Reconstructing David Huffman's Legacy in Curved-Crease Origami

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David Huffman's curved-crease origami models are elegant, beautiful, and illustrative of Huffman's deep understanding of curved creases. Sadly, Huffman's death in 1999 left us without his deep understanding, and only with his early paper describing the local behavior of creases [Huf76] (and the subsequent [FT99]) and his many models. This project proposes to reconstruct David Huffman's curved crease patterns and models to recover his insight and uncover the mathematical beauty underlying the artistic beauty.

History. The first known reference of curved-crease origami is the work of a Bauhaus student in a course by Josef Albers in 1927–1928 [Win69, p.434]. Since the 1930's, Irene Schawinsky, Thoki Yenn and Kunihiko Kasahara have built similar models. More intricate curved-crease origami sculpture was designed by Ronald Resch in the 1970s. From the 1970s to the 1990s, Huffman created hundreds of models that represent the majority of work done in this field [Wer04]. Our goal is to better understand the behavior of curved creases exploited in these models, given the lack of mathematical and algorithmic tools for designing curved-crease origami.

Approach. We propose experimenting with both physical models and computer models to reconstruct Huffman's models. We analyze Huffman's designs by studying photographs carefully and studying features that occur frequently in his designs. Based on personal communication with David Huffman in 1998, we assume that all of Huffman's creases are conic section (quadratic) curves. Figures 1–3 show the crease patterns on the left and images of a few examples we have reconstructed.

Figure 1 shows fours curves converging in a square, a common motif in Huffman's designs.

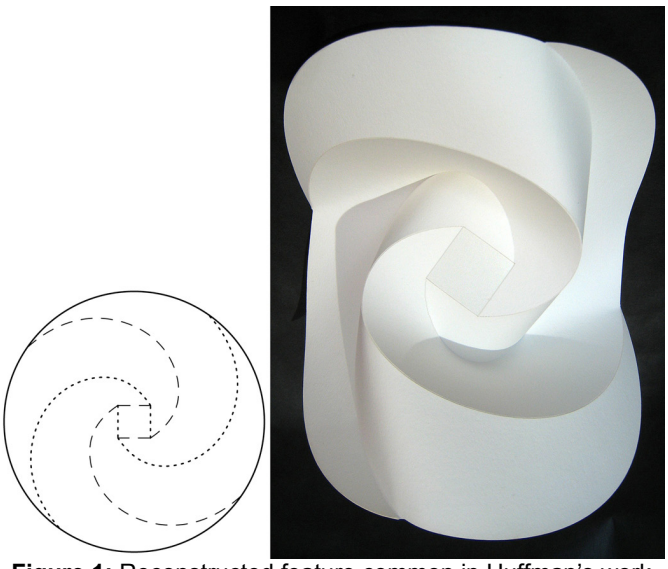

Figure 1: Reconstructed feature common in Huffman's work

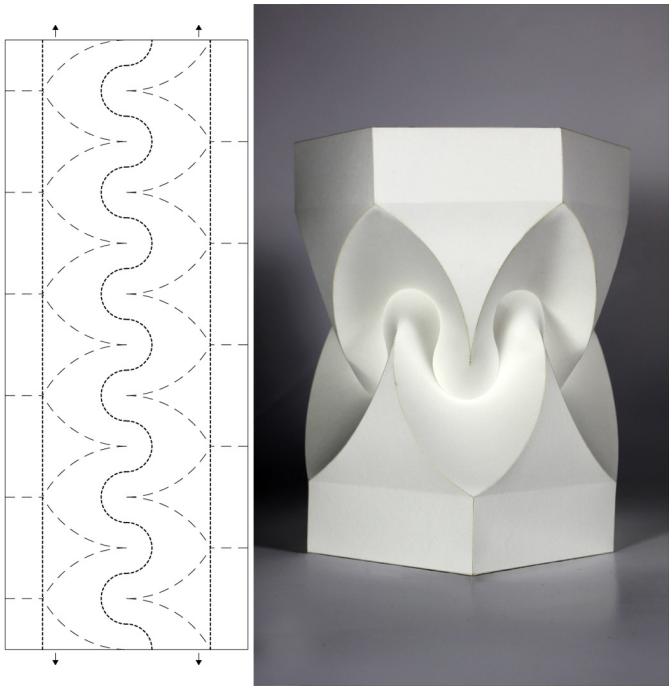

Figure 2: Physical reconstruction of Huffman's model

Figure 2 shows a fully reconstructed example of Huffman's designs similar to a reconstruction by Saadya Sternberg [SS09]. Figure 3 shows a fully reconstructed design as a digital 3D model. Truncated mirrored cones (mirror planes in red) are constructed using a pleating pattern with alternating mountain and valley creases.

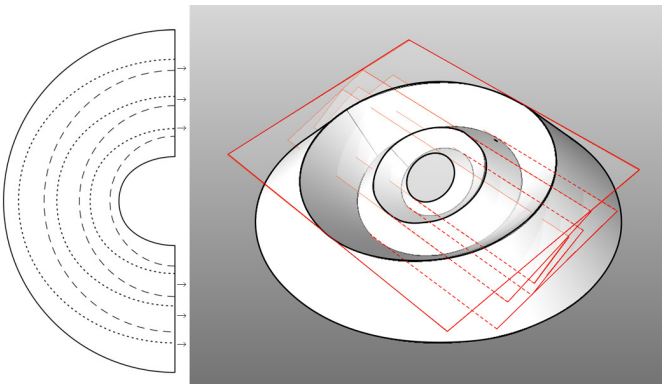

Figure 3: Digital reconstruction of Huffman's model

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