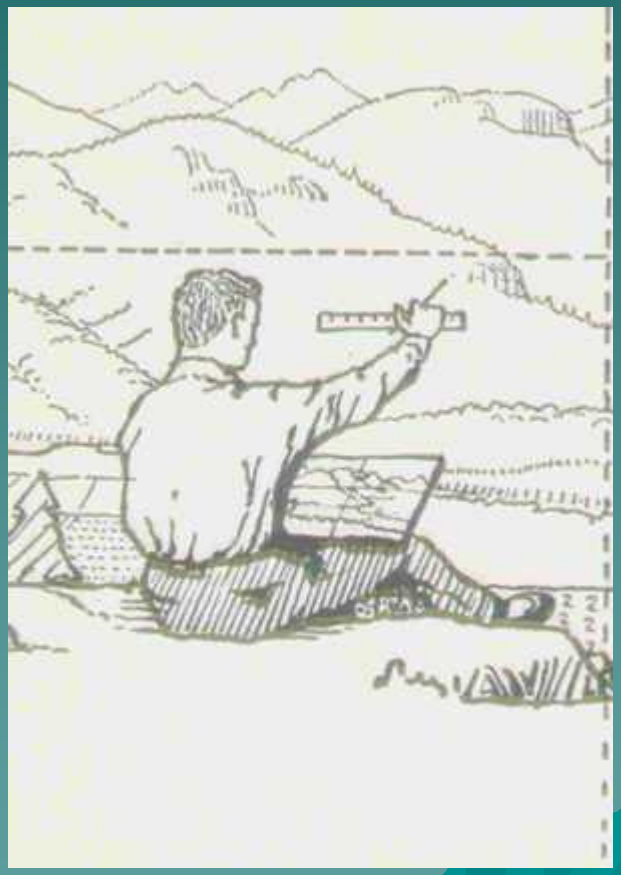
- Block diagrams represent
  - Landscape views in perspective
  - Underlying bedrock geology
- They employ
  - Large scale views
  - Pen and ink renderings

Armin Lobeck

- Lobeck wrote a wonderful book on block diagrams and other perspective landscape illustrations
  - Lobeck, A.K (1958) "*Block diagrams and other graphic methods used in geology and geography.*" Emerson-Trussell Book Co., Amherst, MA.
- It contains drawing instructions and many examples

Purpose of My Project

- Automate pen & ink rendering techniques
- Generate views from DEMs using expert systems approach
- Several interesting problems arise…

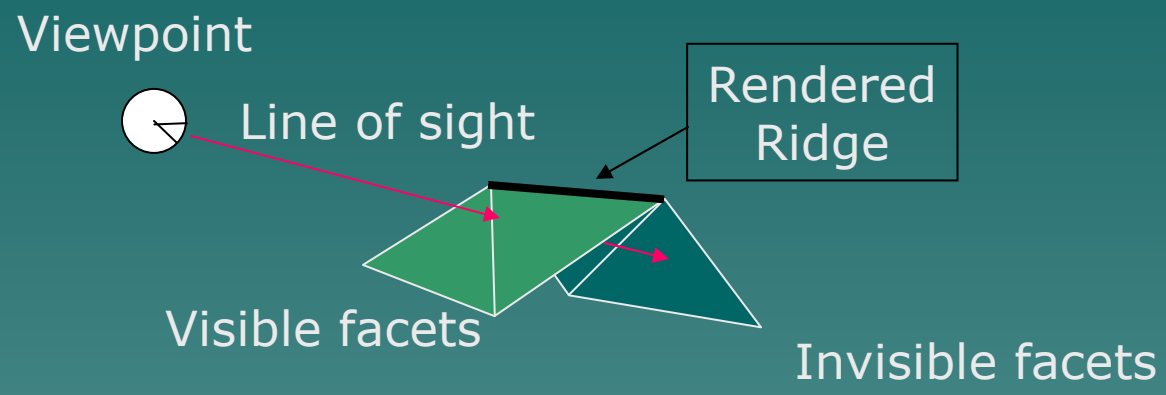


Easy Problems to Solve

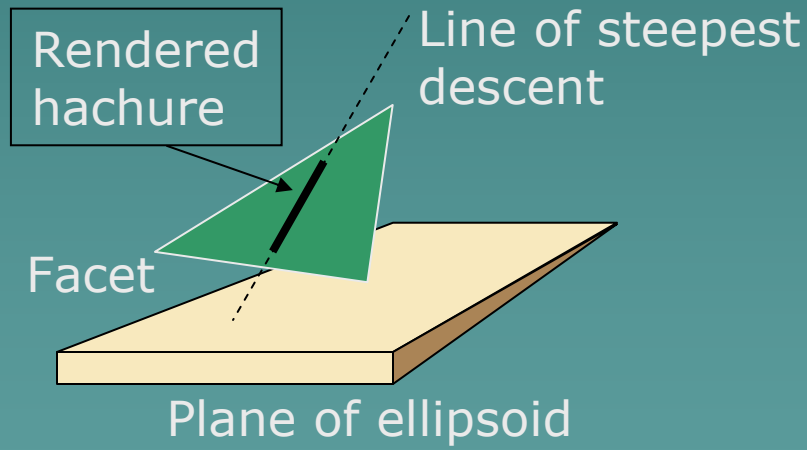
- Geometry
  - Using Direct3D, render surface using only “ridge lines” and hachures
  - Hachures are implemented as the line of steepest descent through a triangular surface facet
  - Ridges are implemented as boundary lines between visible and invisible facets relative to the viewpoint

