1 Theme

Motion estimation has been a classic problem in Computer Vision. Many techniques for describing motion in a scene have been proposed and are being used. Most of these try to compute Optic flow at each pixel in the imagery under some assumptions about the scene. Although these techniques try to come up with a solution to the general problem of motion estimation, they tend to break down when the underlying assumptions do not hold.

Often it is desirable to use a technique, which may not be the solution to the general problem but should be able to work robustly enough for a subset of applications. The aim here is to come up with a motion description which may be coarser than traditional optic flow but is able to characterize certain movements at a level higher than just pixel motion.

We would build on the concept of Motion History Images (MHI) and Motion Gradient Images (MGI) developed by James Davis and Aaron Bobick, and use these images for building Motion Histograms which should be indicative of the kind of motion happening in the scene.

These histograms can then be used for
- Distinguishing between various movements.
- Using these motion characteristics to control synthetic animation.
- Other unforeseen applications.

2 Detailed Description

1. Definitions -

- An MHI is an image obtained by squashing the image-time volume onto a single image. The intensity values in the MHI are indicative of the time at which that pixel last witnessed motion or object presence.
• An MGI is the gradient image of the MHI, where the gradient gives a sense of the
direction of motion of each pixel in the image.

2. **Approach** - We intend to do coarse motion estimation, so it is probably a good
idea to work with silhouette images so that texture (and individual pixels) do not play
a very important role. We would take videos of human subject performing certain
movements and build motion histograms over these videos and try to compare the
movement characteristics obtained for different movements and different subjects. The
motion histogram computation would involve the following steps -

• Segmenting the video into atomic movements for which the motion descriptions
may be valid. We need to do this because it is possible for a new movement to
overwrite the previous movement in an MHI, if the previous movement is not
segmented out.

• Computing an MHI for the atomic movements.

• Computing an MGI from the MHI

• Computing the histogram for the MGI. The histogram gives an idea of the distri-
bution of directions of motion over the pixels in the image. The histograms can be
computed based on region or time-chunks. This means we can divide the entire
image into regions and then compute histograms for the MGI in each individual
region. Also we can further divide an atomic movement into smaller time chunks
and compute histogram for each time-chunk. The set of these histograms gives
us a description for that particular movement.

These histograms could then be used for comparing different movements, recognizing
a movement or driving animation.

3 **Data and Evaluation** -

The data would be a bunch of videos of different persons performing the same set of move-
ments. The system would compute motion descriptions for each of these movements for each
person and then compare them to see how good they match. We would also try to see how
it does on data not in the training set.
If possible, we would also try to demo an animation driven by a human. The human would be performing certain movements and the synthetic character would try to follow them as closely as possible.