The Pinax-Model for Accurate and Efficient Refraction Correction of Underwater Cameras in Flat-Pane Housings: C/C++ ROS Hydro Examples

Tomasz Łuczyński, Max Pfingsthorn, Andreas Birk

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This paper is a supplementary material to our article: "The Pinax-Model for Accurate and Efficient Refraction Correction of Underwater Cameras in Flat-Pane Housings". Packages were prepared and tested under Linux Ubuntu 12.04 with ROS Hydro.

1 Calculating correction maps and image correction

Example set consists of the following packages:

- *jir_refractive_image_geometry_msgs* and *jir_refractive_image_geometry*: support packages with the definition of message type used in our processing pipeline and some support functions.
- *jir_rectification_remap_lib*: library providing image correction given correction maps.
- *defraction_map_finder*: package used to find correction maps, given calibration information and setup parameters.
- *jir_image_remapper*: example of node correcting refracted image images.

1.1 Use case: image rectification

As an example let's see the full process of correcting the images with our method.

1. Calibrate your stereo system. In our work we used camodocal [1, 2, 3]. This allowed for using more complex camera/lens distortion models. Parts of camodocal code were reused by us when implementing camera models (check license headers in the source code files). Resulting calibration files should be saved (e.g. *camera_left.yaml*).

2. Calculate correction maps for underwater usage. Run *defraction_map_finder* node in *defraction_map_finder* package. This will produce *correctionMap.yaml*. Save it in preferred location.

3. Play included bag file with sample image. Use - *-loop* option.

4. Run *image_remapper.launch* file. Remember to specify the path to the *correctionMap.yaml*. Corrected image is published on the topic specified in the launch file.

References

[1] L. Heng, B. Li, and M. Pollefeys, "Camodocal: Automatic intrinsic and extrinsic calibration of a rig with multiple generic cameras and odometry," in *Intelligent Robots and Systems (IROS), 2013 IEEE/RSJ International Conference on*, pp. 1793–1800, Nov 2013.

[2] L. Heng, M. Burki, G. H. Lee, P. Furgale, R. Siegwart, and M. Pollefeys, "Infrastructure-based calibration of a multi-camera rig," in *Robotics and Automation (ICRA), 2014 IEEE International Conference on*, pp. 4912–4919, May 2014.

[3] L. Heng, P. T. Furgale, and M. Pollefeys, "Leveraging image-based localization for infrastructure-based calibration of a multi-camera rig.," *J. Field Robotics*, vol. 32, no. 5, pp. 775–802, 2015.