Supplementary material for the paper "Brushables: Example-based Edge-aware Directional Texture Painting"

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1. Direction Analysis

The two alternative approaches to orientation field detection in images [Kyp11, KLC07] differ in their representations of the field, and in the methods used to smooth it. Kyprianidis uses a multi-scale filtering approach, whereas Kang employs a multi-lateral filter of variable support on a vector field. We find that these two approaches actually differ in effect. Using a larger filter suppresses local variance, whereas smoothing on a higher scale suppresses high-frequency detail, even if it is coherent. Because both of these effects may be desirable in different scenarios, we let the user choose which to employ.

Figure 1 shows an example where, due to coherent high-frequency detail, the result of the orientation analysis may not accurately reflect the orientation as perceived by the user. The orientation of the main fabric appears vertical, but a closer examination shows that the predominant edge direction at the pixel level is diagonal. This case can not be addressed by increasing the width of the ETF filter, as that would merely lead to a more coherent slanted field. Instead, the user can apply a pre-smoothing Gaussian filter to remove the high frequency detail before input gradients are calculated, making the more visible vertical lines dominant.

Conversely, some input sources, like the fur in Figure 2, have a lot of local variation in their tangents. For these, the user is faced with a choice: should the directionality of the synthesized result precisely follow the painted directionality, or should the local source variation be preserved and propagated to the result? By letting the user tune the spatial extent of Kang et al.'s [KLC07] filter, we give the user this control.

There are cases where the detected direction does not fit the semantics desired by the user. The fabric sample in Figure 1 shows an example: the local direction on the side fringe is horizontal, but semantically, these are the sides of the sample, requiring a vertical direction. We provide the option to use the same *direction brush* that is employed to the painting phase to alter the direction of the such regions. In such cases,
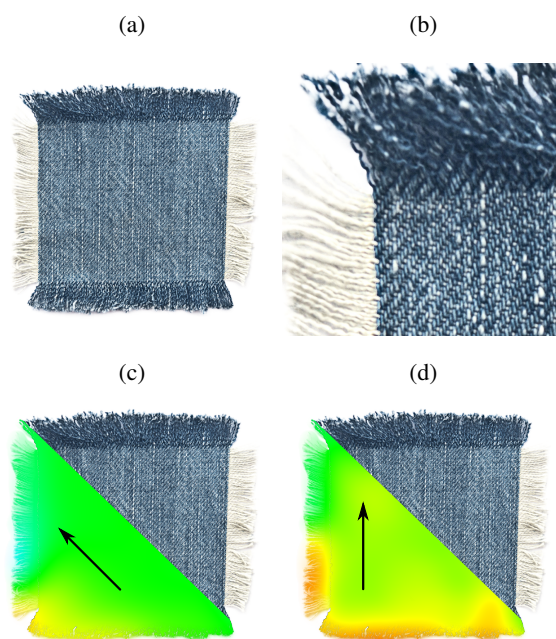
(a) (b)

(c) (d)

