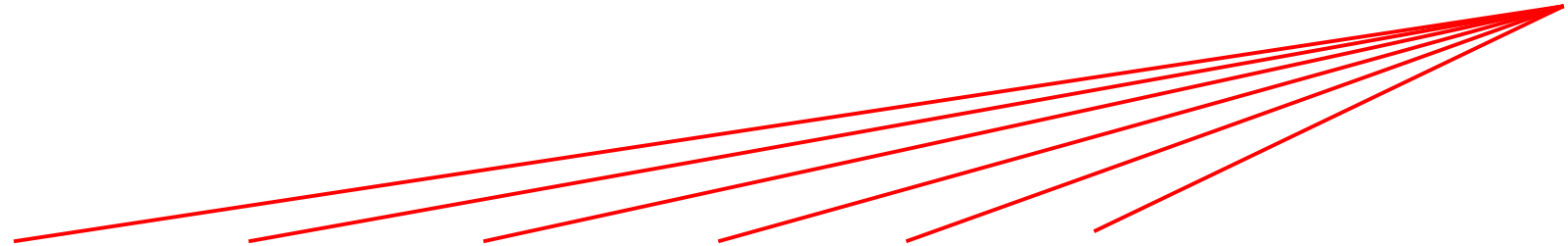
Machine Vision Lab



Projection based 3D laser scanner

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02.12.2010

Automation

JACOBS UNIVERSITY

Outline

- Setup and Goal
- Step 1 – Laser Line Detection
- Step 2 – 3D Object Points
- Step 3 – Using SLAM6D
- Conclusion

Setup

Input:

- Video, where a lazer line is moving over the object, that is located in the corner.

- 90° angle between walls
- Checkerboards on both walls
- No change in the background
- No autoadjustment of the camera

Goal of the Project

Output:

