

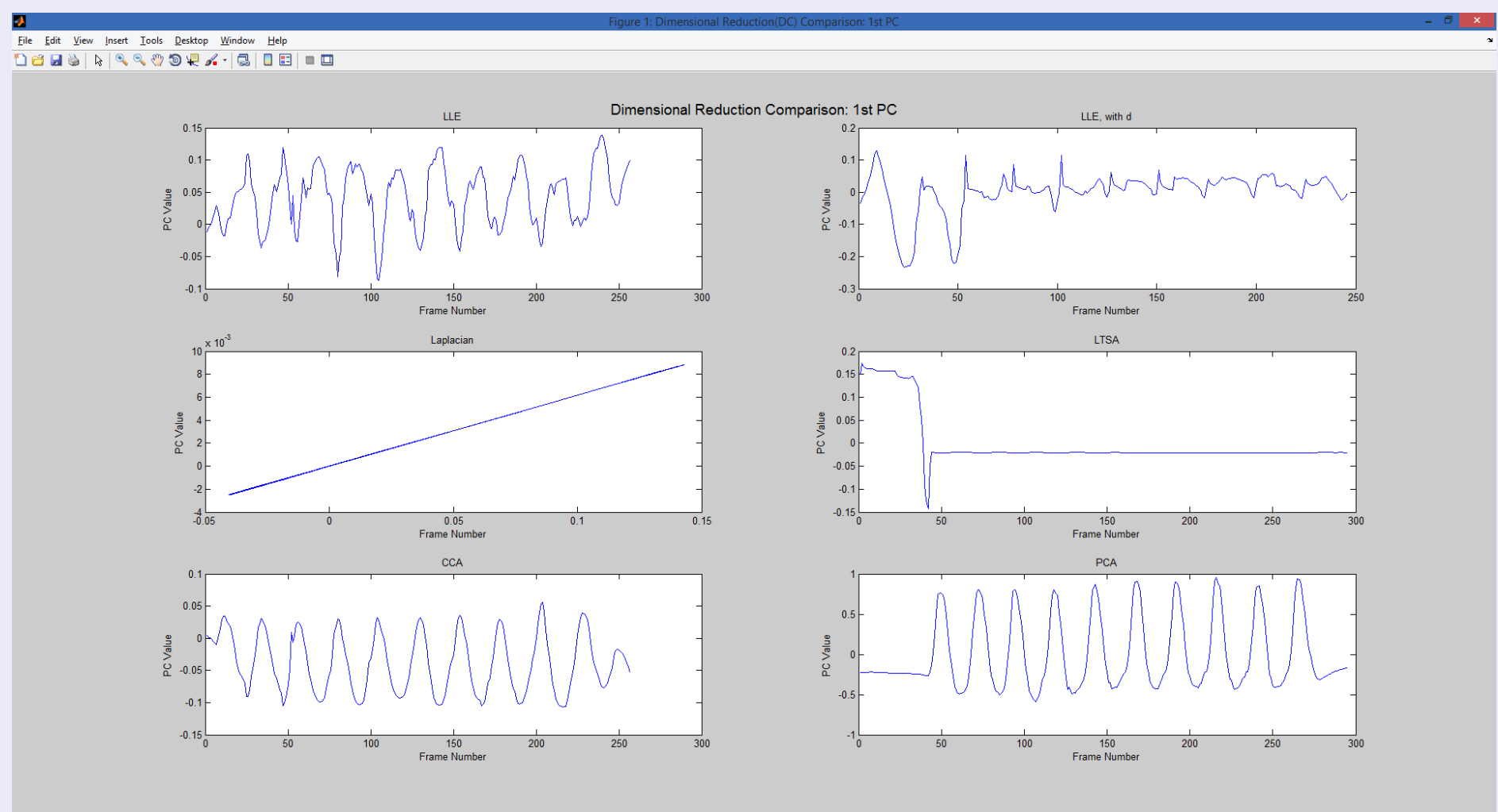
Introduction

Computer aided coaching has revolutionised training approaches and been a key driver in improving sports performance at the highest level. Professional athletes can now use advanced augmented coaching to accurately and reliably measure a range of metrics that are then used as indicators of performance. ZeroToHero implements punch classification & qualitative assessment of boxing pose and technique using the Kinect, a low cost consumer device that can bring specialist boxing coaching to everyone.