Figure 1: The effect of the pre-smoothing Gaussian filter on the orientation analysis: The source image *S* (a) appears to have a vertical directionality but the detail (b) shows high-frequency diagonal edges. Result (c) shows the direction field calculated at full resolution and (d) the field after passing the source through a 4 pixel wide Gaussian filter. *Source credit: denim: inxti @ shutterstock*
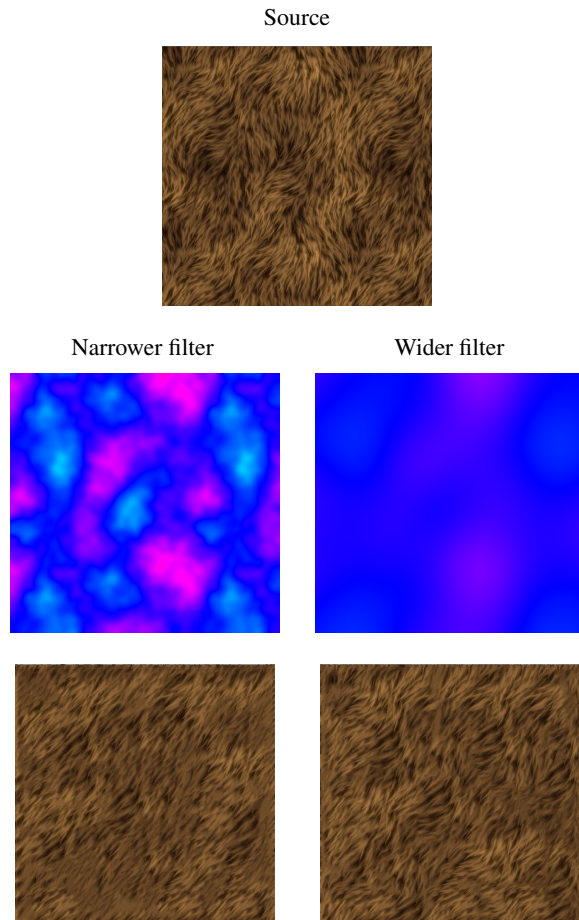
Source

Narrower filter   Wider filter

the tangents of the pixels in the area affected by the brush are flipped to whichever direction follows the suggested direction more closely, and the harmonization pass starts at the boundary of this constrained area. Once the rest of the pixels are harmonized, the tangent field is still filtered normally.

2. Result Details

Figures below display the results of our method more closely along with their direction fields d_s. Also shown are the direction fields d_s and the sources we used to produce these.

References

[KLC07] KANG H., LEE S., CHUI C. K.: Coherent line drawing. In *Proceedings of International Symposium on Non-Photorealistic Animation and Rendering* (2007), pp. 43–50. 1, 2

[Kyp11] KYPRIANIDIS J. E.: Image and video abstraction by multi-scale anisotropic Kuwahara filtering. In *Proceedings of International Symposium on Non-Photorealistic Animation and Rendering* (2011), pp. 55–64. 1

