CS284: Simultaneous Localization and Mapping

Homework 3, Fall Semester 2021

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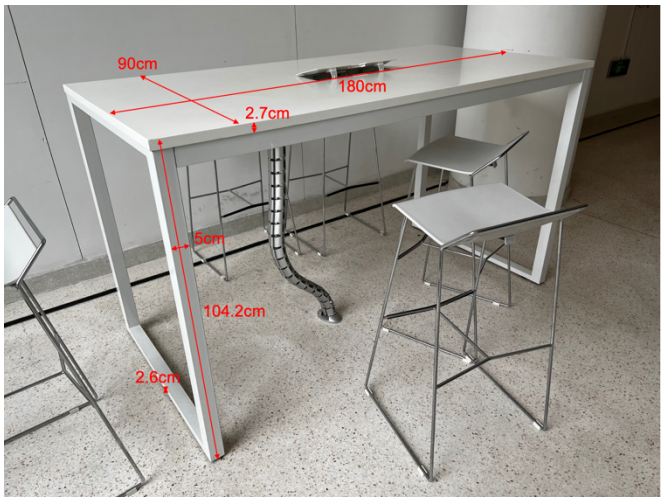
- Deadline: **23:59, 31st of October 2021** (please submit a zip via email to TA)
- **Please reread our policies on academic integrity. It is a very serious matter, and any violations will be prosecuted to the fullest extend.**

Homework 3 is about camera calibration, and involves 3 sub-tasks.

Task 1

Decompose the camera projection matrix P. Given a camera projection matrix, find algebraic expressions for three rotations that—if successively applied to the left 3x3 block of P—will result in the intrinsic camera matrix K (see slide 61-62 of lecture 7, your task is to find out what is c' and s', and c'' and s''). The procedure was explained in class.

Task 2



In the attachment please find three pictures of the table indicated in the figure above. The measures of the table are also indicated in the picture (the table is freely accessible and can be found near the elevator in third floor of Building 1, SIST, feel free to go there and confirm/improve the measurements if you don't trust them). Please use each of the provided pictures in order to calculate the camera matrix for the above images. Are the intrinsics for each view the same? Please comment on your results. You may use the above decomposition algorithm or any alternative to separate the intrinsic from the the extrinsic parameters. Note that there is a requirement to use

points on different planes given that the computation of P becomes degenerate if fails all the points are in the same plane.

Task 3

Now construct 2D-2D correspondences between each possible pair of images (there are 3!). Use them to estimate the essential matrix between each pair of views (using normalized image coordinates). To conclude, decompose each of the three essential matrices and compare the resulting relative transformation result with the one obtained by concatenating the previous extrinsic parameters obtained from the camera matrix decomposition. Again, please add any quantitative and qualitative observations to your report.

Submission

Please submit a PDF report (not more than 3 pages!) along with the code to the TA email address before the deadline (put professor in CC). Then arrange for a time with the TA to demonstrate your code. Your code and results should be the same than what you submitted in the email. Your report must include:

- A description of your implementation. This should cover a basic description of the algorithm. It should also include the physical structure of the program (i.e. file description, dependencies), and instructions on how to compile and use it (i.e. how to interpret the result).
- Visualization of the results. You should list the numerical values in your report and comment on them.
- Any qualitative observations on the results.

Please use ”SLAM HW3 – Your name” as the email-header when sending the email. Please pack all the files into a zip file, the structure should be:

[Your name] folder
– Your name.pdf
– [code] folder