5275 BCI Modification of Lab3

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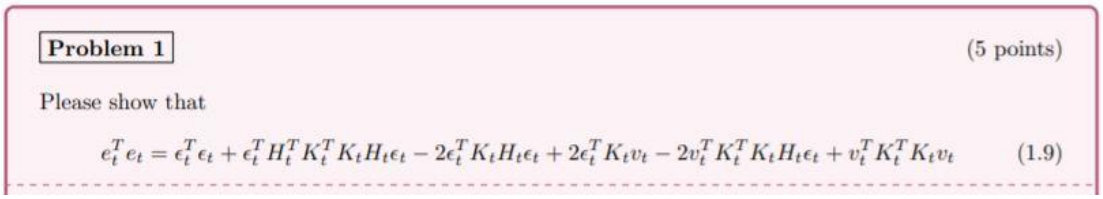
Modification

1. Problem 1

   The fourth term in the right-hand side should be $2\varepsilon_t^T K_t v_t$



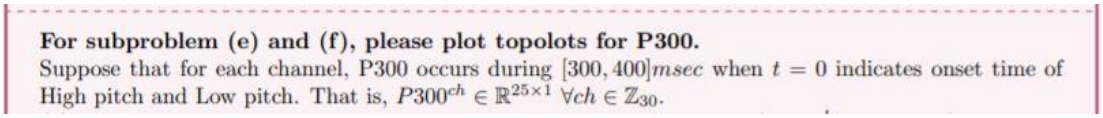
Problem 1 (5 points)

Please show that

$$e_t^T e_t = \epsilon_t^T \epsilon_t + \epsilon_t^T H_t^T K_t^T K_t H_t \epsilon_t - 2\epsilon_t^T K_t H_t \epsilon_t + 2\epsilon_t^T K_t v_t - 2v_t^T K_t^T K_t H_t \epsilon_t + v_t^T K_t^T K_t v_t \quad (1.9)$$

2. Problem 11.c

$$P300^{ch} \in \mathbb{R}^{25\times 1}$$



For subproblem (e) and (f), please plot topolots for P300.
Suppose that for each channel, P300 occurs during $[300, 400]msec$ when $t = 0$ indicates onset time of High pitch and Low pitch. That is, $P300^{ch} \in \mathbb{R}^{25\times 1}$ $\forall ch \in \mathbb{Z}_{30}$.

Hints for mathematical problem

1. Problem 3

   Try to expend ε_t by definition to find term that is uncorrelated to v_t.
2. Problem 4

   Substituting (1.16) and (1.17) into (1.14).
3. Problem 5

   (1.20) should be equivalent to the following formula (you need to prove this formula instead of using it directly)

$$C_{\hat{\theta}_t} = K_t C_v(t,t) K_t^T + (I_k - K_t H_t) C_{\hat{\theta}_{t|t-1}} (I_k - K_t H_t)^T$$

   and then apply (1.18).

Notes for coding problem

1. If you use EEGLab to plot topoplots in problem 11 and 12, please use the parameter `'maplimits',[0,1]`.

```
topoplot(p300_data,EEG.chanlocs,'maplimits',[0,1])
;
```

2. In problem 12, you can apply Min-max normalization to 1 single topoplot or all topoplots. This question is default to apply Min-max normalization to all 20 topoplots.