We focus on placing only accelerometers on the body, as they can be unobtrusively sown into clothing. Current IMU based systems require several days of manual work for 3D reconstruction of a play in ESPN’s Virtual Playbook. Our goal is to produce a cheap, unobtrusive and portable motion capture system that can provide precise athlete performance data in high level sports.

Optical motion capture systems – traditional approach for providing precise athlete performance data – can suffer from motion drift; size of units would impair the performance of high level athletes; speed of movement may result in poor motion reconstruction for the most critical movements. Large spatial volumes; areas with uncontrolled lighting; time-critical applications; manual correction of artifacts may be necessary due to incorrect tracking/occlusion of markers.

The proposed system has three main stages:

1. Offline stage
   - Motion capture database is created
   - Database contains a sample set of the types of motions that we expect to be performed at capture time
   - Motion graph constructed using database
   - Graph encodes how captured database clips may be reassembled in different ways

2. Pre-capture stage
   - Tailor the motion graph to different placements of accelerometers on players
   - Uses virtual accelerometers to generate accelerometer data for each node in the motion graph

3. Online motion reconstruction stage
   - Reproduces novel motions by finding paths in the motion graph that would produce similar accelerations to those measured at capture time
   - Dynamic Programming (DP) search strategy
     - Finds the optimal path through the graph
     - Results in a sequence of poses whose accelerations closely match the recorded accelerometer values
   - Dynamic Programming (DP) / A* search strategy
     - Incorporates root position and orientation into the search strategy
     - Positional information can be obtained from any external source
     - Segments a capture session into action and non-action segments
     - DP solution reconstructs motion during action segments
     - A* search strategy corrects the position and orientation drift of the actor during non-action times

![Diagram showing the proposed system](image)

**Results**

- Quantitative evaluation using 16 tennis motion sequences of different types – see Figure 1
  - Slyper Haar: Prior work in action capture using accelerometers
  - Viterbi (DP): Dynamic Programming
  - A*: Search: The two search strategies outlined in this work
  - Graph encodes how captured database clips may be reassembled in different ways
  - A* search keeps a relatively low error, while also improving upon the positional error of both DP and [1]

![Graph showing joint angle error and positional error comparison](image)

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**References**