This research is borne out of a desire to improve access and cost to boxing coaching which are problems I have encountered first hand through the University Boxing Club. In the wider environment It could be used in developing countries where physical access to coaches with the required expertise may be difficult as well as local clubs in the UK.

1. Dimensionality Reduction

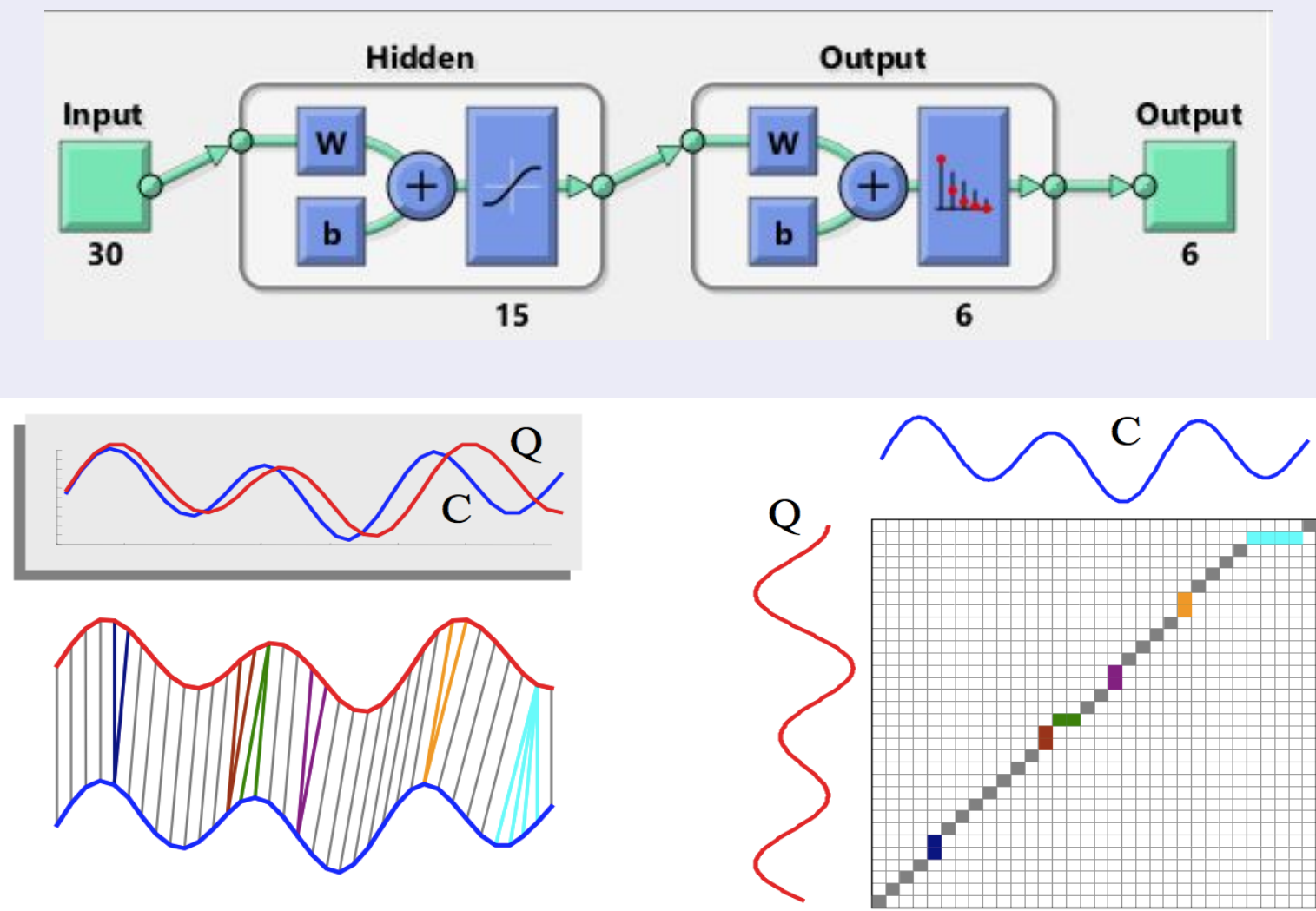
Sets of data were recorded from local boxers, university boxers and professional boxers to “ground-truth” my data. Both linear and manifold learning techniques were tested to compare their effectiveness at producing usefully reduced data.



