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Space Laser Communication Network

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***Abstract*—With the number of satellite cluster, space station and planet detector is sharply increasing, the next challenge we face is to set up space laser communication network.However, it is not only difficult but also cumbersome to use point-to-point laser communication terminal as a data node terminal antenna. The characteristics of rotational paraboloid is that light beam incident from any direction to the parabolic focus will reflect on surface of parabolic,the beam propagation direction is parallel to the symmetry axis of paraboloid ,this structure of optical antenna to overcome constraint of ATP subsystem,when multiple platforms communicate with each other at same time. In this paper we designed an antenna which can meet demand that at least two terminals communicate to it , and next work is we make rotational paraboloid improvement according to space platform orientation.**

***Index Terms*—Space laser communication;optical antenna; network; rotational paraboloid**

I. INTRODUCTION

Free space laser communication has many unique advantages, such as high bit rate, large capacity, anti-interference, anti-interception, boost light weight, and attracts ever increasing attention[1].With the number of satellite cluster, space station and planet detector is sharply increasing , there is an urgent need to build space laser communication network, Laser communication network is extremely difficult because the characteristics of the laser.If segment host want to achieve multi-point to communicate with other terminals , in accordance with the current terminal structure, platform need multiple optical antennas and multiple ATP structures , it is not a good way in the space missions.

Rotational paraboloid is a special optical components, it widely used in the panoramic camera[2], we can take it advantage to design a multi-point optical communications antenna.

II. OPTICAL PROPERTIES OF ROTATING PARABOLIC

People often use rotational paraboloid in difference areas , if a light source placed at the paraboloid focus, we will receive parallel light. As shown in the Figure.1,optical line FP emitted from the focus F will reflect at the point P, PL is the reflected light ,and its direction is parallel to the X-axis.In contrast with this, we used the outside surface of the paraboloid, KP is the incident optical line to the focus F, NP is the reverse extending line of PL.Therefore, we must demonstrate that NP is the reflected light of KP at point P.

From Fig.1we know that :

$$\angle MPL = \angle NPJ$$
$$\angle JPF = \angle KPM$$
$$\theta = \angle NPF = \angle NPJ + \angle JPF =$$
$$\angle KPL = \angle KPM + \angle MPL$$

assuming parabolic curve equation, where is a point on the parabola, then. $C: y^2 = 4cx$, the tangent through point p is:

$$L: y_0 y = 2p(x + x_0) \Rightarrow 2px - y_0 y + 2px_0 = 0$$

and the intersection of line L and X-axis is $J(-x_0, 0)$, while $|PF| = \sqrt{(x_0 - c)^2} = |x_0 + c|$ and $|FJ| = |x_0 + c|$, so $|PF| = |FJ|$, $\angle JPF = \angle MPL$

we proved that incident light from any direction to focus when the reflected light at the outer surface of paraboloid will parallel the optical axis of rotational paraboloid, so we can design optical antenna according to this conclusion.

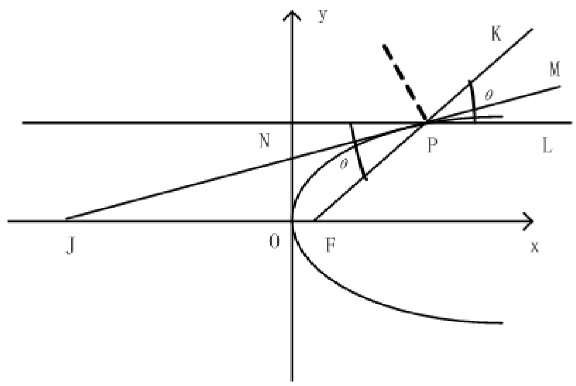

Fig. 1. Parabolic optical principle diagram

III. PARABOLIC OPTIMIZED AND MIRROR SPLICING

We known that characteristic of the paraboloid from section II, however,the actual beam is divergent after reflection which is extremely negative for laser communications,as Fig.2.