**The Challenges of Broadband Feed Design**

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Wide radio frequency bandwidth has become an important requirement for the next generation of radio astronomy instruments. The Frequency Agile Solar Radiotelescope (FASR), the Greenbank Lunar Interferometer for Neutrino Transients (GLINT), and the Square Kilometer Array (SKA) are examples of such instruments, but each will make use of this bandwidth in a unique way. For reflector-type antennas, it is often the feed that limits the functional bandwidth of the instrument as defined by the application. In recent years, there has been a significant amount of research and development directed toward this issue. Progress has been steady, but slowed by a plethora of design challenges.

Why do broadband feeds pose such challenges? The primary reason is that the feed resides at the confluence of electromagnetic and circuit theories. While the radiation characteristics must match the reflector optics and yield adequate polarization requirements, the feed itself must have low ohmic loss and provide an optimum noise match to amplifiers attached at its terminals. This is achieved routinely for narrow bandwidth applications, but attempting this over a 10:1 bandwidth requires is a serious development effort. These design issues become further compounded when ultra low noise, cryogenically cooled, front-end electronics are required for sensitivity. The result is usually a significant compromise in performance.

A broad-based view of wide bandwidth feeds will be presented. The unique requirements for such feeds will be described, and the various design approaches will be examined. The advantages and disadvantages of each will be presented. Future trends and research pathways will be highlighted.