MODULATING SIGNAL DESCRIPTION

Transmitted Signal

The SlimSAR transmits a periodic "chirp" -- so called because the frequency increases linearly over the period of the modulating chirp. Mathematically, one period of the transmitted waveform may be expressed as

$$s_t(t) = A_0 \cos\left[2\pi\left(f_0 t + \frac{k_r}{2} t^2\right)\right]$$

where A_0 is a constant amplitude, f_0 is the starting frequency of the chirp and k_r is the chirp rate. The chirp rate is defined as the ratio of the bandwidth of the transmitted signal to the period of the chirp, or $k_r = B/T_p$. In other words, the transmitted signal is a sinusoid whose frequency begins at a low frequency and linearly increases to the upper bound of the occupied bandwidth during the pulse length, T_p, which is calculated based on aircraft altitude and desired radar performance. The signal is repeated at the pulse repetion frequency (PRF) which is on the order of 17 kHz for the X-Band MIZOPEX application. Pulse length is approximately 2.25 microseconds. The transmit duty cycle of the system is less than 4% which greatly reduces the average effective radiated power. While the peak ERP for the system is 2000 W, the average ERP is 80 W or less. Additionally, the spread-spectrum nature of the transmitted signal minimizes the chance of harmful interference to other narrow-band users of the spectrum.