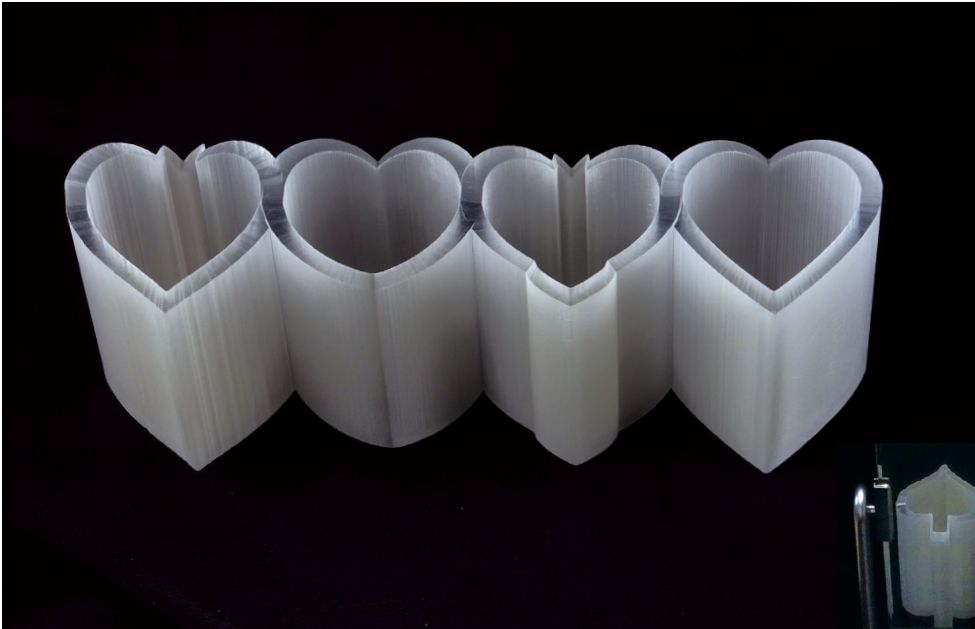# Capricious Hearts

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Kokichi Sugihara "Capricious Hearts" 2017, Material: RGD720, Size: 249.6W x 74.4D x 127.2H (mm)

The object appears to be four hearts in a line when we see it directly, but the reflection in a vertical mirror behind the object appears to be the set of all four suits of the trump, i.e., diamond, club, heart and spade. We know that the shape of an object and its mirror image are mirror symmetric to each other, and hence heart cannot change to diamond, etc., in a mirror; the behavior of this object seems impossible. However, this is possible because our perception is subject to optical illusion.

Keywords: ambiguous cylinder, impossible object, optical illusion

1 Behavior of the Object

From a special viewpoint it appears to be four hearts in a line, but if we rotate it around the vertical axis by 180 degrees, it appears to be the set of all four suits of the trump, i.e., diamond, club, heart and spade. These two appearances will be enjoyed at the same time if we place a vertical mirror behind the object and look at the object and its mirror image simultaneously.

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2 Production Process

I found a systematic method for creating a new class of impossible objects, which I named "ambiguous cylinders." This class of objects generates optical illusion in the sense that their appearances change drastically in a mirror [1]. The ambiguous cylinders are based on two observations, one is physical and the other is psychological.

Physically, a single image of a 3D object does not have information about depth, and consequently there are infinitely many possible 3D objects that yield the same 2D image [2]. Hence, we can generate a 3D object that has two desired 2D appearances when seen from two special viewpoints, if the pair of appearances satisfies a certain condition.

Psychologically, on the other hand, our vision systems have a strong preference for rectangularity in the sense that we are

apt to interpret 2D images as 3D objects with as many rectangles as possible [3]. Hence, if we present cylindrical shape with a constant height, we usually interpret the edge curve of the cylinder as a plane curve perpendicular to the axis of the cylinder, even if it is a space curve.

Combining these two observations, we can construct ambiguous cylinders. This is the basic idea for ambiguous cylinders. I applied this method to four pairs of shapes, one is heart and the other is one of the four suits of the trump, and thus generated four ambiguous cylinders. Finally I joined them to the present object

3 Software & System

With my original program written in Fortran, I computed the shape of four objects corresponding to the four suits, and then generated their STL data. Finally, using the commercialized modeling tools Rhinoceros version 5.0, I merged them into one final object.

References

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[3] Perkins, D. N., Visual discrimination between rectangular and nonrectangular parallelopipeds. *Perception and Psychophysics*, Vol.12, pp.293–331, 1972.