Diffusion Maps & Hidden Markov Models were also looked at but as shown above, PCA produced the most useful periodic time series. Due to it’s linearity it also allowed my to project back and reconstruct my original and check for error.

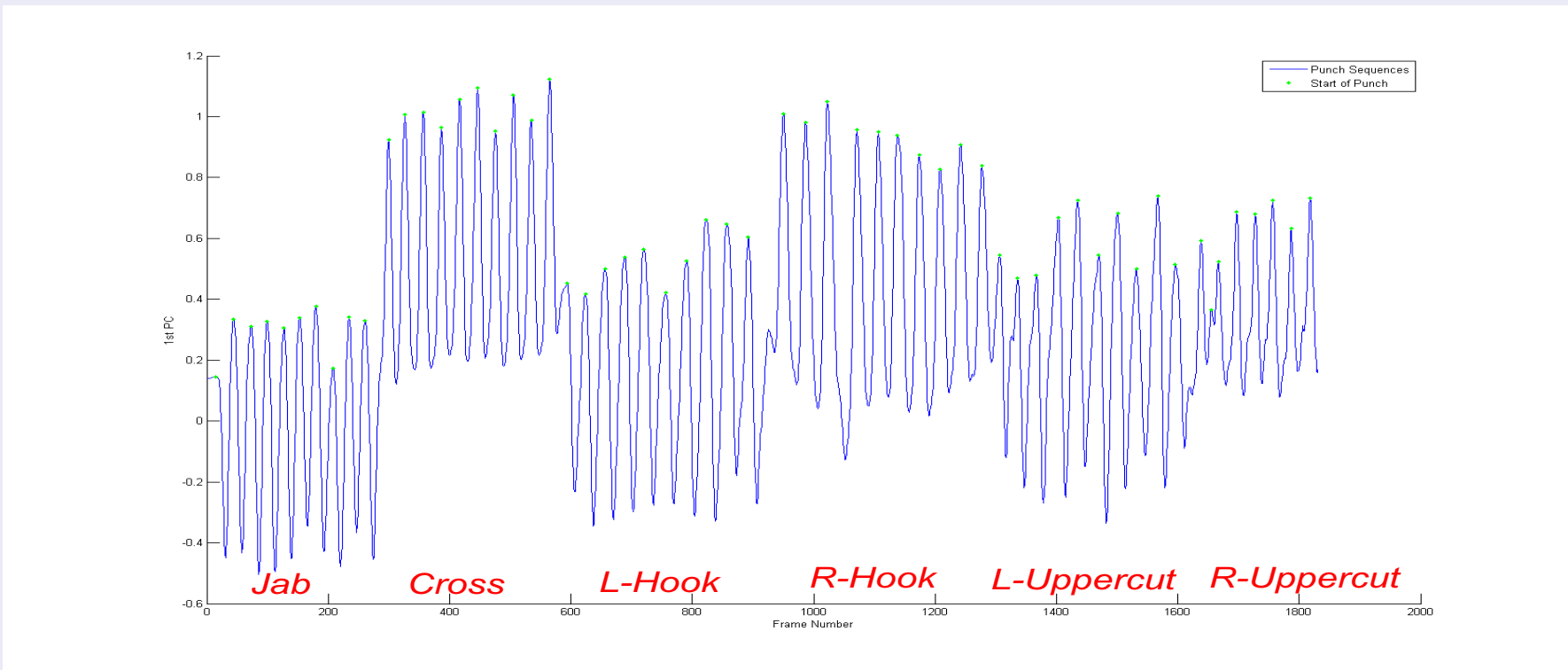
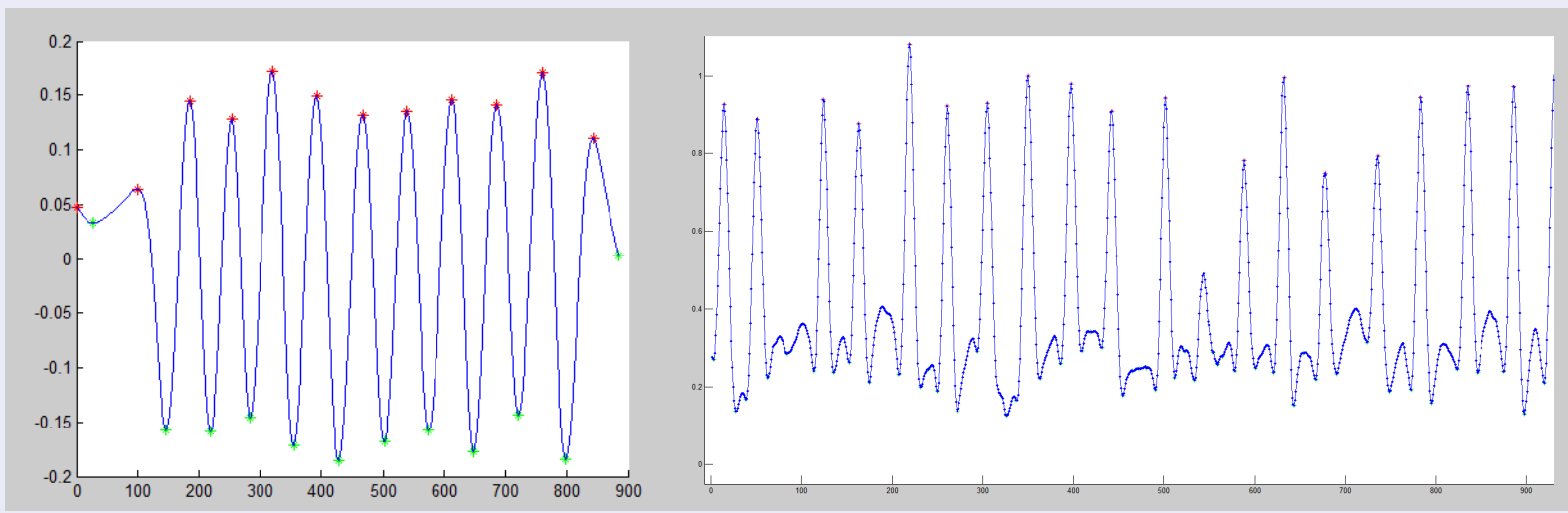
3. Classification

After segmentation a variety of classification methods such as Dynamic Time Warping, FFT, Decision Trees, multi class Support Vector Machines & Neural Networks were trialled.



2. Punch Segmentation

Skeleton data was recorded from local boxers, university boxers and professional boxers whilst performing punches to ‘ground-truth’ my data. Dimensionality reduction was performed on the raw data before using a set of heuristic rules to find the beginning of each punch. Evenly spaced samples are taken from each punch and used as a set of features for that type of punch.



4. Results

When classifying a series of mixed punches a score of **85% – 93%** is achieved. On a two-class problem such as “good jabs vs bad jabs” a **99%** detection rate has been achieved.

