Poisson Vector Graphics (PVG) 泊松矢量图形

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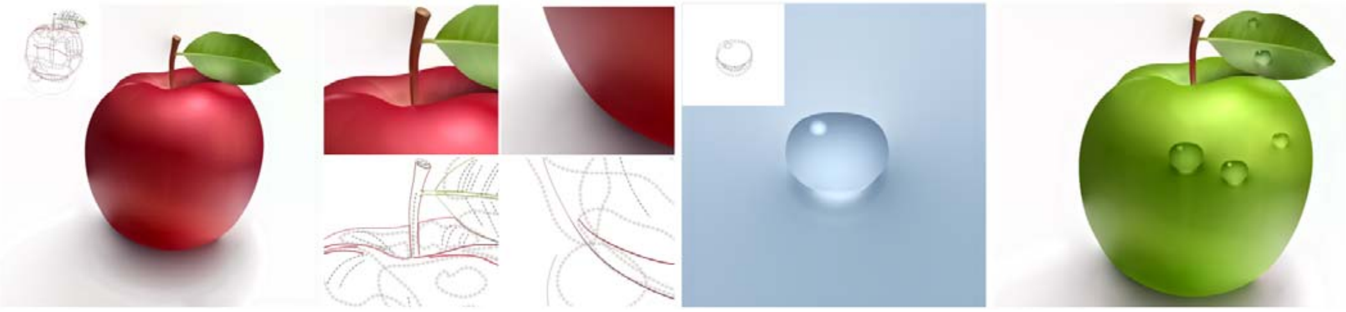

Figure 1. A Poisson vector graphics (PVG) consists of the popular diffusion curves (DCs), specifying the boundary colors, and two new types of primitives, called Poisson curves (PCs) and Poisson regions (PRs), which are associated with Laplacian of colors. The key idea of PVG is to explicitly separate colors and tones so that editing hue and tone is easy and intuitive. For example, we can make a green apple by simply changing only the DCs' color from red to green. Note that all the PCs and PRs remain unchanged. PVG natively supports seamless cloning: the water droplet can be directly copied to the target and then it automatically fits into the new background. DCs, PCs and PRs are depicted by solid lines, dashed lines and loops with hatches, respectively.

Early vector graphics supports only linear or radial color gradients, which do not support smooth propagation of colors. Orzan et al. [1] pioneered diffusion curve images (DCIs), which are curves with colors defined on either side. Mathematically speaking, DCI solves a Laplace's equation with Dirichlet boundary condition to diffuse colors specified at curves to the image domain, producing a harmonic color function. Due to lack of degrees of freedom, Laplacian diffusion does not support controlling color gradients.

We define Poisson vector graphics (PVG, see Figure 1), which solves a *Poisson's equation with piecewise constant Laplacians* f. As the first order Laplacian, PVG obviously takes DCI as a special case with $f \equiv 0$. Extending the zero Laplacian to a piecewise constant function f brings two unique advantages. First, it allows explicit control of local and global shading profiling via manipulating f. Second, PVG does not have the rendering artifacts as in biharmonic DCI [2]. In addition to diffusion curves, PVG provides two powerful painting tools, namely Poisson curves (PCs, see Figure 2) and Poisson regions (PRs, see Figure 3). The former is to model color discontinuity across curves, while the latter is to design smooth shading within the user specified regions.

PVG has 3 salient features: explicit separation of hues and tones, supporting layers by allowing intersecting primitives (except for DC-DC intersection), and native support for seamless cloning, that are favorable for authoring. It is worth noting that none of the existing methods (e.g., DCI, TPS, GDCI) has all of the above-mentioned features. More results are illustrated in Figure 4.

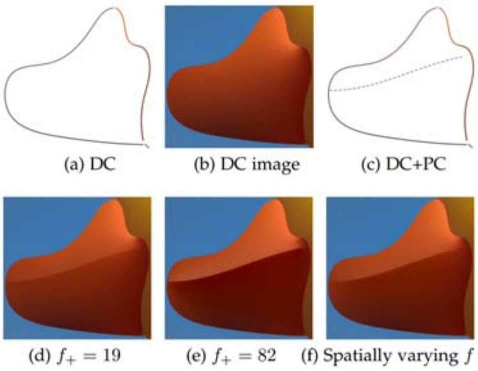

Figure 2. Poisson curves are used to model color discontinuity in a bounded region. (a)-(b): A diffusion curve is used to create the beak of the Rubber Duck. (c)-(d): We can create a sharp edge using a Poisson curve γ (dashed line). Increasing the Laplacian constraint $|f|$ makes a stronger edge. (f) We can also use a spatially varying constraint to define sharp edges with varying strength.

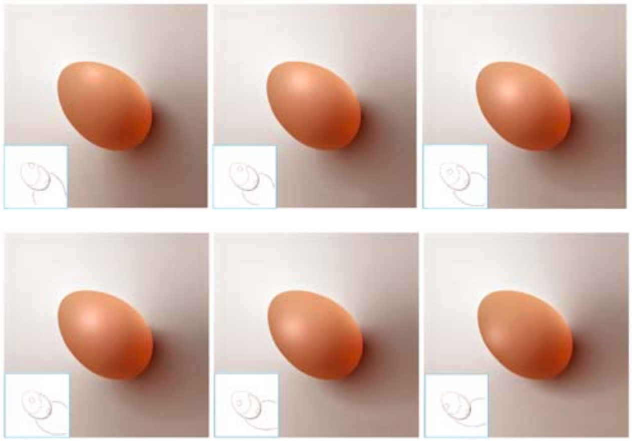

Figure 3. PVG simulates a specular highlight and core shadow using Poisson regions.

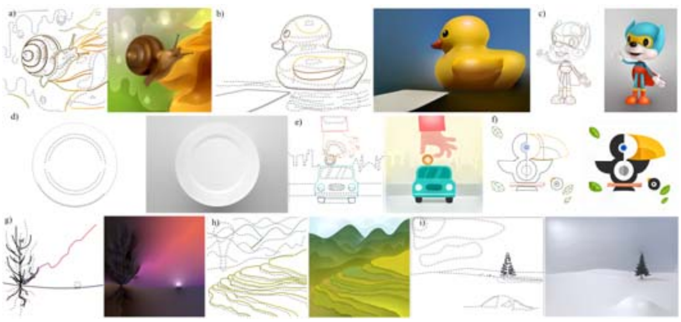

Figure 4. A gallery of Poisson vector graphics.

References:

[1] Orzan, A., Bousseau, A., Winnemoller, H., Barla, P., Thollot, J., and Salesin, D. 2008. Diffusion curves: A vector representation for smooth-shaded images. *ACM Transactions on Graphics, 27*, 3, 92:1–92:8.
[2] Finch, M., Snyder, J., and Hoppe, H. 2011. Freeform vector graphics with controlled thin-plate splines. *ACM Transactions on Graphics, 30*, 6, 166:1–166:10.