GROUND STATION ANTENNAS – SOME RECENT DEVELOPMENTS

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Abstract
Antennas used as ground stations continue to attract wide interest as applications become more demanding than in the past. For example, the quest to better understand the origin of the universe calls for more sensitive receiving stations. The increased interest in interplanetary probes requires better performance and greater flexibility from the ground-based infrastructure. Satellite communications continues to be a vital means of delivering information around the globe to an increasingly large number of mobile terminals. To meet these demands, as well as other new scientific and commercial challenges, ground station antennas with additional capabilities are being developed. This paper will review some of the recent developments.

In many earth-bound applications, the trend is towards smaller individual antennas, wider frequency bands and multiple bands. Smaller antennas are possible due to the use of higher frequencies, higher transmitter powers or arraying to achieve the required gain and sensitivity. For example, Ka-band (20/30 GHz) is now used in defence and civilian satellite applications where both reflector and lens solutions have been tried. Ka-band is also combined with another band, usually Ku- or X-band for the receive channel, in dual-band systems. This has required the development of compact dual-band feed systems, which though simple in principle to produce tend to be complex in practice. The paper will describe some recent designs of dual and multi-band feed systems for reflector and lens antennas.

A continuing issue for designers of satellite ground stations is the sidelobe levels should be low to minimize interference with adjacent satellites. Some recent progress in the design of low sidelobe ground stations will be described.

Mobile ground-based terminals have been in use for several years and a number of successful antenna designs have been reported for vehicular applications. The increasing size of on-board satellite antennas and radiated power is allowing the use of smaller and sometimes simpler ground station antennas. Recent examples include patch arrays and lenses. The paper will survey recent advances in ground station antennas for mobile terminals.

Another important development has been the increasing interest in ground station antennas that can produce multiple independent beams or have a wide field-of-view (FOV). Two areas where multi-beam ground stations are gaining acceptance are in satellite communications and radio astronomy. Several multi-beam antenna types are now used successfully by the satellite industry, including a dual-shaped offset Cassegrain design by CSIRO. In radio astronomy, one of the most demanding future projects is the square kilometre array (SKA). As well as covering a wide frequency band, the SKA has a FOV of about 100 square degrees. While several antenna configurations have been proposed, most involve hybrid antennas of reflectors with a focal plane array where the individual beams are formed by clusters of elements. This focal plane array has many demands and to meet them all will require wideband feed elements and digital beamforming. The paper will review of the recent research and industrial advances in multi-beam antennas for ground station applications, particularly for radio astronomy and satellite communications. These antennas include shaped reflectors with a wide-angle FOV, Luneburg and spherical lens configurations, and hybrid antennas with focal plane array feeds.