FMAN95 Computer Vision
Assignment 4

Exercise:

Ex 1

$P_1 = [A_1 \ t_1]\begin{bmatrix} c_1 \\ 1 \end{bmatrix} = A_1 C_1 + t_1 = 0 \qquad c_1 = -A_1^{-1} t_1$

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \parallel \qquad\qquad \Rightarrow t_2 = A_2 A_1^{-1} t_1$

$P_2 = [A_2 \ t_2]\begin{bmatrix} c_2 \\ 1 \end{bmatrix} = A_2 C_2 + t_2 = 0 \qquad c_2 = -A_2^{-1} t_2$

we have 3D point $\mathbb{X} = \begin{pmatrix} X \\ 1 \end{pmatrix}$

$\lambda_1 \mathbb{x} = P_1 \mathbb{X} = A_1 X + t_1 \qquad X = A_1^{-1}(\lambda_1 \mathbb{x} - t_1)$

$\lambda_2 \mathbb{x} = P_2 \mathbb{X} = A_2 X + t_2 = A_2(A_1^{-1}\lambda_1 \mathbb{x} - A_1^{-1} t_1) + t_2$

$= A_2 A_1^{-1} \lambda_1 \mathbb{x} - A_2 A_1^{-1} t_1 + t_2$

$\lambda_2 \mathbb{x} = A_2 A_1^{-1} \lambda_1 \mathbb{x}$

$P_2 \mathbb{X} = A_2 A_1^{-1} P_1 \mathbb{X}$

$H = A_2 A_1^{-1}$

Ex 2

Homography transforms 2D point set

H is 3×3 matrix with 9 elements   the scale doesn't matter $(H \sim \lambda H)$

It has 8 degrees of freedom.

Each point pair gives us 3 equations $\lambda_i x_i = H y_i$

and also introduce one unknown λ_i

we have $3n$ equations and $8+n$ DOF $3n \geq 8+n \qquad n \geq 4$

correct pairs 0.9

incorrect pairs 0.1

n iterations

$1 - 0.98 > (1 - 0.9^4)^n$

$\log 0.02 \geq n \log$

$n \geq \dfrac{\log 0.02}{\log(1 - 0.9^4)} \approx 3.67 \qquad n \geq 4$

4 iterations needed.

Ex 3

Essential matrix has 5 degrees of freedom. A rotation has 3 DoF and translation has 3 DoF and the scale doesn't matter.

5 minimal numbers of point correspondences needed

$$1-0.98 > (1-0.9^5)^n$$

$$n \geq \frac{\log 0.02}{\log(1-0.9^5)} \approx 4.38 \qquad n \geq 5 \qquad \text{5 iterations needed.}$$

Computer Exercise 1:

I find 1523 and 1639 SIFT features for two pictures respectively.

After performing the threshold, there are 365 matches left.

The best solution with most number of inliers found is 225.