[LFB*13] LUKÁČ M., FIŠER J., BAZIN J.-C., JAMRIŠKA O., SORKINE-HORNUNG A., SÝKORA D.: Painting by Feature: Texture boundaries for example-based image creation. *ACM Transaction on Graphics 32*, 4 (2013). 3
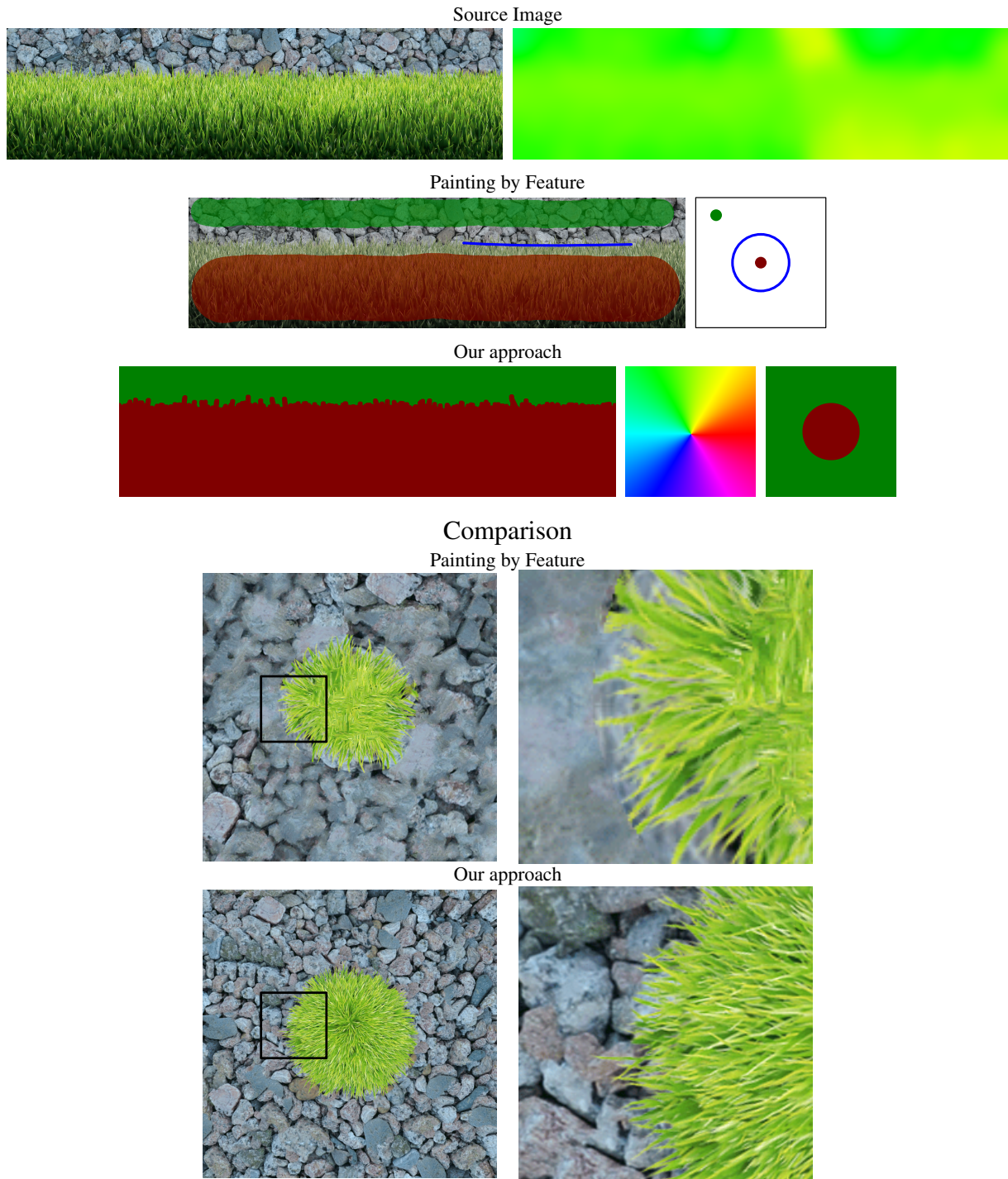
Figure 2: The effect of the spatial extent of the Kang et al.'s [KLC07] filter on the orientation analysis and output. Top: the source image *S*. Middle: Direction fields detected with a low extent (15px, left) and high extent (40px, right) filter. Bottom: Corresponding synthesis results on a constant direction field.
The narrower filter gives lower smoothness and preserves local variation, resulting in more aligned results, while the wider filter gives higher smoothness and preserves variance in the output. *Source credit: soft fur: Filter Forge @ flickr*

Source Image

Painting by Feature

Our approach

Comparison

Painting by Feature

Our approach

Figure 3: *The detailed comparison against* Painting by Feature *[LFB*13].*
Top row: the input image and its detected direction.
Second row, left to right: source with overlaid feature picks; output paths and areas.
Third row, left to right: source segmentation (smoothed from ground truth); output direction field.
The comparison below shows the same images as the figure in the main paper. Source credit: grass: varuna @ shutterstock

Figure 4: Input textures (odd columns) with their detected direction fields d_s (even columns). *Source credits: braided wig: Karina Bakalyan @ shutterstock; plank: My Life Graphic @ shutterstock; ivy leaves: Michael & Christa Richert @ rgbstock; red wig: Lenor Ko @ shutterstock; crochet: anneheathen @ flickr; denim: inxti @ shutterstock; cookie: Alessandro Paiva @ rgbstock; bread: Giles Hodges @ DeviantArt; grass: varuna @ shutterstock*

