RETROREFLECTORS HAVING ACUTE DIHEDRAL ANGLES AND THEIR APPLICATION TO LASER RANGING TARGETS

Nobuo Sugimoto and Atsushi Minato
National Institute for Environmental Studies
16-2 Onogawa, Tsukuba, Ibaraki 305 Japan
Phone: 81-298-51-6111 Facsimile: 81-298-51-4732
E-mail: nsugimot@nies.go.jp

INTRODUCTION

A conventional retroreflector is formed with three mirrors connected each other at right angles. It reflects incident rays exactly into the reverse directions. Incident rays are reflected always at the distance of the corner of the three mirrors, which we will call the origin of reflection.

RETROREFLECTOR HAVING ACUTE DIHEDRAL ANGLES*

The three mirrors connected with two right dihedral angles and one acute dihedral angle at 45 degrees, for example, work as a retroreflector. The value of the acute angle at which the optics works as a retroreflector is 90/N degrees, where N is a natural number (Fig.1). When this condition is met, an imaginary corner cube appears by the reflections of the mirrors.
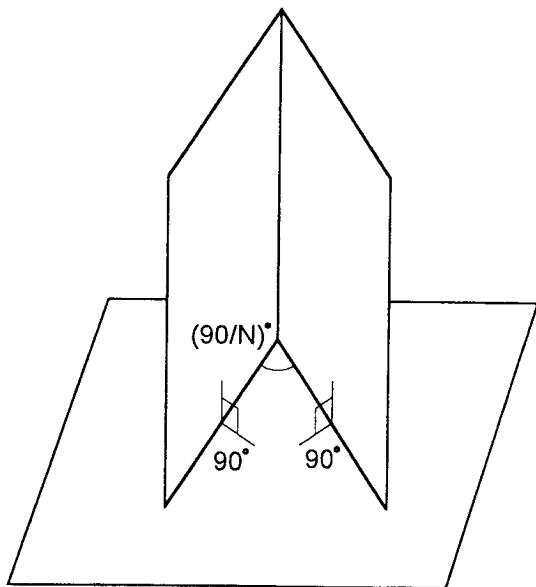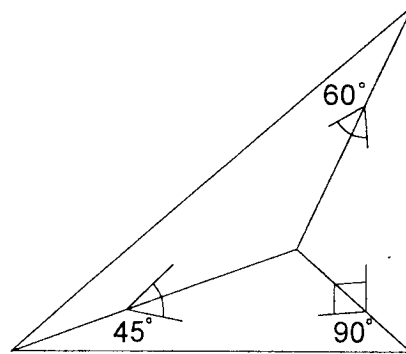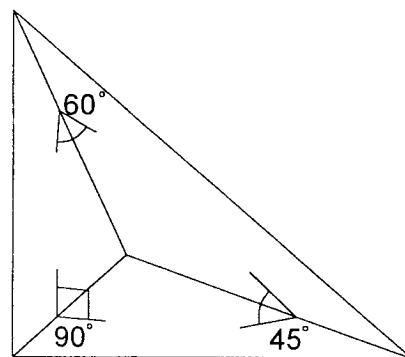
With the similar symmetrical consideration we have looked for retroreflectors having two or more acute dihedral angles. We found that the only combination of three dihedral angles which works as a retroreflector is 90 deg., 60 deg. and 45 deg. There are two types as shown in Fig.2.

(a)

(b)

Fig.2 The retroreflector having two acute dihedral angles.

Fig.1 Retroreflector having one acute dihedral angle.

SINGLE ORIGIN RETROREFLECTOR ARRAY*

A possible application of the acute-angle retro-reflectors is the single origin retroreflector array in which all elements of the array have the identical origin. Manufacturing such a retroreflector array is practicable because a retroreflector works even if the central portion is missing.

The single origin retroreflector array is useful as a target for laser ranging which is used from multiple directions at the same time. Also, it has a great merit as a target for satellite laser ranging (SLR) because it can be designed so that the origin of the reflections coinsides with the center of gravity of the satellite.

A single origin retroreflector array can be formed with usual corner cubes. However, the number of the elements is limited. The number is limited to 3 when the elements are placed circularly. The number of elements is 4 or 5 when the elements are placed on a sphere.

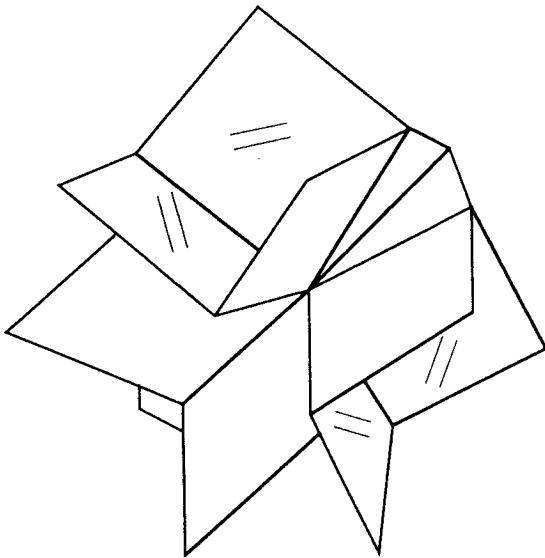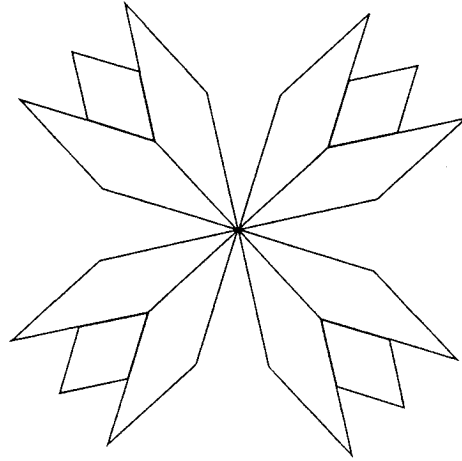Figure 3 shows a 4 element array with a symmetry of tetrahedron.

Fig.4   A single origin circular retroreflector array formed with 4 retroreflectors having one acute dihedral angle.

Figure 5 shows an array of the retroreflectors having two acute dihedral angles. It has 20 elements on a sphere with a symmetry of the regular polyhedron.
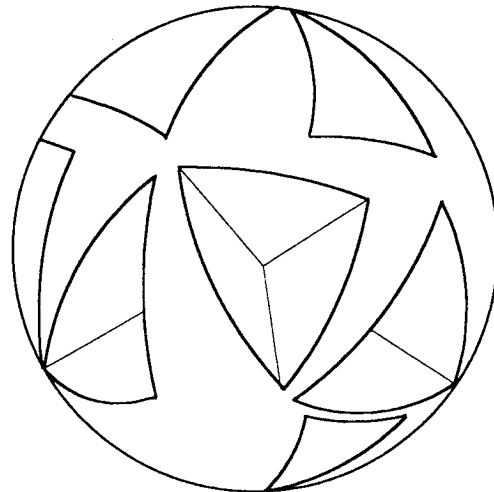

Fig.3   A single origin retroreflector array for SLR target formed with 4 corner cubes.

Fig.5   A single origin retroreflector array for SLR target formed with 20 acute-angle retroreflectors.

The number of element can be increased by using the acute-angle retroreflectors. Figure 4 shows a 4-element circular array formed with retroreflectors having one 45 degree dihedral angle. Such an array in which the direction of the elements is variable may be useful for laser ranging on the ground.

*Patent applied for

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