# Technologies for Feature Animation

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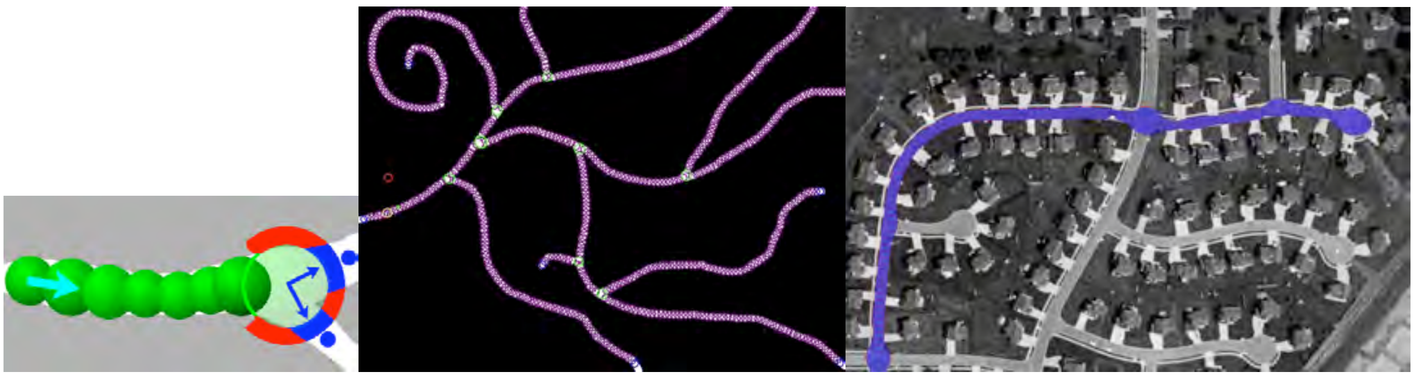
## 1 Pearling: Interactive segmentation of sketches

Pearling is an interactive technique for extracting the centerline and varying thickness of (hand-drawn) curves in images. It works in realtime, is capable of tracing complex curve networks, and supports gesture-driven interactive editing to trim or extend the selection.

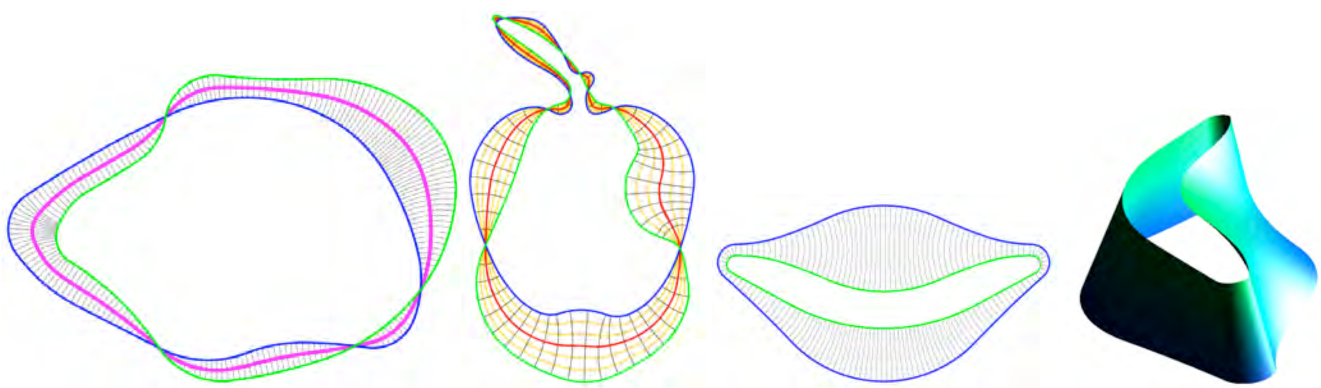


"Pearling: Tube segmentation with pearl strings", J. Rossignac, B. Whited, G. Slabaugh, T. Fang , G. Unal. In preparation.

"Pearling: 3D interactive extraction of tubular structures from volumetric images", J. Rossignac, B. Whited, G. Slabaugh, T. Fang, G. Unal. MICCAI Workshop on Interaction in Medical Image Analysis and Visualization. November 2, 2007.

## 2 Ball-morph: Mapping and morphing between shapes

The (*tangent-ball*) B-morph between two shapes has several advantages over the popular *closest-point* morph: It is symmetric (morphing A to B produces the reverse of the animation morphing B to A), moves points along circular arcs that are orthogonal to both shapes, and minimizes parametric (texture) distortion (even eliminating it when morphing between planar portions). It may be used for constructing pleasing interpolations between key-frames.



"B-morph", B. Whitted, J. Rossignac, F. Chazal, A. Lieutier. In preparation.

