

DEMS BASED LANDSCAPE SKETCHES MAPPING

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ABSTRACT

The traditional form of terrain sketches is a useful and skillful way to represent terrain surface. The richness of available DEM data makes it in a complex way to understand terrain features. Increasing richness in terrain details does not mean richness in understanding. The abstracted representation of terrain structure is important for comprehension of terrain features. The paper discusses and compares a few ways to fulfill the task of terrain abstraction in conveying terrain sketches.

1) Ridge and valley lines

The notion of ridge and valley lines comes from the field of Hydrology. The flow of water over the Earth's surface develops an arrangement of ramified dry channels that form the so-called ridge and valley lines, which are called crease lines in computer graphics community to represent the salient crest of objects. They are defined by the formulas:

$$e_{\max} = 0, \frac{\partial e_{\max}}{\partial t_{\max}} < 0, k_{\max} > |k_{\min}|, \quad \text{Ridge}$$

$$e_{\min} = 0, \frac{\partial e_{\min}}{\partial t_{\min}} > 0, k_{\min} > -|k_{\max}|, \quad \text{Valley}$$

Where k_{\max} and k_{\min} stand for the maximal and minimal principal curvatures, e_{\max} and e_{\min} are the derivatives of the principal curvatures along their corresponding curvatures directions.

2) Suggestive contour lines

Objects can be easily recognized by their contours, DeCarlo et al proposed the concept of suggestive contours. They are curves along which the radial curvature is zero and where the surface bends away from the viewer. These contours are view-dependent linear features on the surface of an object that effectively convey its shape in a linear drawing. It can be understood that they are contours in nearby views.

3) Apparent ridge lines

View-dependent contours plus visually true contours help to convey shapes, but suggestive contours still cannot capture all the feature lines. Judd proposed a new conception called apparent ridge lines. The apparent ridge lines are defined as the locus of points at which the maximum view-dependent curvature assumes a local maximum in the principal view-dependent curvature direction. It is easy to see that the variation of view-dependent curvature assumes local maximum at apparent ridge plot.

DISCUSSIONS AND CONCLUSION

In the area of Loess Plateau, terrain sketches feature lines are composited with silhouettes and occluding lines, break lines or loess shoulder lines, slope toe lines, ridge and valley lines. These significant salient feature lines form the skeleton of terrain surface. Once these feature lines are captured, the general shape of terrain surface appears. Earlier works on terrain sketches convey such shapes to some extent, but in the loess plateau area, some of the terrain surface feature lines omitted. As is shown in figure 1 (a) and (b), these two figures only reflect the outer skeleton (silhouettes and occluding lines), but break lines, ridge lines and valley lines are missed compared to lines labeled in figure 1 (d). Suggestive contours can reflect some ridge and valley lines by putting contours in nearby views together, but it seems to be of high density

pointed out in figure 1(f) which is not proper for comprehension. One more disadvantage of suggestive contours is that the omission of slope toe lines, ridge and valley lines shown in figure 1(f). Ridge and valley lines method is of equal importance to apparent ridge method, they both can reflect break lines, slope toe lines, ridge and valley lines in figure 1(d, f). The difference between them is the abstraction of details. The former one is view-independent, it does not change when viewpoint changes. So sketches by this method hold more details. The latter one is view-dependent and some local details are abstracted when viewpoint changes, but significant terrain feature lines remain.

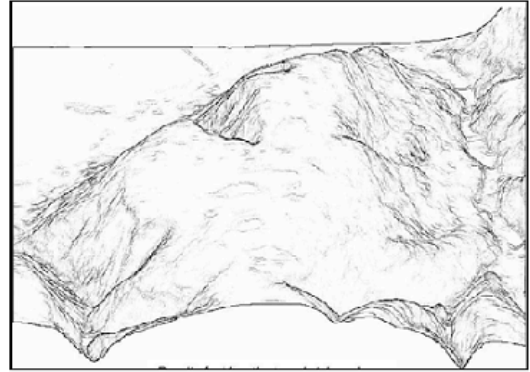
The experiences show that the silhouettes and occluding lines can only represent boundary lines of landform units in view direction and the sketches lines are small and disconnected, it is not an ideal method; the viewport-dependent method of suggestive contour lines which is reported good at conveying shapes omits some significant terrain feature lines at the break edges while some are of too much detail in the flatter areas; the viewport-dependent method of ridge and valley lines represents the skeleton of landscape and it is superior to silhouettes and occluding lines both in connection and abstract of details. The best results are obtained by apparent ridge line method. Sketches by this method seem to be better in both connectivity and representing the abstracted significant feature lines without too much dense short lines.

ACKNOWLEDGMENTS

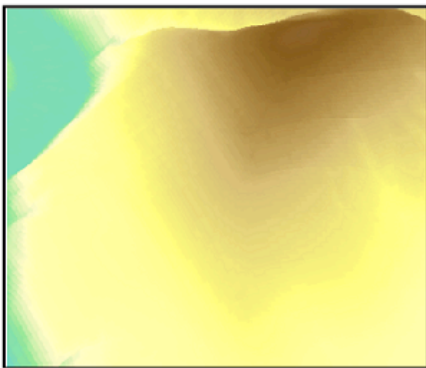
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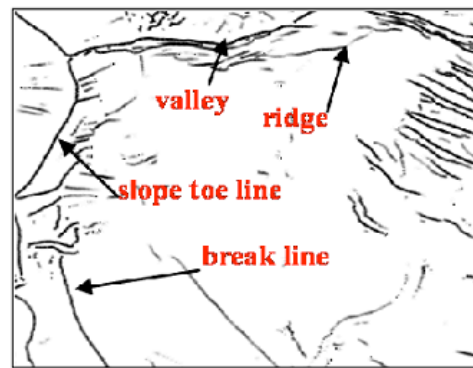
a. P-stroke(J. C. Whelan 1998)



b. Superimposition of vertical and horizontal sketches by sobel (P.-L.Lesage 2002)



c. DEM in colored rendering



d. Apparent ridges



e. Ridge and valley lines



f. Suggestive contours

Figure 1. Comparisons of sketches by P-stroke (a), edge detection (b) , apparent ridges(d), ridge and valley(e),suggestive contours(f) and DEM data of loess plateau areas(c).

KEYWORDS

DEM; Cartography; Sketches of terrain surface; suggestive contour; apparent ridge.