Introduction to Session 8: New Reflector Designs

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How to design an optimum reflector for far targets?

There are two partially contradicting requirements for a reflector:

1. sufficiently high effective radar cross section in the direction of velocity aberration
2. minimal pulse spreading

The best choice for precision is a single element reflector (cube corner or Luneberg lens)
However, the first requirement dictated the use of a high number of cube corners (about 100) in the case of high orbiting satellites.
Nevertheless, single element reflectors for high satellites and even for the Moon are seriously considered since several years. In the case of the Moon, efficient matching to the velocity aberration can be achieved by a cube corner with a two-spot far field. These spots become sharper with increasing aperture. Therefore, a single cube corner of 10 to 15 cm aperture diameter can be equivalent or even better as an Apollo array. Note that a lower number of returns are required for a given normal point precision in the case of a single element.
Navigation satellites are stabilised in the nadir direction only. This requires an annular far field to match to the mean velocity aberration (as in the case of spherical satellites). Therefore a single corner cube must have about 15 cm aperture to attain more than 100 Mio m² effective cross section.
However, a considerably smaller cube corner would be sufficient, if it could be mounted on a base which is self aligning with respect to the velocity vector. In this case the two-spot concept would be applicable and the aperture diameter can be reduced to 5….7 cm. This can be a solid cube corner or an open reflector.
The technology for solid cube corner prisms is well established. Metal coatings should be avoided to minimise thermal stress, but total internal reflection produces a phase shift between the two components of polarisation and this spreads the far field spots. This could be avoided by dielectric coatings.
Open reflectors are to be considered because they may be more resistant to sun heating if proper materials with high thermal conductivity and low coefficient of expansion are used. The achievement of the necessary joining precision and stability is not easy however.