"Ball Map: Homeomorphism between compatible surfaces", F. Chazal, A. Lieutier,, J. Rossignac, B. Whitted. Submitted. GVU Tech Report GIT-GVU-06-05. 2006. VIDEO: www.gvu.gatech.edu/~jarek/videos/Ball1.mov

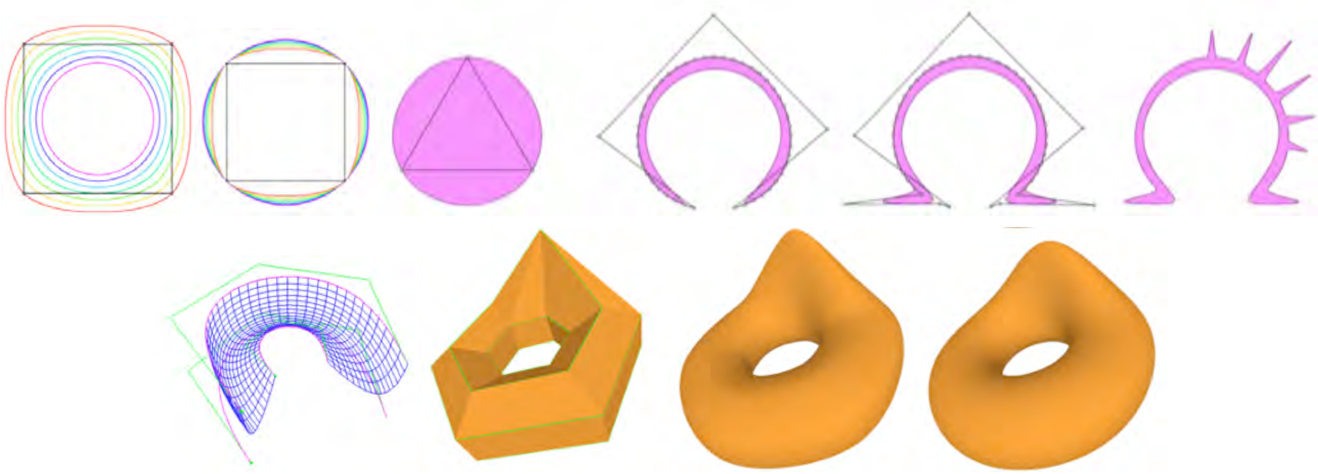
# 3 Jarek splines: Reduce popping in multi-resolution rendering

To reduce transmission or rendering costs, multi-resolution models and progressive refinements are often used when rendering curves and surfaces. Several techniques have been explored for reducing the popping effect when switching from one level-of-detail to the next (for instance when zooming on an object). The Jarek splines (below-left) minimize the discrepancy between successive resolutions of a subdivision curve or surface while offering $C^2$ smoothness (continuity of curvature).

"Ringing Js Refinements", J. Rossignac and S. Schaefer. December 2006. GVU Tech Report GIT-GVU-07-06.

# 4 J-splines: $C^2$ and $C^4$ curves and surfaces

Humans perceive discontinuities in curves, surfaces, and animations at places where slope, curvature and even higher derivatives changes rapidly [http://www.springerlink.com/content/x826540p334x0385/]. To address this problem, we have developed the J-spline refinement schemes which may be used to model, edit, render, and animate curves and surfaces that offer up to $C^4$ continuity (selectable by the designer) and may (if desired) interpolate the control vertices. J-splines may be used for multi-resolution modeling of 2D and 3D shapes and for designing smooth variations of animation parameters. A complex shape, such as the spiked Ω below-right may be produced with less than a dozen mouse drags.

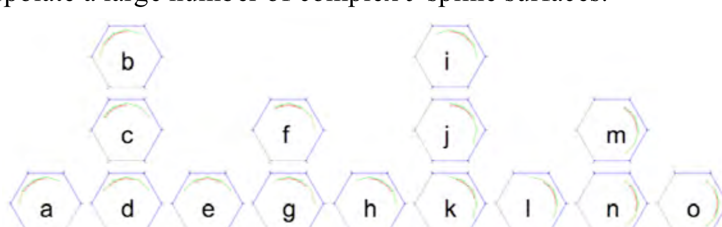


"Ringing Js Refinements", J. Rossignac and S. Schaefer. December 2006. GVU Tech Report GIT-GVU-07-06.

*APPLET: [www.gvu.gatech.edu/~jarek/demos/ring/](www.gvu.gatech.edu/~jarek/demos/ring/)*

# 5 Ringing: Small footprint rendering and animation of subdivision surfaces

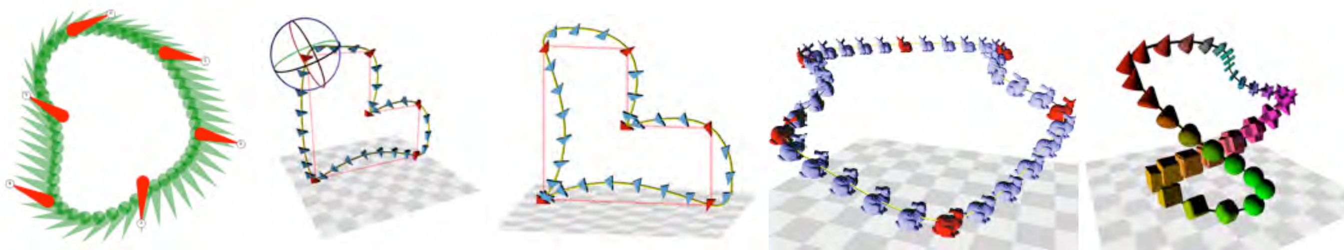
The evaluation and rendering of subdivision curves, surfaces, or animations requires performing several iterations of recursive refinement steps. Each one multiplies the number of control vertices by 2 for curves, 4 for surfaces, and 8 for animations. For example, a 4×4×4 array of control vertices may be used to represent the animation of one small surface patch. Representing the result of 6 recursive refinements requires storing over 16 million vertices. The clever ringing scheme invented by Prof. Rossignac reduces the storage cost to 3750 vertices and may be used to render in realtime animations that smoothly interpolate a large number of complex J-spline surfaces.




