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## Digital Biosignal Processing - Laboratory Report 1

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### 1. Laboratory 1

#### 1.1. Optimal alignment of channel1 & channel2

Initially, a temporal delay exists between channel 1 and channel 2. By determining the optimal delay (5.86 ms) and subsequently applying it to channel 2 (moving it forward), alignment of the two signals can be achieved. The plot of the optimal alignment is shown in figure 1, and set of parameters is reported in table 1. As a result, optimal delay is 5.86 ms and estimated conduction velocity is 4.10 m/s.

Parameters	Values
Step Size	0.2
Number of Steps	100
Downsampling Factor	1
Optimal Delay	5.86 ms
Estimated Conduction Velocity	4.10 m/s
Optimal MSE between Channel 1 & 2	17.08%

Table 1: parameters and values

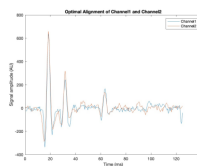


Figure 1: Optimal Alignment

#### 1.2. Estimation error with different downsampling factors(M)

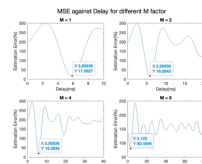


Figure 2: MSE against Delay for different M factor

M	Optimal Delay	Estimated Conduction Velocity	Optimal MSE
1	5.86 ms	4.10 m/s	17.08%
2	5.86 ms	4.10 m/s	16.80%
4	5.86 ms	4.10 m/s	19.28%
8	3.12 ms	7.68 m/s	80.48%

Table 2: results with different downsampling factors

Figure2 presents the estimated error, which is mean squared error (MSE), against delay for four different downsampling factors (1, 2, 4, 8). For each downsampling factor M, the points of optimal delay are labeled (the x-axis represents the real-time domain).

Table2 report all detailed result for those four M. When M is set to 1, 2, or 4, both the optimal delay and the estimated conduction velocity remains constant at 5.86 ms and 4.10 m/s, respectively. The optimal MSE is also quite similar, hovering around 17%.

When M increases to 8, minor fluctuations in both the optimal delay and conduction velocity are observed. However, there is a significant jump in the optimal MSE, which escalates to 80.48%. This increase may be attributed to aliasing, indicating that the sampling frequency is below twice the signal bandwidth.