Rendered Lines

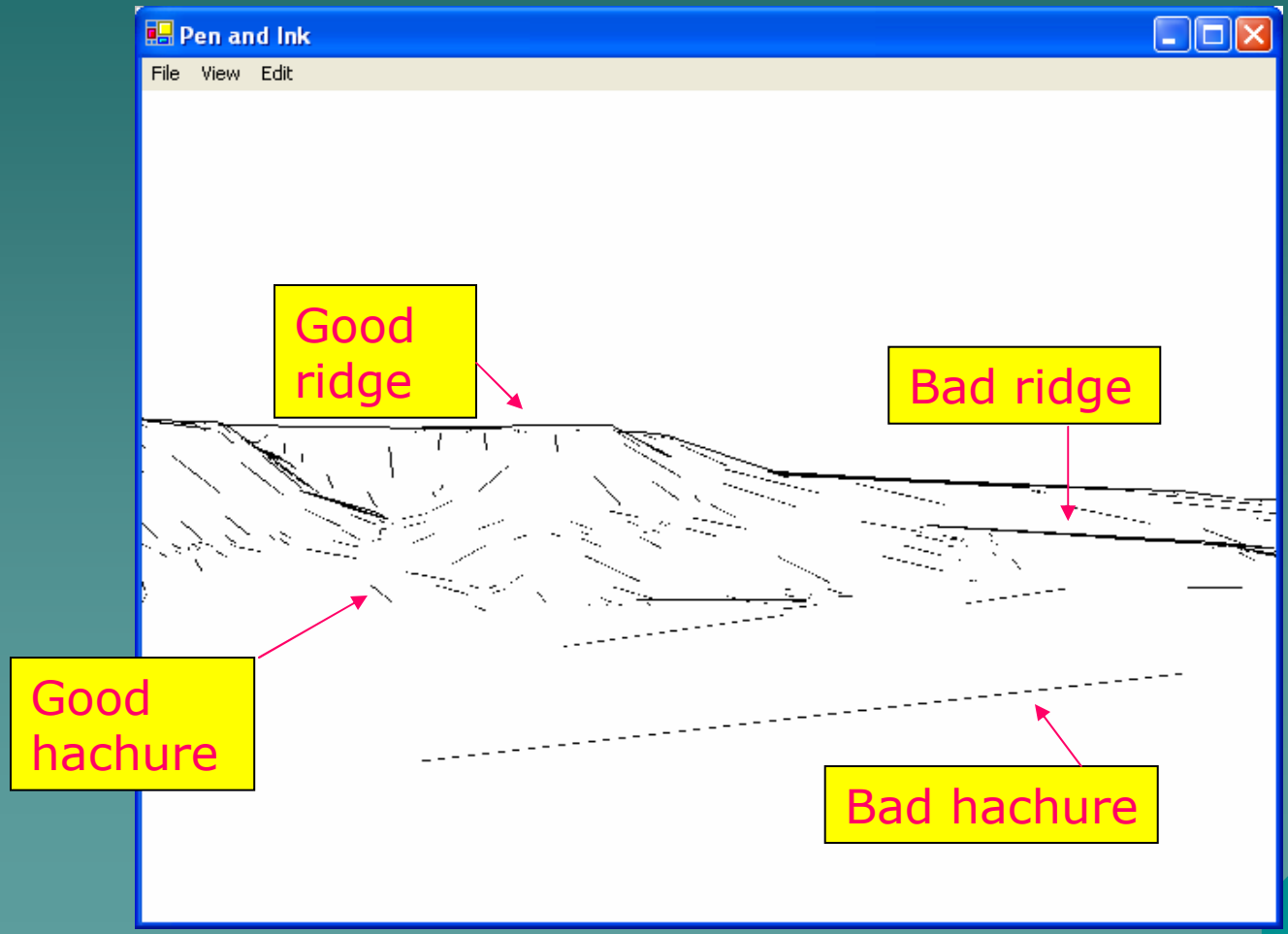
Ridge



Hachure



Easy Problems Solved! But…



How Do You Eliminate Crud?

- Controlling hachure and ridge density automatically
  - A generalization problem
  - At a given rendered thickness, hachures should never touch one another
  - Both ridges and hachures should not be drawn for purely geometric reasons
  - Must define significance for both types of renderings

Defining Significance

- Slope criteria
  - Only show a ridge line if the angle of the intersecting facets is greater than a minimum value
  - Only draw a hachure if its plane exceeds a minimum slope and is beyond a minimum distance from the VP

Other Significance Criteria

- Only show a ridge line if it coincides with a hydrological ridge
  - A drainage basin boundary
  - Might be too restrictive
    - Escarpments are not necessarily drainage basin boundaries
- Detect 2D line proximity after rendering
  - Create buffers around hachures, check for intersection, delete lowest slope

Significance Criteria (cont.)

- Adaptive surface resampling
  - The input DEM is a TIN with variable resampling with distance from the VP
  - Resampling is currently performed from a densely sampled DEM in a separate program
  - Could perform resampling on the fly in this program

Lots of Things To Do

- But that’s the fun part!
- Questions?