

Software Project Outline – 2017

Some Notation

I'll use x_i , $i = 1, 2, 3, 4$ for the Euclidean coordinates and r, s, t , for parametric variables.

Basic Functionality

1. A dimension is selected (either 2,3, or 4)
2. Objects can be assumed to be in a -10 to 10 bounding box, i.e. $-10 \leq x_i \leq 10$ for all i .

Inputing Objects

1. As a Cartesian Equation

$$x_1^2 + 3x + 2^2 + 4x_4^2 \leq 1.$$

2. As a Convex Hull of Points

- a. Points are entered (here in 3D where at lease 4 should be required)

$$p_1 = (1, 0, 0), p_2 = (0, 1, 0), p_3 = (0, 0, 1), p_4 = (1, 1, 1).$$

- b. $\text{HULL}(p_1, p_2, p_3, p_4) = \{s_1 \cdot (1, 0, 0) + s_2 \cdot (0, 1, 0) + s_3 \cdot (0, 0, 1) + s_4 \cdot (1, 1, 1)\}.$

3. Parametrically

$$\begin{aligned}x_1 &= r \cos(4\pi t) - s \sin(4\pi t) \\x_2 &= r \sin(4\pi t) + s \cos(4\pi t) \\x_3 &= 5t\end{aligned}$$

with these equations and the limits below entered by the user.

$$0 \leq r \leq 1, \quad 0 \leq s \leq 1, \quad -1 \leq t \leq 1.$$

Viewing Sections (3D example)

1. The user specifies a coordinate direction (either x_1 , x_2 or x_3 and a color.
2. Sections orthogonal to the specified direction are shown via “slider” or “movie” (user choice) beginning with -10 and ending with 10 .
3. Sections of 4D objects are 3D solids so picturing a particular section and pulling it around as per *Mathematica* would be nice but is not necessary.

Viewing Objects

1. In 2D this is clear.
2. In 3D this is “pretty clear” but again the *Mathematica* style viewing would be nice.
3. In 4D this may only be meaningful in the convex hull case. Then a choice needs to be made as to whether “perspective view” or “projection view” is seen. Perhaps these could be toggled.