Figure 5: Selected results (odd columns) along with their direction fields d_t (even columns)
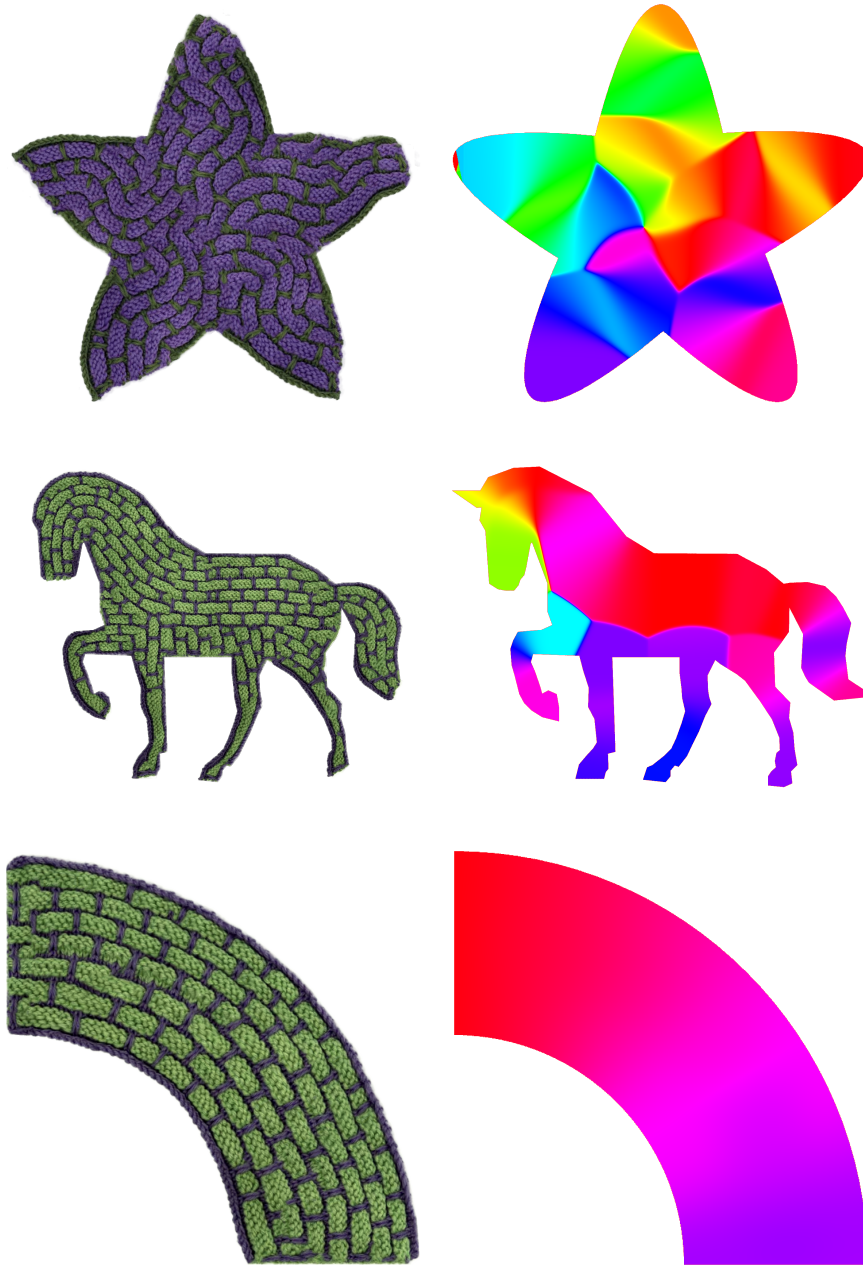
Figure 6: Selected results (odd columns) along with their direction fields d_t (even columns) contd.
