Paper Sculptures with Vertex Deflection

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Abstract

This workshop presents mathematical concepts vertex deflection and Gauss-Bonnet Theorem with hands on experiences using paper, plastic, stapler and glue. We show how to create sculptor Ilhan Koman's mathematically motivated developable surfaces [1, 3, 4]. We also present how one can construct a variety of shapes creating saddle, maxima and minima using nip and tuck.

1 Workshop Overview

This workshop shows how a mathematical concept called vertex deflections [2] can be used to intuitively construct developable surfaces using paper, plastic, stapler and glue [1]. We will provide an intuitive introduction to vertex deflection using Ilhan Koman's sculptures as shown in Figure 1 [1, 3]. The sculptures of Koman discussed in [1] visually provides information about vertex deflection and can help anybody to understand local behavior around a extreme point such as saddle or maxima as shown in Figure 2. We also show how to create other Koman developable sculptures such as hyperforms (see [1].)

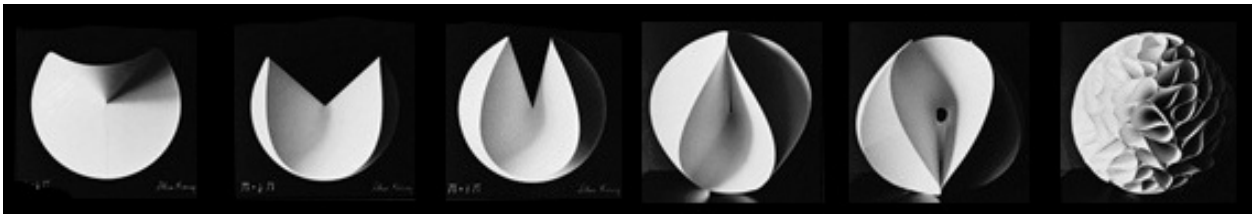
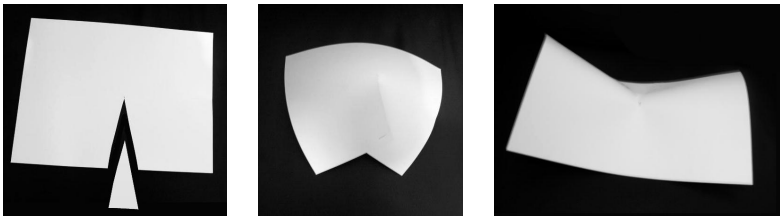


Figure 1: Ilhan Koman's Developable Sculptures. These were constructed with sheet metal in the 1980's. In these sculptures, the connections are almost invisible (photos by Tayfun Tunçelli).



Initial Paper **Maxima** **Saddle**

Figure 2: Creation of maxima and saddle with subtracting and adding angles to a flat surface.

The workshop is intended for all Bridges attendees who are interested in the creation of interesting shapes and sculptures; and teaching how to construct those sculptures. With the papers, staplers and glue in the room all participants will have an hands-on experience with vertex deflections.

The beginning part of the workshop covers construction of Ilhan Koman's developable sculptures after a short overview. Ilhan Koman's sculptures such as hyperforms will be created by participants with hands-on experiments. The concepts of saddle, minimum and maximum will be introduced by nipping and tucking circular pieces of papers. In the second part, we show to intuitively construct paper sculptures with hands-on experiences, such as the ones shown in Figure 3. We will also create Architectural forms together with participants. Figure 3 shows two examples of paper sculptures we have created based on the insight coming from vertex deflections [2] and Gauss-Bonnet theorem [5].

Figure 3: Paper sculptures. Cat mask is created from a 8.5×11 paper that is cut into one square and one rectangular pieces. These pieces are later stapled together to create the cat mask. Swan is created from a shaped and folded paper using only three staples.

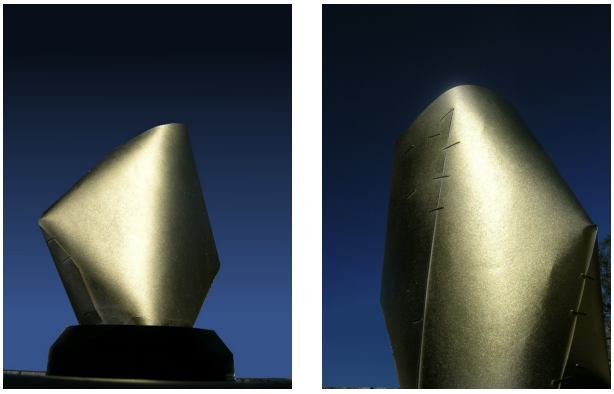


Figure 4: Architectural forms that are created using vertex deflections.

References

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[4] John Sharp, D-forms and Developable Surfaces, Bridges 2005, pp. 121-128, 2005.

[5] "Eric W. Weisstein", "Gauss-Bonnet Formula", 2005, From MathWorld–A Wolfram Web Resource. http://mathworld.wolfram.com/Gauss-BonnetFormula.html