"Ringing Js Refinements", J. Rossignac and S. Schaefer. December 2006. GVU Tech Report GIT-GVU-07-06.

# 6 ScrewBender: Smooth interpolating 3D motions

A rigid-body motion may be defined by a series of control frames (or key-poses). ScrewBender is a tool for the realtime generation and animation of smooth ($C^2$ continuous), interpolating motions. Remarkably, the approach is independent of the coordinate system in which the key-poses are specified. The artist does not need to worry about coordinate systems, angles, or parameters and may specify and edit each key-pose by direct 3D manipulation using the mouse or a 3D tracker. ScrewBender may be used to specify paths for moving objects or cameras. For example, 2 key-poses suffice for producing a smooth swinging motion, 3 key poses for specifying a perfect circular motion.



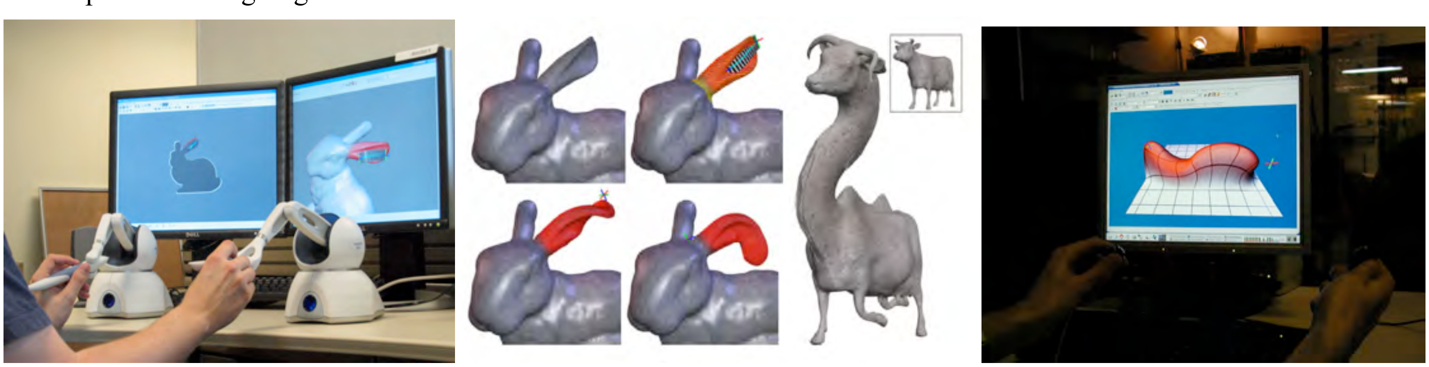
"ScrewBender: Smoothing Piecewise Helical Motions", Alex Powell and Jarek Rossignac, January 2007. Accepted to the IEEE Computer Graphics and Applications. VIDEO: [a-lex.powelltown.com/screwbender/ScrewBenderH264.mov](a-lex.powelltown.com/screwbender/ScrewBenderH264.mov)

# 7 TurboWarp: Realtime image or shape warps

Deformations or animations that perturb an image or 2D drawing may be trivially designed through simple strokes (4 red dots in the image below-center) and rendered in realtime by using TurboWarp's direct conjugate gradient solver.

# 8 Twister and Bender: Two handed editing of shapes and animations

Two 3D trackers, one in each hand, may be used to grab, pull, twist, and bend 3D shapes in realtime either for editing a 3D shape or for designing 3D animations.



"Bender: Deforming and animating 3D shapes by bending and twisting a virtual ribbon with both hands", Ignacio Llamas, Alex Powell, Jarek Rossignac, Chris Shaw. Accepted for the ACM Symposium on Solid and Physical Modeling, MIT, pp. 89-99, June 2005. GVU Tech. Report GIT-GVU-04-15. (Bender.pdf). VIDEO: [a-lex.powelltown.com/BenderClipsSmall.mov](a-lex.powelltown.com/BenderClipsSmall.mov)

"Twister: A space-warp operator for the two-handed editing of 3D shapes", Ignacio Llamas, Byungmoon Kim, Joshua Gargus, Jarek Rossignac, and Chris D. Shaw. Proc. ACM SIGGRAPH, pp. 663, 2003. VIDEO: [www.gvu.gatech.edu/~jarek/videos/Twister1.mov](www.gvu.gatech.edu/~jarek/videos/Twister1.mov)