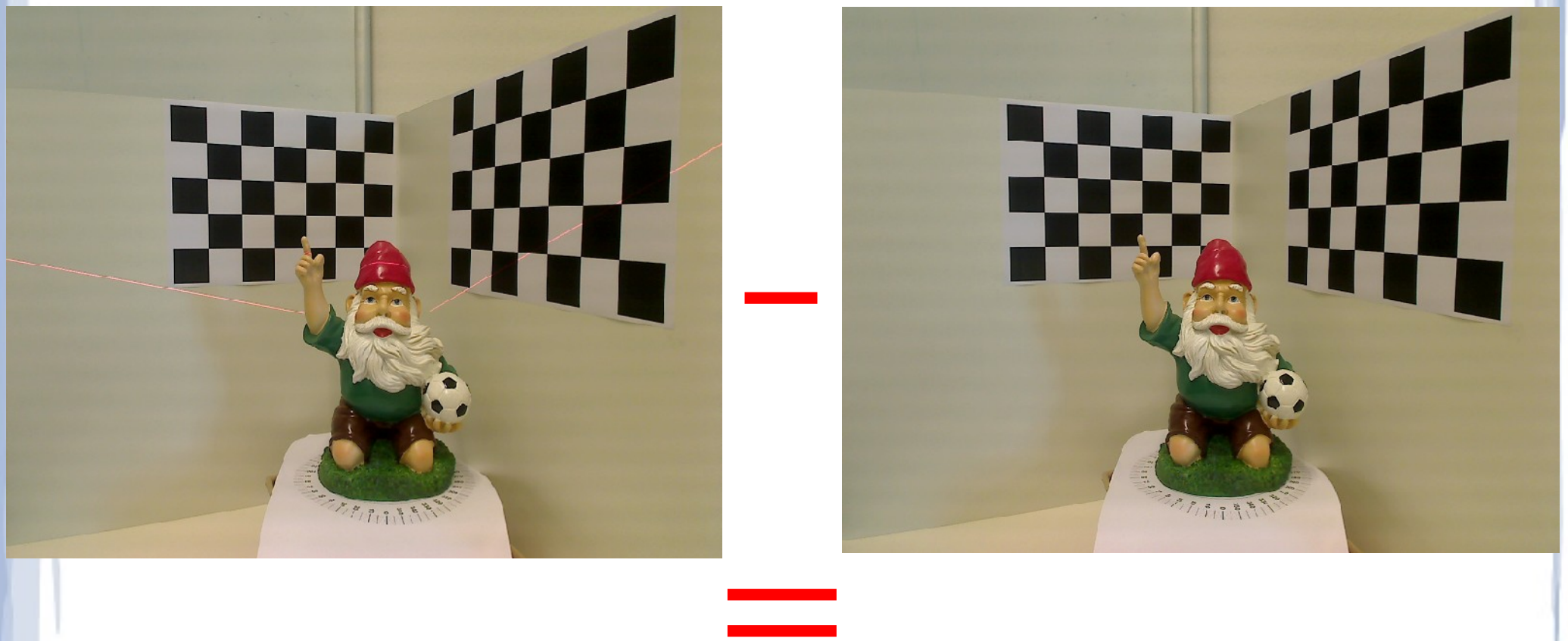
Complete 3D model of the object

3D point cloud (X,Y,Z)

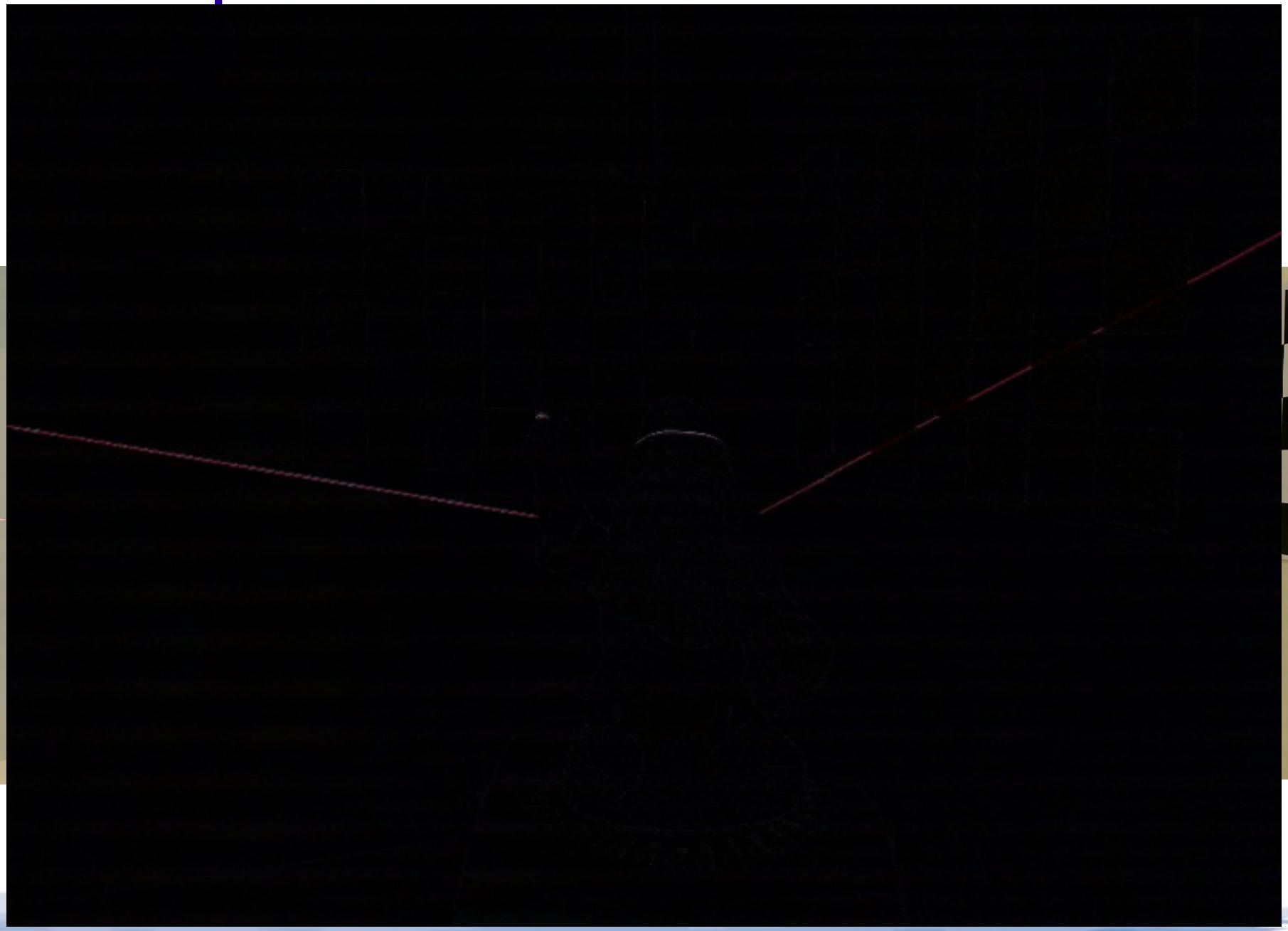
Colored points (R, G, B)

