A function $f \in L^1(\mathbb{R})$ is $\Omega$-band-limited if its Fourier transform $\hat{f}(\omega) = 0, \forall \omega \notin [-\Omega, \Omega]$. We then have the inversion formula:

$$f(t) = \frac{1}{2\pi} \int_{-\Omega}^{\Omega} \hat{f}(\omega)e^{-i\omega t}d\omega, \text{ a.e. } t \in \mathbb{R}$$

The extrapolation problem is:

\begin{align*}
given & \quad f(t) \quad t \in [-T, T] \\
\text{find} & \quad f(t) \quad t \notin [-T, T] \\
\text{where } & \quad T = \text{const.} > 0.
\end{align*}

A regularized spectral estimation formula and a regularized iterative algorithm for band-limited extrapolation are presented. The ill-posedness is taken into account. First the Fredholm equation is regularized. Then it is transformed to a differential equation in the case where the time interval is $\mathbb{R}$. A fast algorithm to solve the differential equation is given by the finite difference and a regularized spectral estimation formula is obtained. Then a regularized iterative extrapolation algorithm is introduced and compared with the Papoulis and Gerchberg algorithm. (Received July 17, 2005)