

5 Experimental results and evaluation

5.1 Overview

This chapter presents the results of evaluating the system with different kinds of sample inputs. The system was evaluated using two approaches. They are;

- Statistical Analysis
- Peoples' perception on output.

These are discussed separately in the following sections.

5.2 Testing Strategy

Video sample is tested with different noise filtering level and statistics on output video, peoples' feedback on the quality of the videos were collected.

5.3 Test input

Testing was conducted for videos having different camera movement.

Scenario 1 - Video that does not have any camera shake, static scenery in focus
Scenario 2 - Camera has mild horizontal shake, static scenery in focus
Scenario 3 - Camera has high horizontal shake, static scenery in focus
Scenario 4 - Camera has mild horizontal shake, moving scenery in focus
Scenario 5 - Camera has high horizontal shake, moving scenery in focus
Scenario 6 - Camera has mild vertical shake, static scenery in focus
Scenario 7 - Camera has high vertical shake, static scenery in focus
Scenario 8 - Camera has mild vertical shake, moving scenery in focus

Scenario 9 - Camera has high vertical shake, moving scenery in focus
Scenario 10 - Camera does not have a shake, moving scenery in focus.
Scenario 11 - Camera has a shake, larger area of the frames cover a moving object. Smaller static background area.
Scenario 12 - Camera has both vertical and horizontal shake, stationary scenery in focus.

Table 8 Test Input Videos

5.4 Overview of results

This section presents the results of the evaluations carried out.

5.4.1 Statistical Analysis

Testing was conducted for each test scenarios above with very low noise filtering levels and very large filtering sizes. Generated output files were fed to the system back with same noise filtering levels and the relevant graphs were analyzed. It was checked for whether the vertical and horizontal graphs were smooth and has a close shape to the previous estimated camera movement graph. Graphs below demonstrate this process.

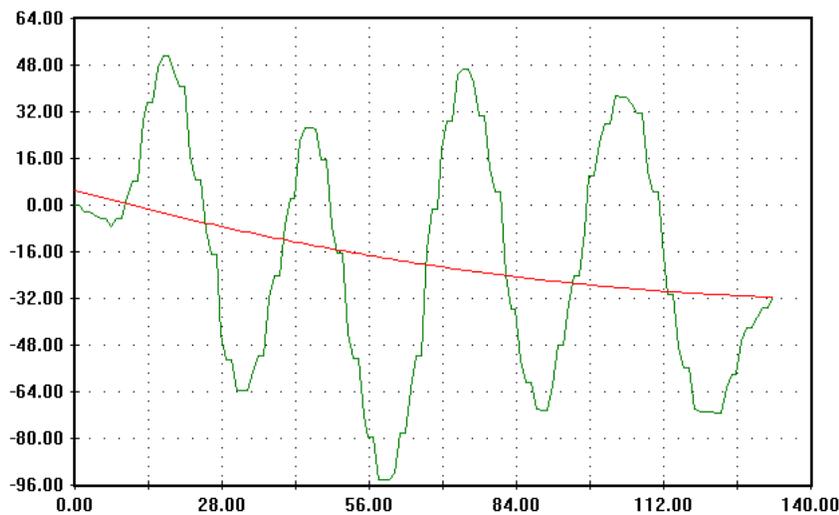


Figure 13 Test results – Vertical component (For Input Video, Max filter size)

[original is in colour]

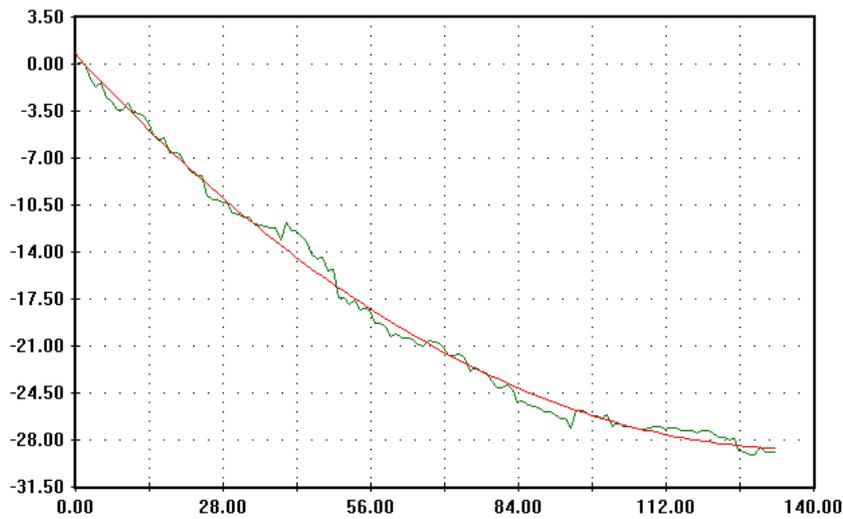


Figure 14 Test results – Vertical component (For Output Video, Max filter size)
 [original is in colour]

Top most green coloured graph shows the vertical camera movement of input video for Test Scenario 7. The output video of the process was fed to the system with same noise filter values and corresponding graph is shown in the next figure in green colour. This is a clear indication that smoothing process has happened successfully as expected.

System was successfully operated in all the cases other than Scenario 11. The reason for the failure is discovered as the behavior of the algorithm used to identify the background. Algorithm assumes that most of the image is covered by the background and it tries to group background point based on that. However by modifying the background identifying algorithm to operate under this condition, system can be improved.

This category of testing can identify the system's ability to remove unwanted camera movement. However power of the system in reconstructing undefined area does not get tested here, but it is covered by the testing done with people as described below.

5.4.2 Perception of people

Input and output of the each test scenario was provided to a Group of people having different technical background and their feedbacks were recorded. Most of them were very positive about the level of smoothing the system is capable to perform except in Test Scenarios 11. However their satisfaction on reconstruction of undefined area was about 3/4th and it can be improved by using few image processing operations. Since the testing was done with 10 adjacent frames for reconstruction of undefined areas, some missing areas could be observed in Test Scenarios 3, 5, 7, 9.

5.4.3 Performance Analysis

Performance of prototype was tested on ordinary personal computer having following common hardware configurations.

System	Processor	RAM
System 1	1.8 GHz	1 GB
System 2	2.4 GHz	2 GB

Table 9 Configuration of Test computers

In both cases, irrespective of the system configuration, following average performance could be achieved for each step of video stabilization process. The performance did not depend on the amount of unwanted movement to be removed.

Processing time for 100 frames of 640x420 video

Process Type	Time taken for the process
For Initial Processing	11 seconds
Video Generation – without reconstruction of undefined areas	16 seconds
Video Generation – with reconstruction of missing areas using 6 adjacent frames	82 seconds

Table 10 Performance table