信号处理原理 第 4 次作业

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1

求 $f(t)=e^{-at}$, $a>0, t>0$ 的傅里叶变换.

$$
\begin{aligned}
F(j\omega) &= \mathcal{F}[f(t)] \\
&= \int_0^{\infty} f(t)e^{-j\omega t}\mathrm{d}t \\
&= \int_0^{\infty} e^{-(a+j\omega)t}\mathrm{d}t \\
&= \frac{e^{-(a+j\omega)t}}{-(a+j\omega)}\Big|_0^{\infty} \\
&= \frac{1}{a+j\omega}
\end{aligned}
$$

2

求 $f(t)=\begin{cases} t & 0\le t<\tau \\ \tau & \tau\le t<2\tau \\ 0 & other \end{cases}$ 的傅里叶变换.

$$
\begin{aligned}
F(j\omega) &= \mathcal{F}[f(t)] \\
&= \int_{-\infty}^{+\infty} f(t)e^{-j\omega t}\mathrm{d}t \\
&= \int_0^{\tau} te^{-j\omega t}\mathrm{d}t + \int_{\tau}^{2\tau} \tau e^{-j\omega t}\mathrm{d}t \\
&= \frac{j\omega\tau+1}{\omega^2}e^{-j\omega\tau} - \frac{1}{\omega^2} + \frac{j\tau}{\omega}(e^{-j\omega\tau}-1)e^{-j\omega\tau} \\
&= -\frac{1}{(j\omega)^2}e^{-\tau j\omega} - \frac{\tau}{j\omega}e^{-2\tau j\omega} + \frac{1}{(j\omega)^2}
\end{aligned}
$$