Step 1 – Laser Line Detection

- For each frame compute the difference with the frame with no laser line



Step 1 – Laser Line Detection



Step 1 – Laser Line Detection

- For each frame compute the difference with the frame with no laser line
- Find redish pixels and emphasize them

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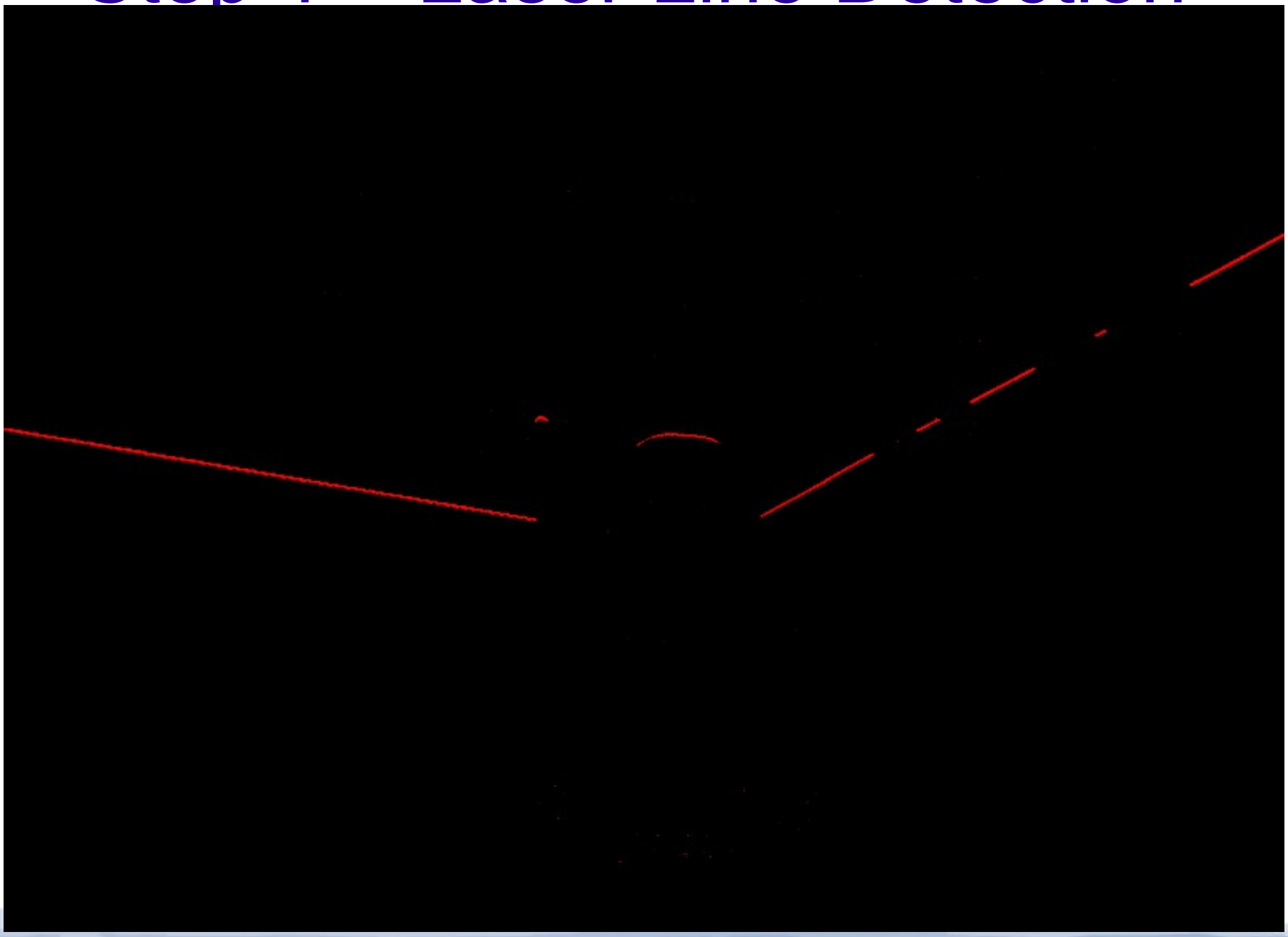
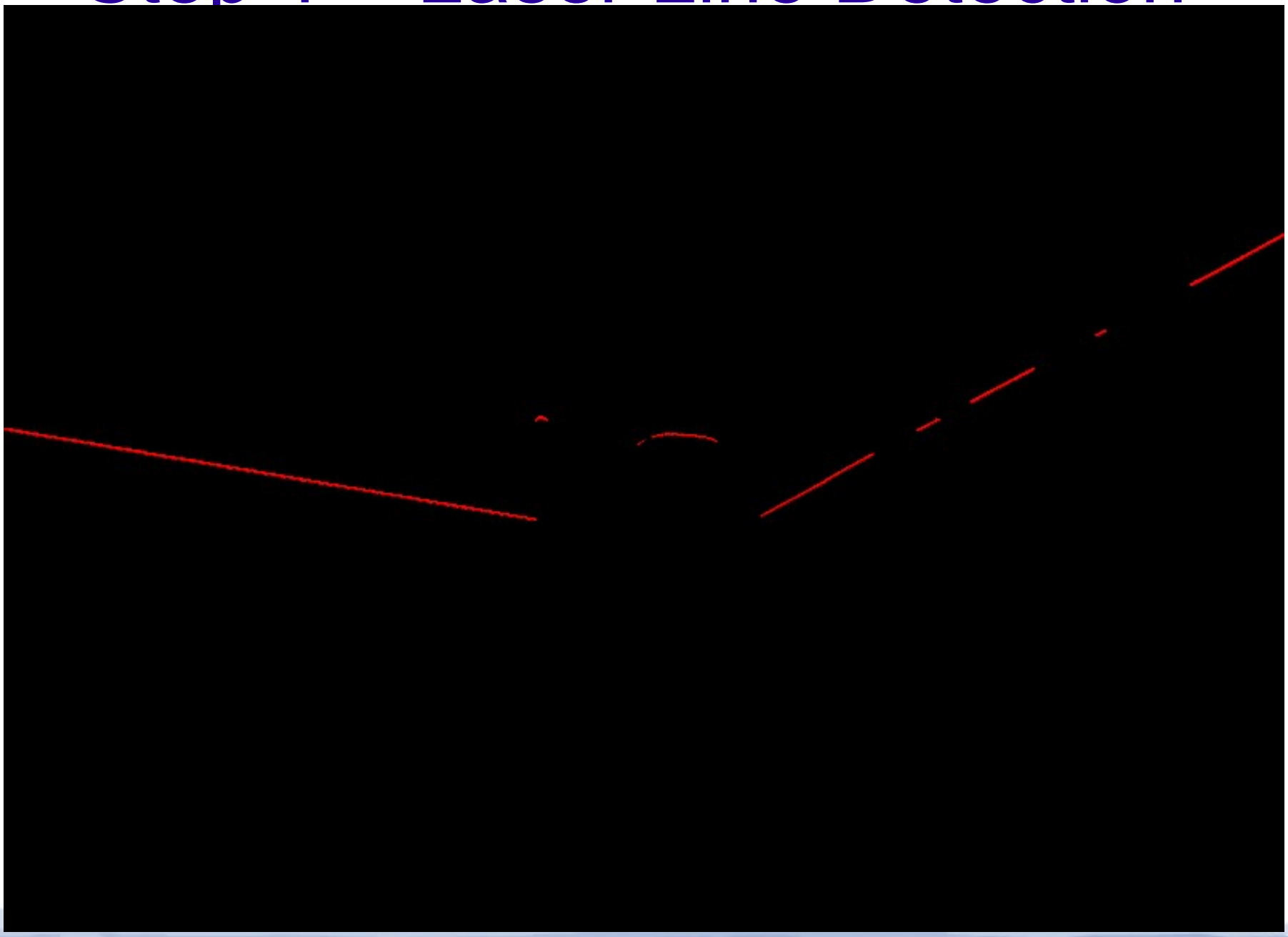


