Ultra-wideband samplers (10 to 20GSps) for use in radio astronomy

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Ultra-wideband samplers with sampling rates of 10Gsps to 20 Gsps (giga-samples per second) will be needed to process the wide bandwidths available from current-generation radio astronomy receivers. These samplers will enable full utilization of the wide bandwidth available from current and future generations of front-end amplifiers and heterodyne mixers and can dramatically increase the sensitivity and capability of most radio telescopes. Although multiple tunable downconverters and narrower bandwidth samplers (eg. 1GSps samplers) can be combined to cover wide bandwidths, the issues of cost, complexity, and spectral baseline flattening can be prohibitive. Ultra-wideband samplers can remove most of the expense and time consuming development of analog components and puts the wideband astronomical signals into the digital domain where the relentless advance of Moore's law can be exploited.

The initial application for research into ultra-wideband samplers is to improve the sensitivity and capability of the 23 element CARMA[1] interferometer. The technology will however, be immediately applicable to many other interferometer arrays and single dish telescopes. The added processed bandwidth will directly improve the sensitivity for continuum observations and give increased spectral bandwidth for line searches and multi-line observations. The reduced amount of RF and analog electronics will make it practical to implement full bandwidth capability on dual-polarization and multi-pixel systems. The range of radio astronomy science that can benefit from this development ranges from cosmology investigations using the SZ effect to planetary line observations and everything in between.

Because the initial application of the ultra-wideband samplers is for the CARMA system which utilizes double sideband heterodyne as well as HEMT and MMIC amplifier front ends, we will address the delay and phase switching issues associated with interferometers. This automatically encompasses essentially all issues or techniques that are important for single sideband interferometers or single dish spectrometers.

[1] Combined Array for Research in Millimeter-Wave Astronomy