

EEG Electrode Reduction: Autoencoder Example

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Data

```
% load data
load('EEG.mat')

% autoscale variables i.e. divide variables by mean and divide by standard deviation
X = ((EEG.Variables - mean(EEG.Variables))./std(EEG.Variables))';
```

Plot a few electrode time series at random

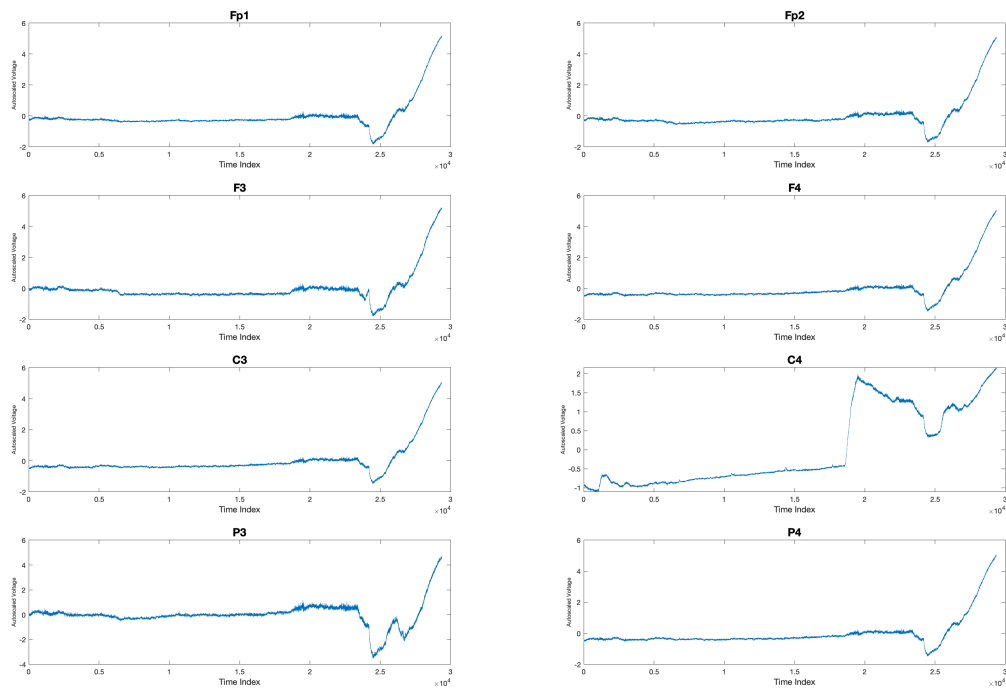
```
% pick electrodes at random and plot their voltage time series
idx = randi(64,8,1);

% create figure
fig = figure(1);
fig.Units = 'normalized';
fig.Position = [0 0 1 1];

% create subplots for each electrode
for i = 1:length(idx)

    subplot(4,2,i)
    plot(X(idx(i),:))
    title(EEG.Properties.VariableNames(i), 'FontSize', 16)
    ylabel('Autoscaled Voltage', 'FontSize', 8)
    xlabel('Time Index', 'FontSize', 12)

end
```



Train Autoencoder

```
% define number of hidden neurons
q = 3;

% train autoencoder
autoenc = trainAutoencoder(X, q);

% use autoencoder net to predict X
predX = predict(autoenc, X);
```

Method Evaluation

Plot true and estimated electrode time series of same electrodes as before

```
% create figure
fig = figure(2);
fig.Units = 'normalized';
fig.Position = [0 0 1 1];

for i = 1:8
```

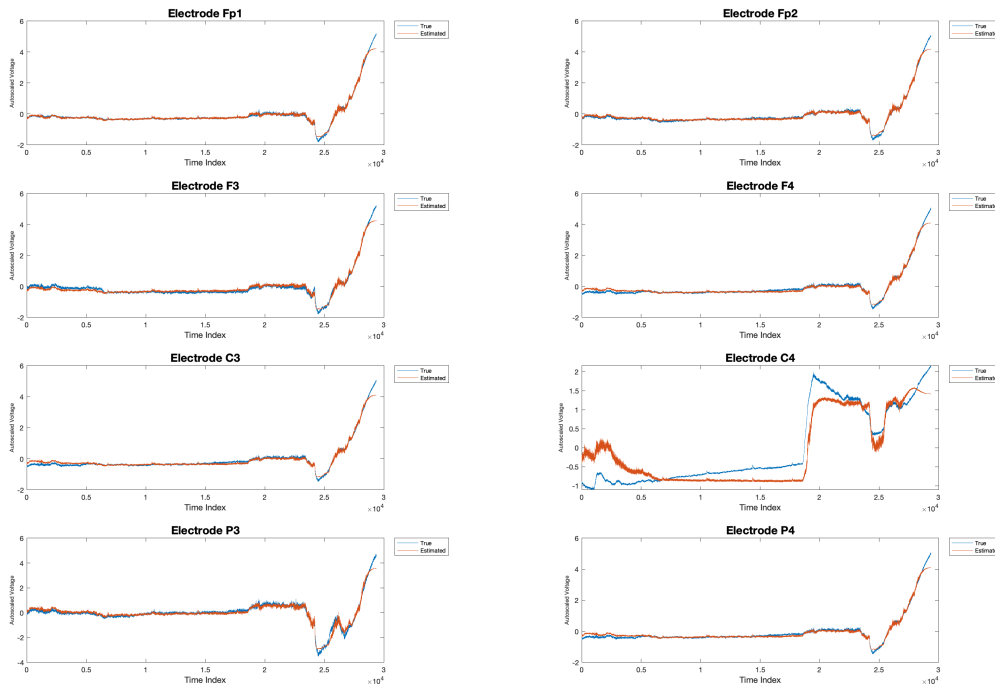
```

subplot(4,2,i)
plot(X(idx(i),:))
hold on
plot(predX(idx(i),:))
title(strcat("Electrode ", EEG.Properties.VariableNames(i)), 'FontSize', 16)
ylabel('Autoscaled Voltage', 'FontSize', 8)
xlabel('Time Index', 'FontSize', 12)

legend('True', 'Estimated', ...
       'Location', 'bestoutside', 'FontSize', 8)

end

```



Compare true and estimated aggregated electrode time series

```

% average all voltage values
X_agg = mean(X);
predX_agg = mean(predX);

% correlation coefficient between average voltage of true and estimated data
R = corrcoef(X_agg, predX_agg);
r2 = round(R(1,2)^2, 3);

% create figure
fig = figure(3);
fig.Units = 'normalized';
fig.Position = [0 0 1 1];

% plot comparison of true and estimated averaged eeg voltages
scatterhist(X_agg, predX_agg)

```

```

hold on
plot([min(X_agg) max(X_agg)], [min(X_agg) max(X_agg)], ...
     'k--', 'Linewidth', 2)
legend("R^2= " + string(r2), '1:1', 'Location', 'southeast', 'FontSize' ,16)
axis tight
hold off
title('Performance of Aggregated Dynamics Estimation', 'FontSize',16)
xlabel('True Averaged Voltage (\muV)', 'FontSize' ,16)
ylabel('Estimated Averaged Voltage (\muV)', 'FontSize' ,16)

```

