RegionSketch: Interactive and Rapid Creation of 3D Models with Rich Details

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we present a method that allows users to model a freeform surface with complicated details and high genus using a more convenient sketching interface. We propose to make use of the Poisson's equation to construct smooth surface with complicated details and arbitrary holes. In addition, we introduce a new sketch interface, which allows users to control the concave-convex variation of the model flexibility.

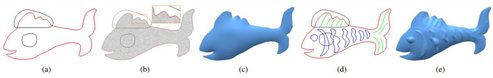

Figure 1: *Single-view modeling pipeline. (a) The input stroke primitives (red/black for boundary curve/soft bump curve), (b) The 2D domain mesh, (c) The basic surface, (d) The input stroke primitives (blue/green for hard bump region/feature curve), and (e) The final surface.*

As show in the Fig. 1, we define the following 4 types of primitives to model the freeform surface:

boundary curve - represents the boundary of the surface patch, and the curves are shown in red.
soft bump region - adjusts the local bump of the surface with soft boundary, which is shown in black.
hard bump region - adjusts the local bump of the surface with hard boundary, which is shown in blue.
line feature curve - is used to produce a concave/convex line feature, which is drawn in green.

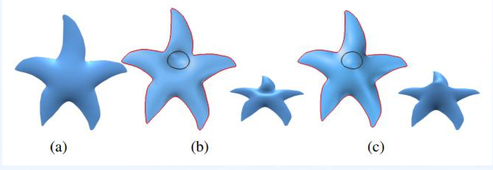

Figure 2: *Soft bump region*

Soft bump region. As shown in Fig. 2, when the height field is constructed only by the boundary curves (Fig. 2(a)), the height propagates smoothly from the mesh boundary to the inner vertices. When the user draws a sub-region on the W using the soft bump region (Fig. 2 (b), (c)), the local concave-convex of the model can be easily adjusted through various values assigned to f in the region.

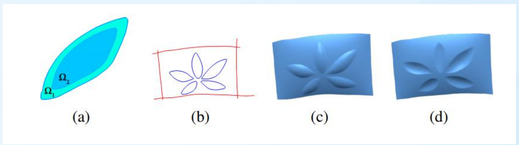

Figure 3: *Hard bump region*

Hard bump regions. Unlike the soft bump region, we design the hard bump region to create a bump with clear boundary. Inspired by [1], each hard bump region is determined by two subregions Ω_1 and Ω_2 (see Fig. 3(a)), and the outer sub-region Ω_1 should be very narrow to maintain the sharpness of the hard bump region. Then we specify a constant f_i for each of the two subregions of the hard bump region, where the signs of f_1 and f_2 are opposite, and we keep the integral value of the Laplacian in region Ω to 0 by adjusting the values of f_1 and f_2.

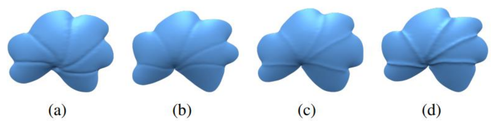

Figure 4: *Line feature curves*

Line feature curve. To create a narrow wrinkle (either concave or convex) on a surface, we design a line feature curve. When the user draws a line feature curve and sets the parameter p for it, our system first circles a narrow region of interest (ROI) along the primitive, and the ROI contains all the vertices within γ ($\gamma = 0.05$, about 4 times of the edge length of the triangle mesh). Second, our system updates the Laplacians of the vertices in the ROI, where the Laplacians of the vertices on the line feature curve are f, the Laplacians of the internal vertices of the ROI are 0, and the Laplacians of the vertices of the ROI boundary is $-0.5f$. See Fig. 4 for an example.

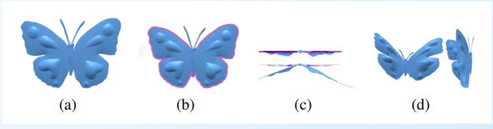

Figure 5: *Boundary curve height editing*

Boundary curve height editing. To draw objects with complex boundary curves, the user can rotate the view and draw refine curve to edit the height of the selected boundary vertices at the new view (Fig. 5).

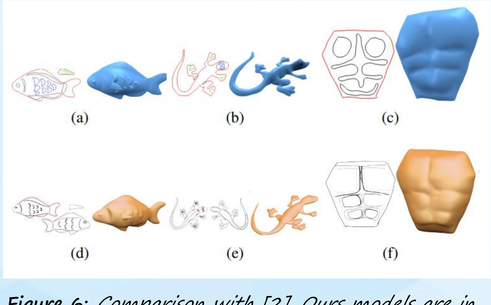

Figure 6: *Comparison with [2]. Ours models are in blue and theirs are in orange. The left of every model illustrates the input sketch. Our inputs are more concise and the resulting models have clearer geometric details.*

References:
[1] HOU F., SUN Q., FANG Z., LIU Y.-J., HU S.-M., HAO A., QIN H., HE Y.: Progressive volumetric extrusion (PVG). IEEE Transactions on Visualization and Computer Graphics (2018), 1–12.
[2] LI C., PAN H., LIU Y., SHEFFER A., WANG W.: Robust flow-guided neural prediction for sketch-based freeform surface modeling. ACM Trans. Graph. (SIGGRAPH ASIA) 37, 6 (2018), 238:1–238:12.