Step 1 – Laser Line Detection

- For each frame compute the difference with the frame with no laser line
- Find redish pixels and emphasize them
- Get rid of some of the noise by removing all red pixels that have less than 2 red neighbors

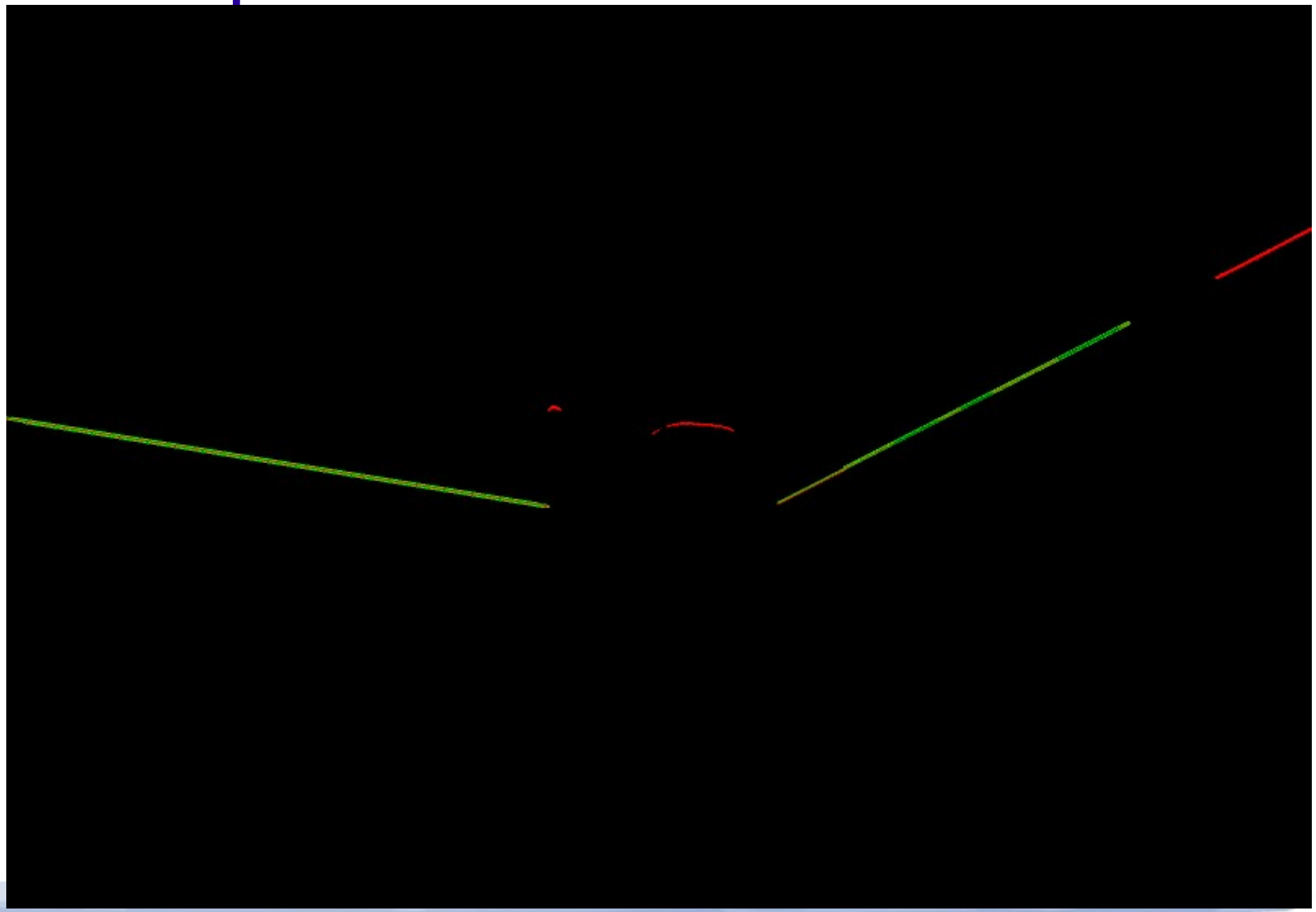
Step 1 – Laser Line Detection



Step 1 – Laser Line Detection

- For each frame compute the difference with the frame with no laser line
- Find redish pixels and emphasize them
- Get rid of some of the noise by removing all red pixels that have less than 2 red neighbors
- Use Hough transform to detect lines, draw them in green

