信号理論基礎 課題レポート 1

細川 夏風

2025 年 6 月 13 日

授業より，$a_m = \frac{1}{\int_0^4 (f_m)^2 dt} \int_0^4 f f_m dt$，$f_1 = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$，$f_2 = \begin{bmatrix} 1 \\ 1 \\ -1 \\ -1 \end{bmatrix}$，$f_3 = \begin{bmatrix} 1 \\ -1 \\ -1 \\ 1 \end{bmatrix}$，$f_4 = \begin{bmatrix} 1 \\ -1 \\ 1 \\ -1 \end{bmatrix}$，を用いる.

(1). $f = \begin{bmatrix} 5 \\ 1 \\ -5 \\ 3 \end{bmatrix}$ のときの a_1~a_4 を求めよ.

$$
\begin{aligned}
a_1 &= \frac{1}{4}\int_0^4 f f_1 dt \\
&= \frac{1}{4}\langle f, f_1 \rangle \\
&= \frac{1}{4}\left\{5 \cdot 1 + 1 \cdot 1 + (-5) \cdot 1 + 3 \cdot 1\right\} \\
&= \frac{1}{4} \cdot 4 \\
&= 1
\end{aligned}
$$

よって $a_1 = 1$.

$$
\begin{aligned}
a_2 &= \frac{1}{4}\int_0^4 f f_2 dt \\
&= \frac{1}{4}\langle f, f_2 \rangle \\
&= \frac{1}{4}\left\{5 \cdot 1 + 1 \cdot 1 + (-5) \cdot (-1) + 3 \cdot (-1)\right\} \\
&= \frac{1}{4} \cdot 8 \\
&= 2
\end{aligned}
$$

よって $a_2 = 2$.

$$
\begin{aligned}
a_3 &= \frac{1}{4}\int_0^4 f f_3 dt \\
&= \frac{1}{4}\langle f, f_3 \rangle \\
&= \frac{1}{4}\left\{5 \cdot 1 + 1 \cdot (-1) + (-5) \cdot (-1) + 3 \cdot 1\right\} \\
&= \frac{1}{4} \cdot 12 \\
&= 3
\end{aligned}
$$

よって $a_3 = 3$.

$$
\begin{aligned}
a_4 &= \frac{1}{4}\int_0^4 f f_4 dt \\
&= \frac{1}{4}\langle f, f_4 \rangle \\
&= \frac{1}{4}\left\{5 \cdot 1 + 1 \cdot (-1) + (-5) \cdot 1 + 3 \cdot (-1)\right\} \\
&= \frac{1}{4} \cdot (-4) \\
&= -1
\end{aligned}
$$

よって $a_4 = -1$.

(2). $f = \begin{bmatrix} 4 \\ 0 \\ 0 \\ 0 \end{bmatrix}$ のときの a_1~a_4 を求めよ.

$$\begin{aligned} a_1 &= \frac{1}{4}\int_0^4 ff_1 dt \\ &= \frac{1}{4}\langle f, f_1 \rangle \\ &= \frac{1}{4}\{4\cdot 1 + 0\cdot 1 + 0\cdot 1 + 0\cdot 1\} \\ &= \frac{1}{4}\cdot 4 \\ &= 1 \end{aligned}$$

よって $a_1 = 1$.

$$\begin{aligned} a_2 &= \frac{1}{4}\int_0^4 ff_2 dt \\ &= \frac{1}{4}\langle f, f_2 \rangle \\ &= \frac{1}{4}\{4\cdot 1 + 0\cdot 1 + 0\cdot (-1) + 0\cdot (-1)\} \\ &= \frac{1}{4}\cdot 4 \\ &= 1 \end{aligned}$$

よって $a_2 = 1$.

$$\begin{aligned} a_3 &= \frac{1}{4}\int_0^4 ff_3 dt \\ &= \frac{1}{4}\langle f, f_3 \rangle \\ &= \frac{1}{4}\{4\cdot 1 + 0\cdot (-1) + 0\cdot (-1) + 0\cdot 1\} \\ &= \frac{1}{4}\cdot 4 \\ &= 1 \end{aligned}$$

よって $a_3 = 1$.

$$\begin{aligned} a_4 &= \frac{1}{4}\int_0^4 ff_4 dt \\ &= \frac{1}{4}\langle f, f_4 \rangle \\ &= \frac{1}{4}\{4\cdot 1 + 0\cdot (-1) + 0\cdot 1 + 0\cdot (-1)\} \\ &= \frac{1}{4}\cdot 4 \\ &= 1 \end{aligned}$$

よって $a_4 = 1$.

参考文献

[1] 無し