Debugging 101
Debugging tips

• Don’t look at code, look at values.
• Track the impossible results.
• Simplify code/data.
Don’t look at code, look at values

% Don't look at code, look at values
% gray.im1 = rgb2gray(im1);
% gray.im2 = rgb2gray(im2);
% window_size = 5;
% wind11 = zeros(window_size, window_size);
% wind22 = zeros(window_size, window_size);
% best_pxls match = [0, 0];
% score_hist = [1];
% Go through pts1
% for i=1:size(pts1,1)
% % Arbitrary large value (where the minimum score of a 5x5 window will
% % be stored)
% min_dist = 500000;
% % Search through each points in pts1
% cur_pointi = [pts(1,:), 1];
% % Find epipolar line
% ep_line = F * cur_pointi';
% % Search corresponding pts2 on the line
% % - ep_line has (a,b,c)
% % - and has an equation ax + by + c = 0
% for x=size(im2,2)
% y = round(ep_line(1)*x + ep_line(3))/(-ep_line(3));
% % Feature matching
% % Assumes both images has the same dimensions:
% % RcountPix=1;
% % Rowum_squares(1,1,3);
% % sum_w1 = 0;
% % Go through the 5x5 window
% for r_dim-1:floor(window_size/2):floor(window_size/2):
% for c_dim-1:floor(window_size/2):floor(window_size/2):
% % (x,y) = (c,y)
% % cur_r.pt1 = round(cur_pointi(1) + r_dim); cur_c.pt1 - round(cur_pointi(2) + c_dim);
% % cur_pt1 = [cur_r.pt1, cur_c.pt1];
% % cur_pt2 = [x + c_diff];
% % Checking bounds
% if cur_r.pt1 < 0 || cur_r.pt1 > size(im1,1) || cur_c.pt1 < 0 || cur_c.pt1 > size(im1,2)
% % - Take difference of each pixel
% end % \[\text{\texttt{\small \textcopyright 2019-2021}}\]
Don’t look at code, look at values

-200,000,000
Track the impossible results

Good

Impossible
Track the impossible results
Track the impossible results

Good

Impossible
Track the impossible results
Track the impossible results

Good

Impossible
How to know impossible?

• My reprojection error is 7 pixels.
  • Maybe, a distance function (SSD, NCC) is not good enough...
  • Maybe, I need to normalize pixel coordinates in estimating F...
How to know impossible?

• My reprojection error is 7 pixels.
  • Maybe, a distance function (SSD, NCC) is not good enough...
  • Maybe, I need to normalize pixel coordinates in estimating F...
• The code has a bug. Given a pair of pixels on epipolar lines, 3D point may be false but the reprojection error is 0.
How to know impossible?

• My reprojection error is 7 pixels.
  • Maybe, a distance function (SSD, NCC) is not good enough...
  • Maybe, I need to normalize pixel coordinates in estimating F...
  • The code has a bug. Given a pair of pixels on epipolar lines, 3D point may be false but the reprojection error is 0.

• In triangulation, I solved $Ax=0$ ($A$ is 4x4) and obtain a solution $x'$.
  • $Ax'$ is not close to 0. Oh maybe, it has to be zero and my use of SVD is wrong...
  • Maybe, my feature matching is wrong and SSD may have a bug...
How to know impossible?

• My reprojection error is 7 pixels.
  • Maybe, a distance function (SSD, NCC) is not good enough...
  • Maybe, I need to normalize pixel coordinates in estimating F...
  • The code has a bug. Given a pair of pixels on epipolar lines, 3D point may be false but the reprojection error is 0.

• In triangulation, I solved $Ax=0$ ($A$ is 4x4) and obtain a solution $x'$.
  • $Ax'$ is not close to 0. Oh maybe, it has to be zero and my use of SVD is wrong...
  • Maybe, my feature matching is wrong and SSD may have a bug...
  • If correspondences satisfy epipolar constraints, $Ax$ must be very close to 0. Maybe my projection matrices are wrong (from F to P1, P2)...

How to know impossible?

• Hard one to master.
• Need math, knowledges, experiences.
• I should provide help here: “I get this result which looks strange.”, “Potential problems may be here and there.”
Simplify code/data

Good

Impossible
Simplify code/data

Good

Loop over all the x coordinates ->
Only check the impossible x

Impossible

No need to keep the best x as we
have only one x.
Simplify code/data

Loop over all the x coordinates ->
Only check the impossible x

Good

Impossible

No need to keep the best x as we have only one x.
Don’ts

• This is my code, do you see anything wrong?
  One should not debug code, but values.

• Here is my final broken result, can you help?
  One needs to track intermediate results.

• What is a fundamental matrix?
  Come to lecture and read the slides first.
Demonstrations