

Using the D3D-style stereo projection matrix and projecting a point into the left view gives us:

$$\begin{bmatrix} d & 0 & 0 & 0 \\ 0 & ad & 0 & 0 \\ S & 0 & Q & 1 \\ dT & 0 & Qn & 0 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix} = \begin{bmatrix} dx \\ Sz + dT \\ ady \\ Qz \\ Qn \\ z \end{bmatrix}$$

After the reciprocal divide and considering only the  $x$  values, we end up with:

$$\begin{aligned} x_{left} &= \frac{dx}{z} - S + \frac{dT}{z} \\ &= x_{center} - S + \frac{dT}{z} \end{aligned}$$

Where  $x_{center}$  is the result of non-stereo projection.

Expanding and simplifying, we end up with:

$$\begin{aligned} x_{left} &= x_{center} - S + \frac{dT}{z} \\ &= x_{center} - S + \frac{dSc \cdot \tan(fov / 2)}{z} \\ &= x_{center} - S + \frac{Sc}{z} \end{aligned}$$

(Recall that  $d$  is  $\cot(fov/2)$ ). Similarly, for  $x_{right}$ :

$$x_{right} = x_{center} + S - \frac{Sc}{z}$$

Subtracting these gives the displacement between the left and right views in NDC space:

$$\begin{aligned} x_{right} - x_{left} &= x_{center} + S - \frac{Sc}{z} - x_{center} + S - \frac{Sc}{z} \\ &= 2S - \frac{2Sc}{z} \end{aligned}$$

However, NDC space has a range from -1 to 1.

To convert this to a displacement for texture coordinates, which range from 0 to 1, we halve the distance, which gives us:

$$x_{right} = x_{left} + S - \frac{Sc}{z}$$

If we replace  $S$  with  $s$ , this is clearly the same as the equation in **Figure 6**, so  $s$  is just  $S$  when reprojecting from a left eye view to a right eye view. Note that for center reprojection, we would split the difference going from center to left and center to right, and so halve the displacement.

Again, signs are important for computing this: for reprojecting and rendering the left eye, we'd use  $-s$ ,  $+sc/z$ ,  $-S$ , and  $+T$ . For the right eye, we invert the signs and so use  $+s$ ,  $-sc/z$ ,  $+S$ , and  $-T$ .

The end result is quite nice. We get most of the speed benefits of reprojection, with the good-looking alpha of standard stereo, and all it took was a little bit of math and some extra setup.