Step 1 – Laser Line Detection



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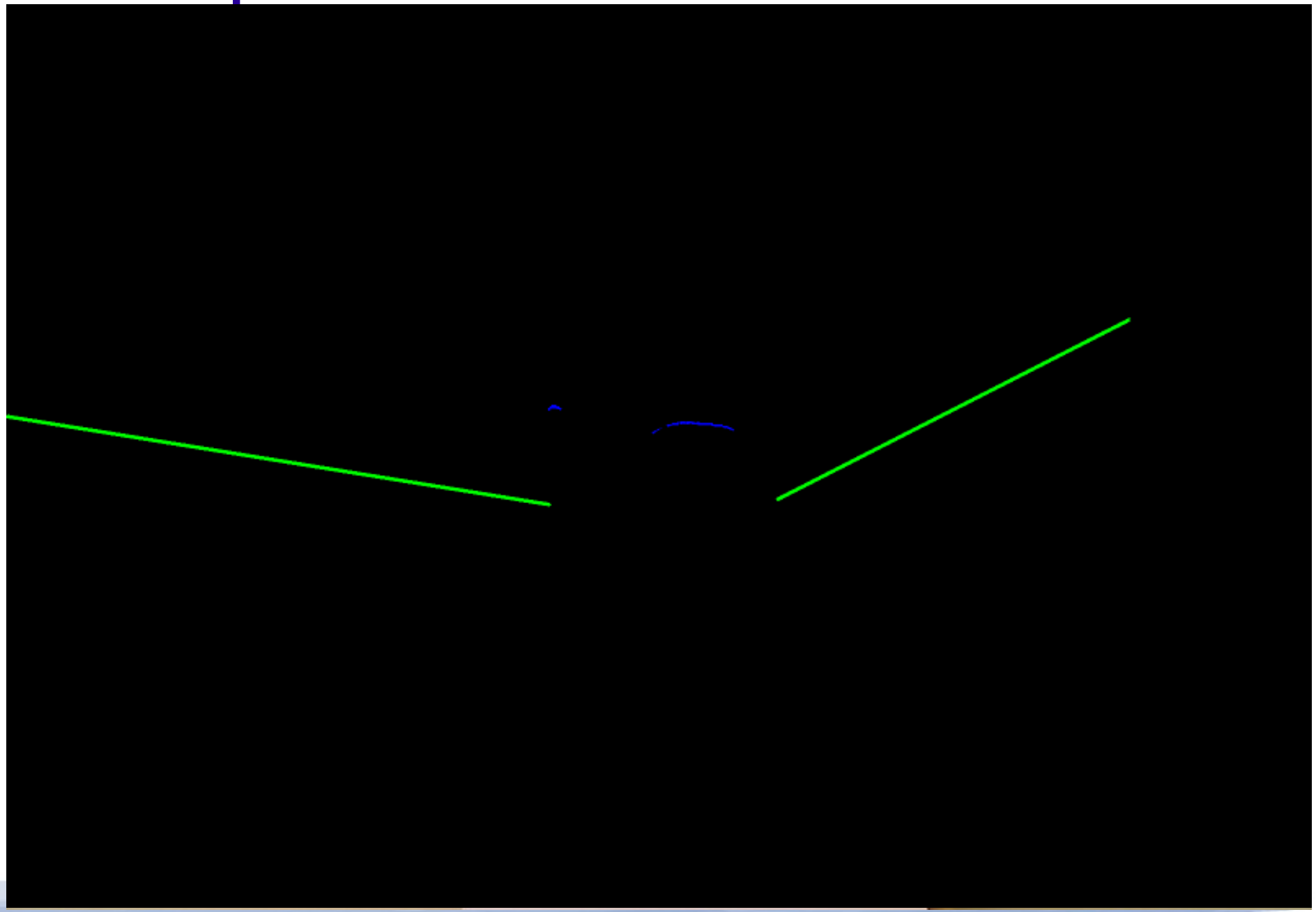

