THE LARGE ADAPTIVE REFLECTOR, A WIDE-FIELD OPTICAL DESIGN FOR LARGE RADIO TELESCOPES

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The Large Adaptive Reflector (LAR) is an "optics" design for a radio-reflector telescope that mechanically decouples the two main components, a deformable reflector and a moveable, focal-plane antenna-array. This combination enables the construction of larger reflectors (diameter > 150 m) than possible with traditional designs, while maintaining a field-of-view similar to that possible only with much smaller reflectors. Since the concept could find applications at other wavelengths and in other situations, it is presented as generally as possible, while the application as the Large Adaptive Reflector is explained in more detail.

The LAR reflector is designed with a nominal 2.5 focal ratio (f/D), much larger than the 0.3-0.4 range, typical of traditional reflectors. The result is a nearly "flat" parabolic profile, which can be implemented as interconnected panels that form a "faceted" approximation to an offset parabolic surface. The panels are supported on vertical actuators that support the surface uniformly over the entire reflector area. The actuators, which permit deformation of the reflector, can change the position of the focal point in 3-D space. This simultaneously changes the offset and the focal length so that the telescope can effectively be pointed to any Azimuth and all Zenith Angles up to about 60°. This technique avoids the limitation of traditional, mechanically tilted, fixed focal-length reflectors, which concentrates the structural loads into a small area, making diameters much greater than 100 m impossible.

For a 200-m diameter reflector, the focal distance is about 500 m, a problem for mounting the focal apparatus, which must "follow" the pointing direction. Somewhat arbitrarily we have chosen a semi-hemispheric surface centered on the reflector as a focal-point trajectory-surface. We have selected a system involving a stabilized platform supported by an aerostat, from which a focal plane array (FPA) can illuminate the reflector.

Off-axis aberrations are small compared with those suffered by antennas with small focal ratios. The FPA is an adding interferometer array placed in the focal plane. The FPA uses simple, wide-band elements that can be spaced at $\sim \lambda/10$ at the lowest frequency in the band. This critical property permits full Nyquist sampling of the focal-plane fields over large bandwidths. By combining the weighted outputs of an array of simple elements in a beam-forming network, multiple adjustable feed patterns are available. This meets the fundamental need for an adjustable feed pattern to compensate for angular foreshortening of the reflector with Zenith Angle. It also decouples aperture size from the field-of-view by forming multiple beams. It is possible to "receive signal" from an area of sky that is limited only by off-axis aberrations.

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