BendFields: Regularized Curvature Fields from Rough Concept Sketches

Response to SIGGRAPH 2014 reviews

Dear reviewers,

This paper was first submitted at SIGGRAPH 2014 under the title *BendFields: Regularized Curvature Fields from Concept Sketches*, with ID **0210**. We provide the full reviews as supplemental material and detail here our response to the main concerns.

Evaluation of vectorization algorithms
The goal of our work is to estimate normal fields from rough concept sketches. Our approach works on raw bitmaps, without requiring vectorization of the lines in the drawing. An alternative approach would consist in vectorizing the bitmap sketch and use the resulting curves as input for the CrossShade algorithm [Shao et al. 2012]. We provide an evaluation of such an approach by running the state-of-the-art vectorization algorithm of Noris et al. [2013] on a sketchy drawing. We also explored the use of an image filter to clean-up the sketch before vectorization. While vectorization produces clean curve segments, in many configurations these segments do not form continuous curves across junctions. However, because CrossShade assumes that each curvature line forms a single curve, manual cleanup and merging of segments would be required to process the vectorized curves. In a personal communication, Noris confirmed ``our method does not merge segments at junctions because there are multiple ambiguous options. We have the concept of smoothness, so we could merge based on what is the most straight, but I am not sure how well that would work in practice. This is why we did not do it."

Our work explores the different, novel approach of estimating 3D information directly from a rough bitmap sketch.

Robustness to sketchy drawings
We have recomputed all our results on more sketchy drawings. We also provide an evaluation of the robustness of our algorithm to various levels of sketchiness, and illustrate the effect of our parameters on smoothness and fidelity to the input drawing. We also discuss the limitation of our algorithm in the presence of strong foreshortening.

Comparison to CrossShade and ground truth
We compare our method against CrossShade by rasterizing the curves of the original CrossShade paper. We provide comparisons on a simple model (toothpaste) and a complex one (camera). We also provide a comparison to ground truth curvature lines and normals on parametric surfaces.

User interface
We provide a video recording of a typical interactive session to illustrate how users work with our system. We also provide as supplemental materials links to the original drawings that we reproduced for input to our algorithm. These drawings were collected from various design sources and illustrate the distortions and inaccuracy found in real sketches.

Algorithm
We have added a figure and additional motivation to explain the need for discrete transition functions, which we handle with a mixed-integer formulation. We also re-wrote significant portions of the technical sections to clarify each step of our algorithm, which we summarize in Section 5.3.

Applications
While we designed our algorithm to estimate 3D information from 2D drawings, we strongly believe that our core technical contributions have the potential to benefit other applications in Computer Graphics and Computer Vision. We include in the conclusion of our paper initial results for two such applications, namely shape-from-texture and non-orthogonal quad re-meshing. We also provide a visualization of some heighfield surfaces integrated from our normal fields, paving the way for 3D sketch-based modeling from rough input drawings.