Automating the Handmade:
Shading Thousands of Garments for *Coco*

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ABSTRACT

Coco presented a challenge for the garment shading team. Firstly, the scale of the movie is significant with both the human and skeleton worlds filled with primary, secondary, and background characters. Secondly, the garments speak to a specific culture and our shading needed to be very detailed to convey both modern Mexico and Mexican culture through time. We had to employ new techniques for shading seams and embroidery, optimizing render cost, and handling variation in crowd scenes.

CCS CONCEPTS

• **Computing methodologies** → *Texturing*;

KEYWORDS

shading, garments, texture.

1 AUTOMATIC SEAMS

Shading seams is a laborous task that requires multiple layers of textures along curves. This process is typically performed by manually stamping exemplars on meshes with limited distortion control. For *Coco*, we were in need of a way to scale the creation of seam textures to thousands of garments. To this end, we developed a power tool, AutoSeams, that separates the artistic process of authoring seam curves from the actual texture synthesis.

Our tool represents seam curves as edge sets and generates local UVs by thickening these edges until a user-prescribed thickness is reached. This yields a low distortion parameterization that flattens the curve to a straight line segment while preserving arc-length. Our approach extends the method of [Schmidt 2013] to general polygonal meshes by employing intrisinc frame fields via connection angles [Zhang et al. 2006] and handling closed loops through periodic boundary conditions. The resulting seam textures are then synthesized procedurally by simply replicating any input exemplar

Figure 1: Our tool generated seam textures on the pockets (top) by constructing curve parameterizations (bottom) and then replicating a stitch texture exemplar. ©Disney/Pixar.

within the curve parameterization. Figures 1 and 3 show examples of textured seams and curve parameterizations.

2 EMBROIDERY

A key feature of traditional Mexican clothing is hand-sewn embroidery. Although an important component of the production design of *Coco*, painting this intricate stitch-work for thousands of garments is time-prohibitive. By authoring a library of specialized embroidery exemplars, we leveraged texture synthesis to generate individual, detailed stitches inside a masked region on the garment. This enabled us to translate broad patterns into very detailed and unique clothing embellishments (as depicted in Figure 2).

Figure 2: Embroidery exemplars (left) were used to synthesize detailed stitching textures (right). ©Disney/Pixar.

3 BAKING

Our garment shading approach tended to trade artist time for render resources. With the studio having recently moved to fully path-traced rendering, *Coco* faced added constraints for geometry weight and shading performance. Of particular concern was our use of a large and general garment library shader and the UV data generated by AutoSeams. The key to keeping both artists and renders efficient was our broad deployment of an automated shader baking system. By generating lightweight, baked versions of user-authored shaders at regular intervals, it was possible for us to use almost any feature

Figure 3: Multiple views of a hoodie with stitching textures generated by our power tool. ©Disney/Pixar.

of our shading pipeline without being overly concerned about its impact on performance. In practice, keeping up with the pace of production and the diversity of assets was a major challenge for us, but *Coco* couldn't have been rendered without it.

4 COLOR RETARGETING

Despite creating thousands of unique looks for our garments, we found that we needed more variation in crowd scenes. Prior to *Coco*, we would replace the existing look with something simpler and vary the overall color to achieve the needed variety. Unfortunately, this process would also minimize or lose the details in the garment shading. Besides the fact that the fabric patterns, embroidery, and stitching contribute to the overall cultural appeal of the film, we wanted to use all of the shading work that was already done. We employed a "retargeting" shader that would re-color the garment on-the-fly, shifting its base color to a new, target color and then selecting visually compatible colors for all of the garment details (Figure 4). This maintained the original garment's intent while giving us the ability to create a nearly infinite number of color variants. This technique worked for both baked and full shaders.

Figure 4: The green shirt is the original shading and the other three variants are generated from it. ©Disney/Pixar.

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