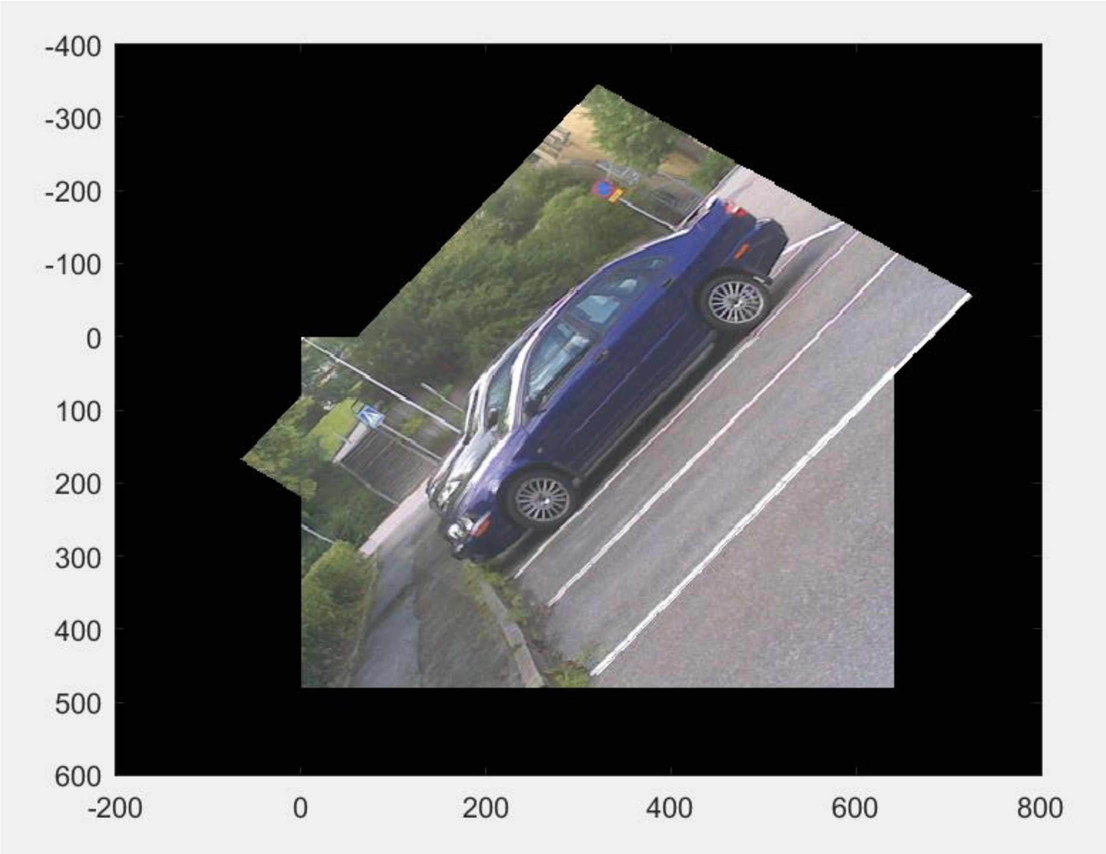

Figure : Plot of the panorama

Computer Exercise 2:

There are 1465 inliers and RMS = 0.4197

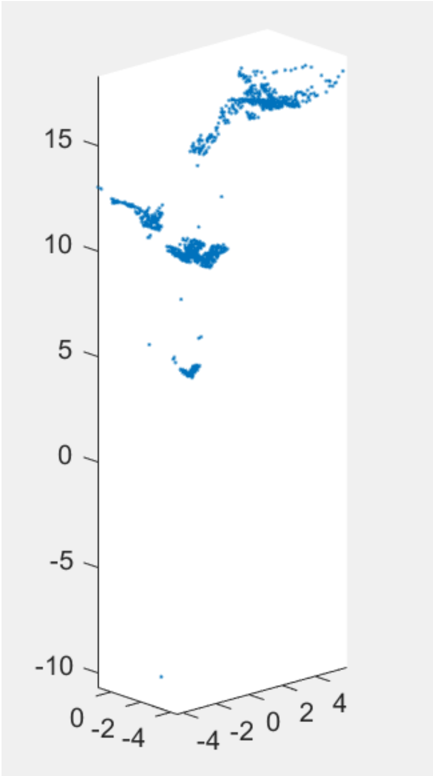

Figure : Plot of reconstruction

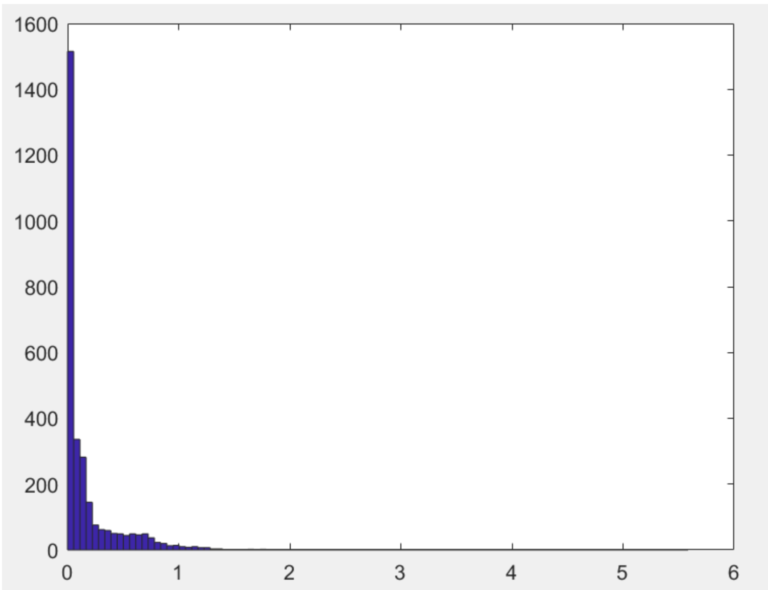

Figure : Plot of the histogram of the reprojection errors

Computer Exercise 3:

After implementing the steepest descent method, the final RMS value is 0.3611.

