University of California at Berkeley College of Engineering Department of Electrical Engineering and Computer Sciences



EECS 120: Signals and Systems Fall Semester 1998

Example of Fourier Series in the Limit of a Long Period

Signal x(t) is a square wave with period T and pulse width $2T_s$.

Fourier series representation: $x(t) = \sum_{\substack{k = -\infty \\ m = -\infty}} X[k]e^{jk\omega_0 t}$, where $X[k] = \frac{2T_s}{T}\operatorname{sinc}\left(k\frac{2T_s}{T}\right)$ and $\omega_0 = \frac{2\pi}{T}$. Note that as $T \to \infty$, we obtain an isolated pulse, which is an aperiodic signal. In this limit, $\omega_0 \to 0$, and, although k is a discrete variable, $k\omega_0$ approaches a continuous variable. In this limit, a plot of $2\pi X[k]/\omega_0$ versus $k\omega_0$ approaches a continuous curve.

In the plots below, the Fourier series representations of x(t) include terms for $-64 \le k \le 64$.



