Real-Time DSP Design & Applications

Assignment

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My matriculation number is G2203629G, so $d_0 = 9, d_1 = 2, d_2 = 6, d_3 = 3, d_4 = 0, d_5 = 2, d_6 = 2$

Q1

(i)

$a = (-1)^3(6 + \frac{2}{10}) = -6.2$

$d_0 + 1 = 10$

$a = 11010.0011001100$

(ii)

$b = d_6 + \frac{d_5}{10} = 2.2 = 00010.0011001100$

(iii)

$$\begin{array}{rr} & 11010.0011001100 \\ + & 00010.0011001100 \\ \hline & 11100.0110011000 \end{array}$$

No overflow.

Q2

(i)

$d_3 + 1 = 4$

So, the signal is like x.xxxx

Quantization step size $= Q = 10^{-4}$

(ii)

Variance $= \frac{Q^2}{12} = 8.3 \times 10^{-10}$

(iii)

Variance due to input $= \frac{Q^2}{12} \times \frac{2\Delta}{2\pi} = \frac{Q^2}{12}\frac{1}{d_2+2} = \frac{Q^2}{96}$

Variance due to output $= \frac{Q^2}{12}$

Total variance $= \frac{Q^2}{96} + \frac{Q^2}{12} = \frac{3Q^2}{32} = 9.375 \times 10^{-10}$

Q3

(i)

$B = 10d_1 + d_0 = 29\text{kHz}$

$f_c = 100d_6 + 10d_5 + d_4 = 220\text{kHz}$

$\frac{2f_c+B}{m+1} \leq f_s \leq \frac{2f_c-B}{m}$

$m = 0 \quad 469\text{kHz} \leq f_s \leq \infty$

$m = 1 \quad 234.5\text{kHz} \leq f_s \leq 411\text{kHz}$

$m = 2 \quad 156.33\text{kHz} \leq f_s \leq 205\text{kHz}$

$m = 3 \quad 117.25\text{kHz} \leq f_s \leq 137\text{kHz}$

$m = 4 \quad 93.8\text{kHz} \leq f_s \leq 102.75\text{kHz}$

$m = 5 \quad 78.17\text{kHz} \leq f_s \leq 82.2\text{kHz}$

$m = 6 \quad 67\text{kHz} \leq f_s \leq 68.5\text{kHz}$

$m = 7 \quad 58.63\text{kHz} \leq f_s \leq 58.71\text{kHz}$

$m = 8$ and above does not satisfy $f_s \geq 2B$

(ii)

According to answers in (i), there will **not** be aliasing when $f_s = 100\text{kHz}$.