Sketching terrain

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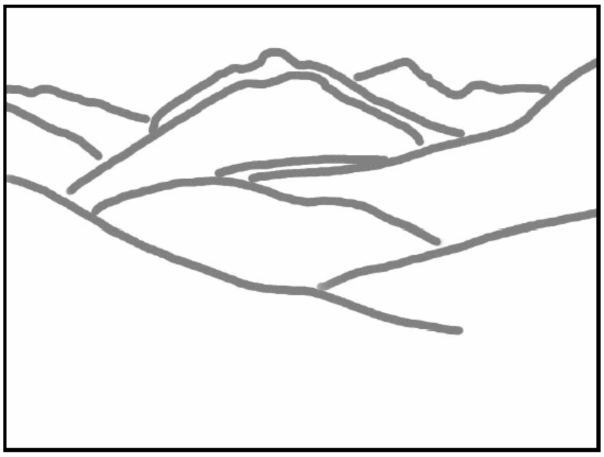

Context and Motivation

When we observe a terrain, it is usually from a viewpoint at ground level. This is also the way an art director would imagine a terrain when storyboarding a scene in a game or a film. However, traditional terrain modeling systems work from a top-down viewpoint, usually by applying painting operations on an image which is then interpreted as a height-field. Currently, computer artists need to mentally translate their vision of the terrain they want into the pixel intensities they are painting in the height-map, which is not easy! Giving the terrain the required look from a specific viewpoint requires a number of trial and error and thus takes a lot of time.

The aim of this project is to develop a method to automatically generate a plausible terrain that fits a sketch, as the one above. Indeed, the silhouettes alone do not provide any depth information, nor do they specify the shape of the terrain along the view-direction. The main challenges for are thus:
- inferring a plausible depth for the sketched silhouettes
- shaping the deformation of the ground to meet them.

Two previous landscape sketching systems were proposed [1,2]. They addressed depth determination by requiring the user to begin and end each stroke on the existing landscape, and determining the depth through intersection. This approach is fine when this point is visible, but often it is not. Landscapes can be composed from the back to the front using such an approach, but it isn't then possible to add large mountains behind existing ones. Also when the viewpoint we sketch from is close to the ground, points in the far distance occupy points very close together in screen space due to foreshortening - so for this technique to be accurate the camera must be lifted far above the ground plane and aimed down at it, which is no longer a natural viewpoint. In [1] the ground was raised to meet the contour, interpreted as a flat silhouette line. The profile shape of the contours could not be specified and the results were limited to simple rolling hills along linear paths. In [2] the profile shape of the deformation was inferred from the silhouette, guessing that the most mountains are isotropic. In both cases, each deformation had an individual area of influence, so some parts of the terrain could remain simply planar.

Goals and method

The goal of this project is to develop a method for sketching terrains that both eases user control and improves the plausibility of results compared to previous work. To reach the first goal, users should only be asked to sketch “what they would see” of a terrain. To reach the second one, any possible a priori knowledge on the nature and standard shapes of terrains should be used while procedurally generating a shape that fits the sketch.

The main problems to be solved are:

1. Converting the set of sketched silhouette curves into a set or a graph of 3D curves serving as position constraints for the terrain model. Note that silhouettes should not be considered as necessarily planar, and that their set belongs to the complex sketch category [4], due to the presence of T-junctions. The depth of a silhouette may be determined by intersection with the ground wherever possible; else, a new silhouette will start or end near an existing one, forming a T-junction. This will constrain the possible depths available to the new silhouette. Given the set of constraints either a simple heuristic will be used to initially position the curve (for example, place it halfway between two existing features) or a more complex depth embedding based on relative weights could be used (similar to the 1D mass-spring system used in [4]), where larger screen space height differences translate to larger z-differences.
2. Defining profile curves giving the area of influence of each silhouette in the Z direction. Although a solution would be to ask the user for a profile stroke from the same viewpoint, similar to the approach for sketching folds in garments in [3], defining an automatic method based on some a priori knowledge would reduce user input and increase plausibility.
3. Inferring the terrains shape from the set of 3D curves and profiles generated in step 1 and 2. An idea could be to use an approach again similar to the one we used for forming garments from sketches, but based on the much faster and more sophisticated Poisson equation solver in [5]. The final shape of the terrain would thus be formed via a fast diffusion process operating on a discretized grid of height values, which would smoothly link features together while respecting the hard constraints on positions and profile shape gradients supplied by the curves. A useful analogy is to imagine a set of coat hanger wires fixed in space, following the silhouette and profile shapes, and then draping a thin cloth sheet over these wires to form the landscape surface.
4. Generating finer details, relying on the fractal nature of terrains: this would make the result more realistic, without requiring more user input.

Références

[1] J. Cohen, J. Hughes, and R. Zeleznik. Harold: A world made of drawings, SBIM 2000.
[2] Nayuko Watanabe and Takeo Igarashi. A sketching interface for terrain modeling. In SIGGRAPH 2004 Posters, New York, NY, USA, 2004. ACM.
[3] Jamie Wither. Sketching and annotation for the procedural modeling of complex phenomena. PhD thesis, November 2008.
[4] Olga A. Karpenko and John F. Hughes. Smooth-sketch: 3d free-form shapes from complex sketches. In SIGGRAPH ’06: ACM SIGGRAPH 2006 Papers, pages 589–598, New York, NY, USA, 2006. ACM Press.
[5] Alexandrina Orzan, Adrien Bousseau, Holger Winnemöller, Pascal Barla, Joëlle Thollot, and David Salesin. Diffusion curves: A vector representation for smooth-shaded images. In ACM Transactions on Graphics (Proceedings of SIGGRAPH 2008), volume 27, 2008.