Stabilization of Videos captured using Mobile Phone Cameras

Lohit Bijani, Yash Abooj, Seon Ho Kim
Integrated Media Systems Center
University of Southern California

Introduction

•Most mobile videos are taken while user is in motion, the video obtained by the onboard camera is highly disturbed and should be stabilized to provide good quality video

•In applications as tracking a stabilization block is required

•Videos are stabilized using the Optical Flow technique here

- Trajectory of the camera is estimated using optical flow
- It is then smoothened using a few standard filters to reduce motion blurs

Related Work

Depending on the approach to stabilize images from video, three types of stabilizers are found

- Optical Image Stabilization: manipulates an image before it gets to the camera sensor, light rays reaching the image plane steadied by appropriate arrangement of lenses
- Mechanical Image Stabilization: uses motion sensors such as a gyroscope or mechanical devices such as shock absorbers for passively damping any vibrations
- Digital Image Stabilization: uses electronic processing to control image stability, an image is manipulated after reaching the sensor

Optical Flow technique for Video Stabilization

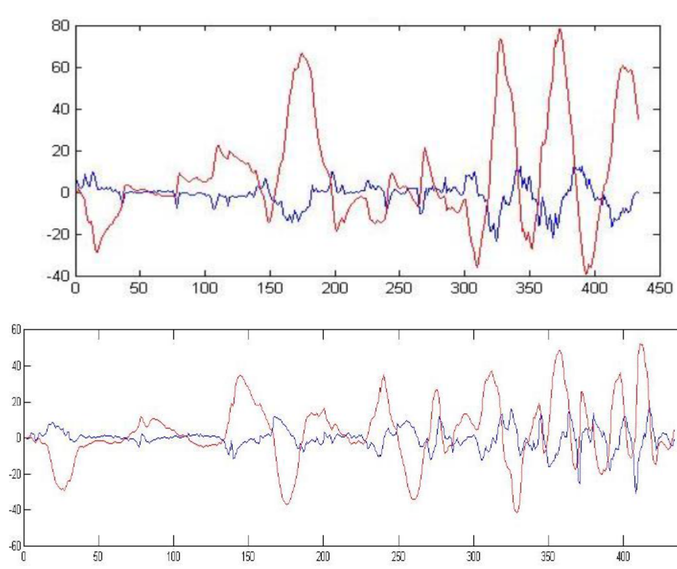
Following is the step-by-step procedure

1. Find transformation from previous to current frame using optical flow for all frames, the transformation consists of three parameters
   - dx (horizontal movement)
   - dy (vertical movement)
   - dtheta (angular movement)
2. Accumulate the transformations to get the “trajectory” for x, y, angle, at each frame and estimate a coarse camera path
3. The shaky vibrations are smoothed out to reduce the camera jerks and the sudden transitions using
   i. Trajectory Averaging: Smooth out the trajectory using a sliding average window
   ii. Kalman Filtering: prediction step produces estimates of the current state variables, along with their uncertainties and the estimates are updated using a weighted average
4. Create a new transformation dx, dy, dtheta considering the smoothed trajectory

   new_transformation = transformation + (smoothed_trajectory - original_trajectory)
5. Apply the new transformation frame-by-frame to the video

Experiments and Evaluation

•Experiments performed on videos captured at different locations around Los Angeles using the MediaQ app



The graphs above show the values of (x’s, y’s) of the camera trajectory before (in red) and after (in blue) the stabilization process. The blue curve shows much smoother transitions as compared to the red one, clearly indicating the ongoing stabilization process

Conclusion and Scope for Further Work

•This method is quite effective with most videos where there is sufficient lighting to match features between consecutive frames

•Performance against OpenCV’s in-built module for video stabilization shows that our algorithm is as effective as their module

•The algorithm does not work very well when there are very large transitions between two frames, like a sudden big turn

•Future work may include preprocessing a video to get a metric on the video quality in terms of jerks and vibrations and deciding to stabilize it automatically