EE373A Progress Report 2

Christian Choe and Min Cheol Kim

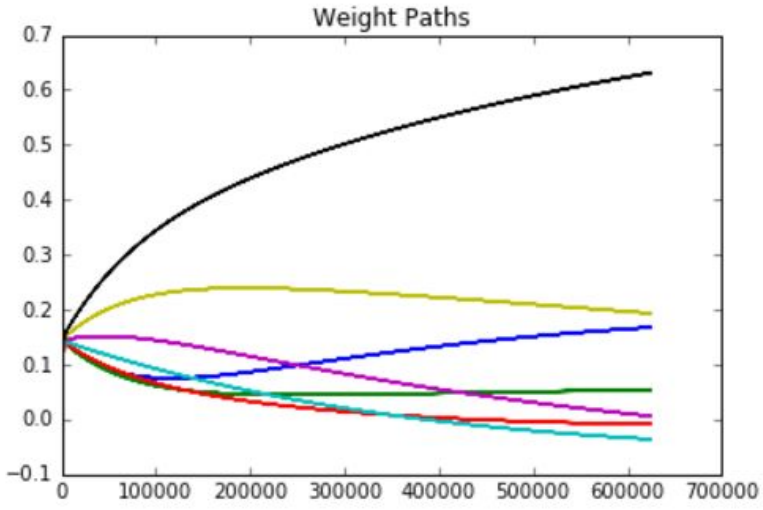
Introduction

This is our second progress report on using adaptive signal processing in order improve the accuracy of Continuous glucose monitoring (CGM) devices. Using a dataset of diabetic patients monitored by CGM devices, we tested various adaptive signal processing techniques to reduce the error relative to the gold standard, blood glucose measurements (BGM).

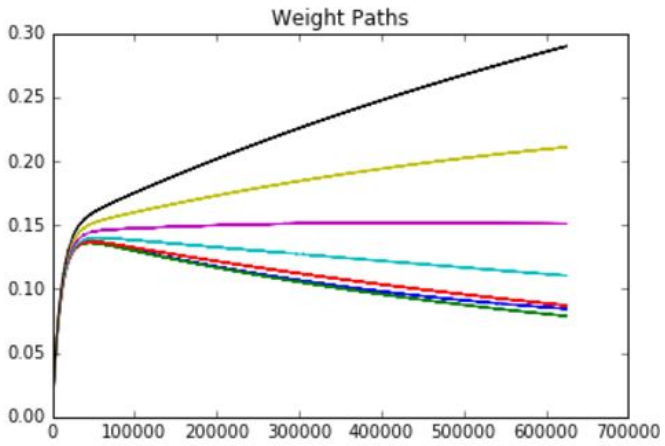
From the last report we had difficulty improving the accuracy of CGM with adaptive signal processing techniques. The weights had a tendency to never converge when using mu-LMS, alpha-LMS, or volterra alpha-LMS. In an attempt to improve convergence, we tested training our adaptive filter with a s maller mu or alpha with many repetitions on our training data.

Results

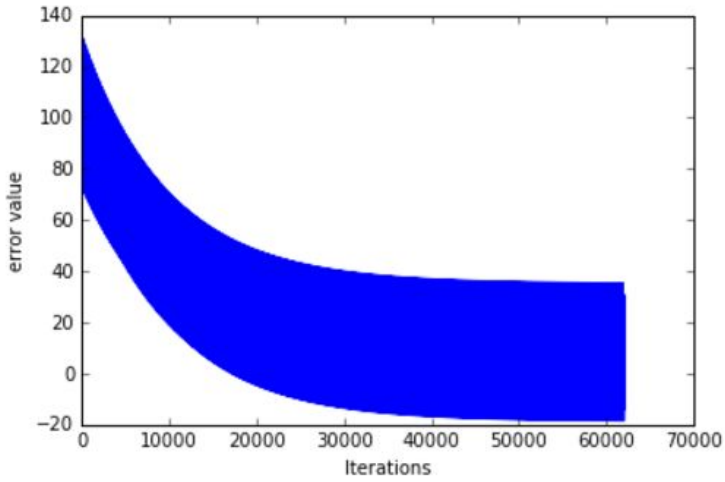
1) With small mu and many reps for the training data, the weights seem to "converge." The weights seem to go from all 0's to a somewhat stable value, although it seems to be diverging at the end. However, even if you stop training when the weights seem reasonable, the actual performance does not increase by much.



2) If we continue to train the weights on the training data, the weights start diverging. It seems like a sweet spot exists for the weights before it starts overfitting to the training signal.



3) Even with "normal" looking weights and error signal, we can't see improvements in the actual similarity to gold standard. The error signal seems to be similar to the plots we made in class, MSE decreasing and oscillating near the bottom of the bowl. However, with each iteration of training, there seems to be repeating increases and decreases that make the weights change continuously.



Discussion of failure

It was interesting to see the weights actually reach some stable magnitude, only to start diverging again. The error signal seemed reasonable as well, aside from the wild oscillations near the optimal MSE.

We believe that it may still be possible to model the blood to interstitial fluid as a linear filter, but our data is not sampled fast enough and long enough to really train our adaptive filters fully. With a 10 minute gap between each continuous glucose measurement, the data points may be too far apart to accurately to be represented. A linear filter may exist when the data is sampled more frequently, perhaps once a minute or so. We initially thought that we might need longer

stretches of data (several days instead of 2-3 days), but based on our analysis of the error signal and the paths of the weights, the more likely problem seems to be the sampling rate.