Pinhole Cameras and Division by Zero Calculus

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Abstract: From the elementary example of pinhole cameras, the essential fact of the division by zero calculus may be looked and at the same time, some great impacts to rational mappings are referred with the basic interrelation with zero and infinity. Some strong discontinuity property at infinity may be looked as a very interesting property.

David Hilbert:

The art of doing mathematics consists in finding that special case which contains all the germs of generality.

Oliver Heaviside:

Mathematics is an experimental science, and definitions do not come first, but later on.

Key Words: Division by zero, division by zero calculus, pinhole camera, rational mapping, isolated singular point, $1/0 = 0/0 = z/0 = \tan\frac{\pi}{2} = 0$.

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1 Introduction and the results

First of all, we recall the simplest model of a pinhole camera based on [3].

On the x, y plane, we shall consider the original object on the line at $x = x$, $0 \leq y \leq D$ with a positive fixed D. Its image through the origin

(pinhole) on the line $x = -1$ is given by $-d \leq y \leq 0$. Of course, the point (x, D) is mapped to $(-1, -d)$. Then, we obtain the relation

$$d = \frac{D}{x}.$$

How will be the situation for the case $x = 0$? The very classical result and idea is then d is infinity and the image is on the point at infinity. However, our result on the division by zero and division by zero calculus result mean that $d = 0$ and with our sense the following is valid:

$$d = \frac{D}{0} = 0.$$

Look the papers in the references. Our result may be natural in the situation, practically. As in stated in the paper [3], our result gives a great impact for the general rational maps.

We shall consider the circle C_x throught the three points of the origin, $(-1, 0)$ and $(-1, -d)$ whose equation is given by the equation

$$x^2 + x + y^2 + \frac{D}{d}y = 0.$$

Then, by our division by zero we obtain the surprising result that for $d = 0$

$$\left(x + \frac{1}{2}\right)^2 + y^2 = \left(\frac{1}{2}\right)^2.$$

2 Remarks

Our results mean that they are like the limit cases of $x \to +\infty$, however, for the case $x = 0$ we obtain the results discontinuously. If x tends to $+0$, then of course, d tends to $+\infty$ and the final circle is the same. The results mean the delicate relation of zero and infinity.

What is infinity? Note that infinity may be caught by means of the concept of limiting idea, and it is not any definite number.

We shall write with $0 \leq \theta \leq \pi/2$ as follows:

$$\tan\theta = \frac{D}{x} = d.$$

If $x \to +0$, then $\theta \to \pi/2$ and also $\tan\theta \to +\infty$. However,

$$\tan\frac{\pi}{2} = 0.$$

This result is the typical and important result of the division by zero calculus.

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