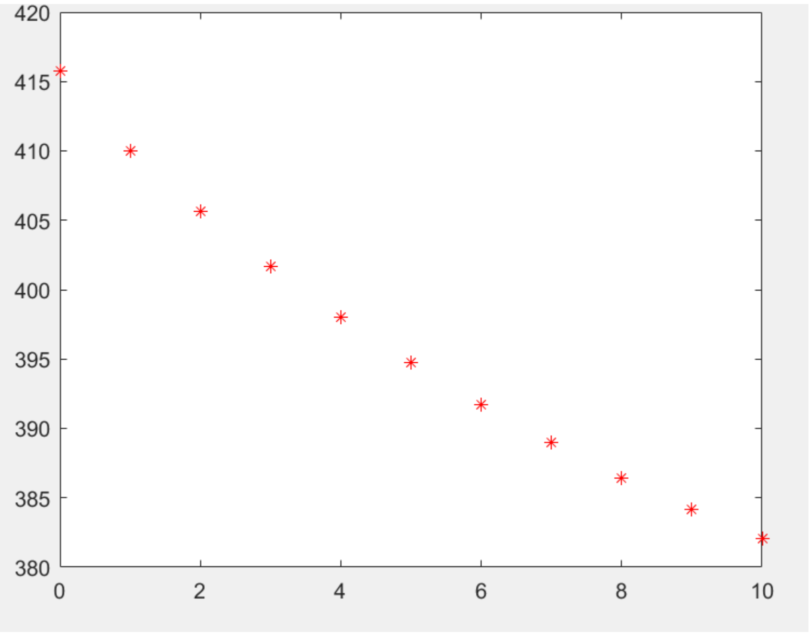

Figure : Plot of objective value vs. iteration number for 10 iterations

Computer Exercise 4:

Implement the Levenberg-Marquardt method with lambda = 0.01.

The final RMS value is 0.2398

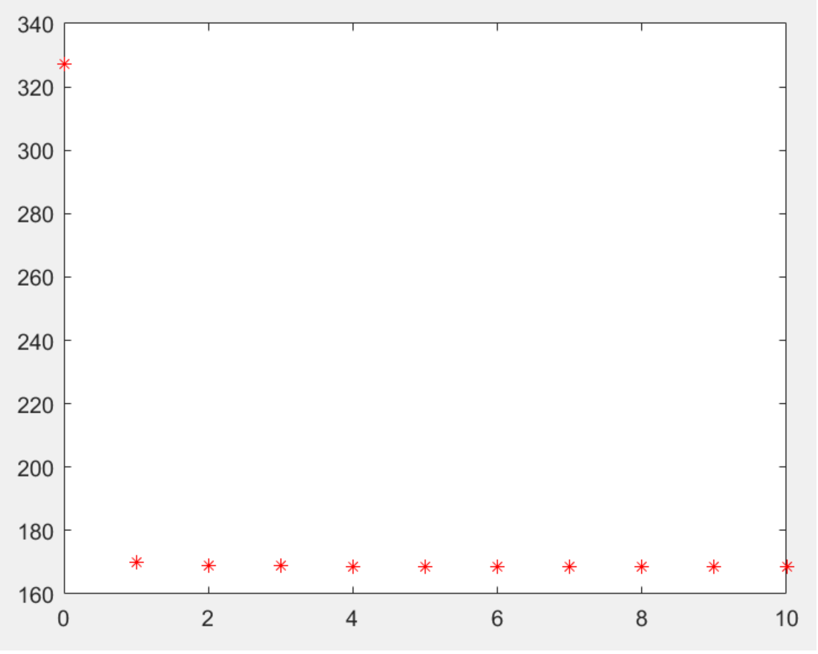

Figure : Plot of objective value vs. iteration number for 10 iterations