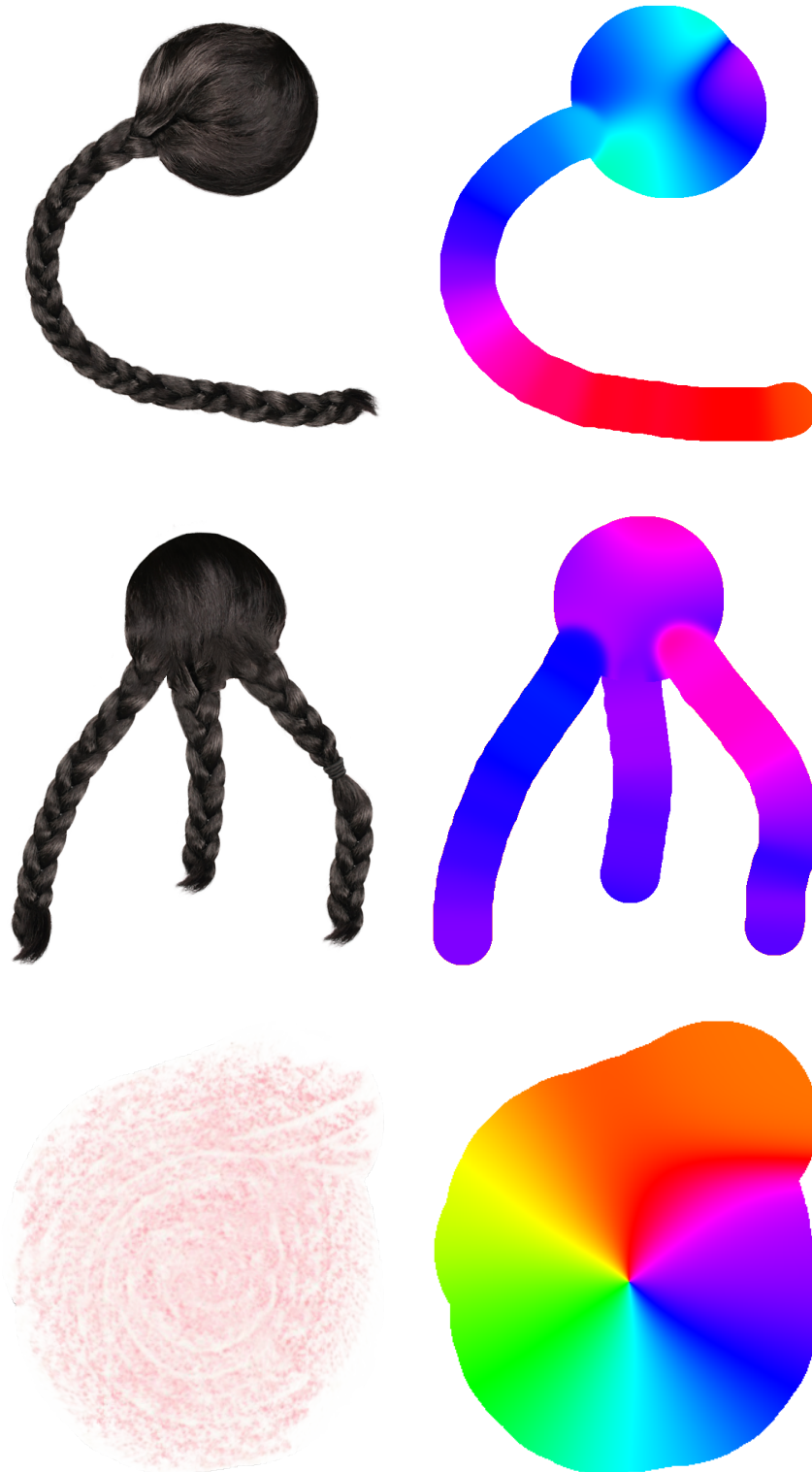
Figure 7: Selected results (odd columns) along with their direction fields d_t (even columns) contd.

Figure 8: Selected results (odd columns) along with their direction fields d_t (even columns) contd.