Step 2 – 3D Object Points

- Given pixels of the points that belong to the object we want to get a 3D point cloud
- Need to calibrate the camera first – find Intrinsic and Extrinsic parameters
- Find the laser plane by taking 3 non-colinear points from the laser lines
- Find 3D coordinates as intersections of rays starting from the camera and the laser plane

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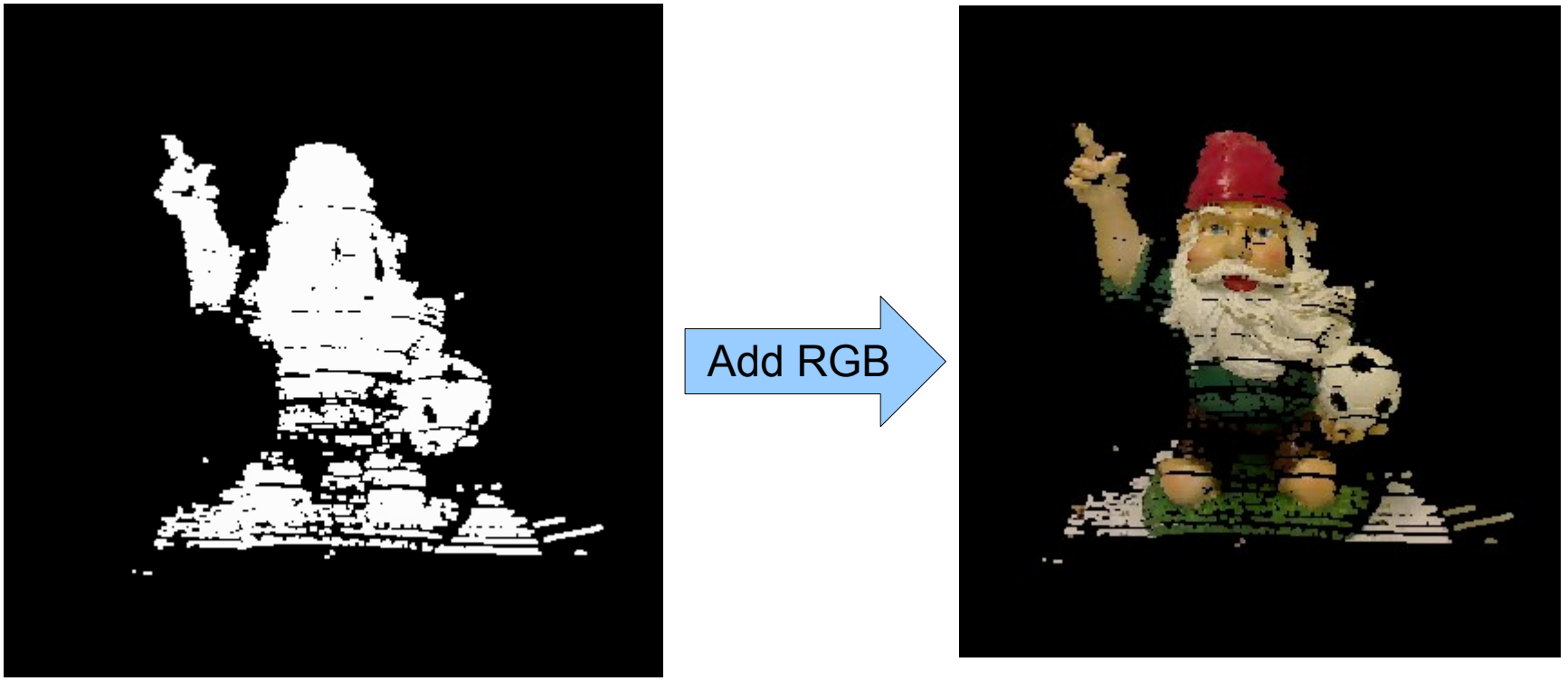
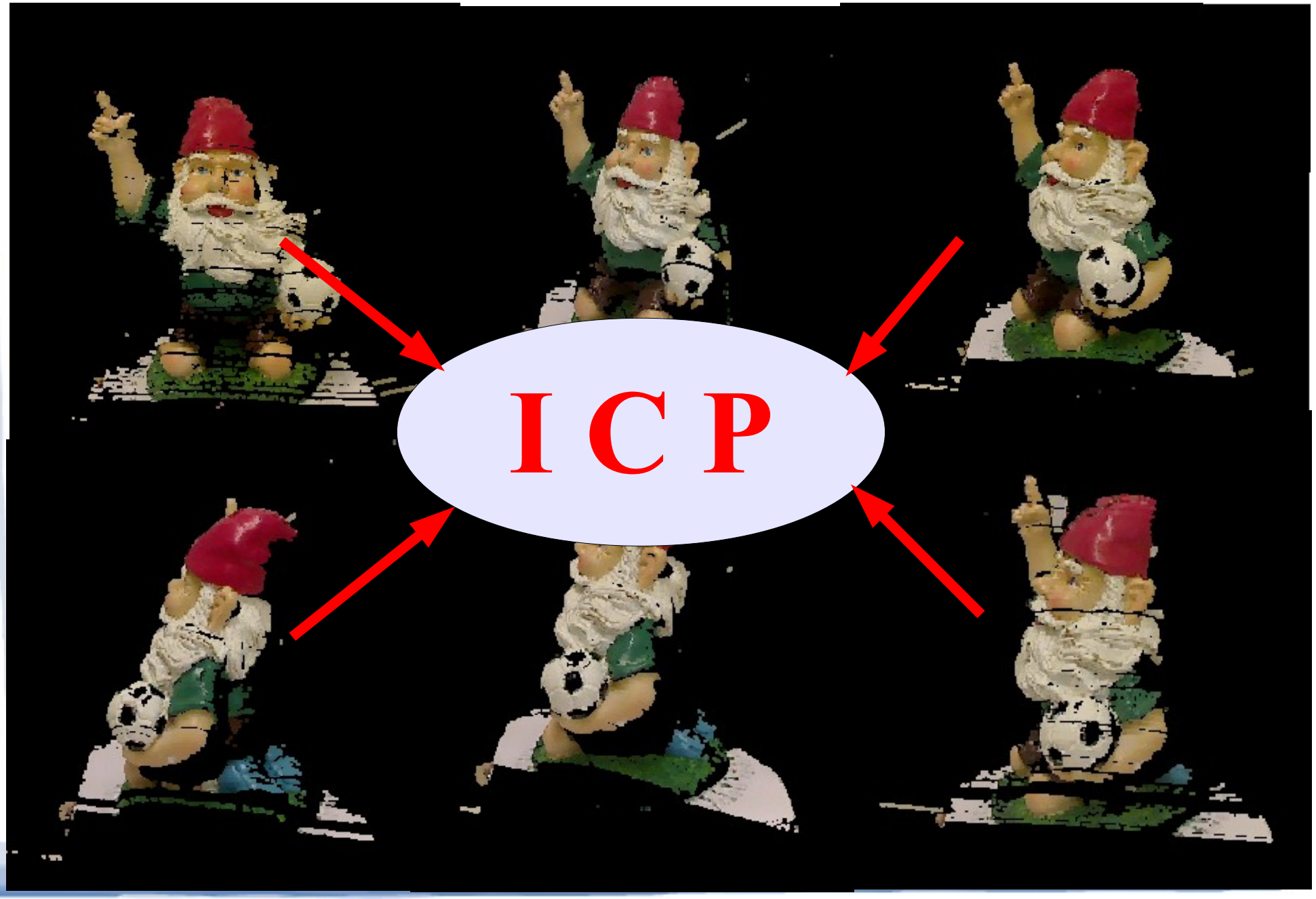
MATH MAGIC!

Step 3 – Using SLAM6D

- Use *show* program to view the point cloud



Step 3 – Using SLAM6D



Step 3 – Using SLAM6D

- In theory *slam6D* program should be able to match several point clouds and put them into the same reference frame
- In practice however matching when using more than 2 data sets didn't perform too well
- Possible reason:
  - Manual setting of .pose files is prone to errors
  - Used sets might need higher overlap (smaller rotation angles)

Step 3 – Using SLAM6D

Conclusion

- 1 semester of work
- ~500 lines of code
- Video of an object with the laser across it => 3D point cloud of the object