Abstract

In this paper, we propose a novel technique to reconstruct 3D surface of an underwater object using stereo images. Reconstructing the 3D surface of an underwater object is really a challenging task due to degraded quality of underwater images. There are various reason of quality degradation of underwater images i. e. , non-uniform illumination of light on the surface of objects, scattering and absorption effects. Floating particles present in underwater produces Gaussian noise on the captured underwater images which degrades the quality of images. The degraded underwater images are preprocessed by applying homomorphic, wavelet denoising and anisotropic filtering sequentially. The uncalibrated rectification technique is applied to
preprocessed images to rectify the left and right images. The rectified left and right image lies on a common plane. To find the correspondence points in a left and right images, we have applied dense stereo matching technique i.e., graph cut method. Finally, we estimate the depth of images using triangulation technique. The experimental result shows that the proposed method reconstruct 3D surface of underwater objects accurately using captured underwater stereo images.

References

- S. Bazeille I. Quidu, L. Jaulin, and J. P. Malkasse. Automatic underwater image pre-processing. In Proceedings of the Caractérisation du Milieu Marin (CMM’06), October 2006.
- U. Castellani, A. Fusiello, V. Murino, L. Papaleo, E. Puppo, S. Repetto, and M. Pittore. Efficient on-line mosaicing from 3d acoustical images. OCEANS’04 MTS/IEEE TECHNO OCEAN’04, 2:670–677, November 2004.
- Olivier D. Faugeras. What can be seen in three dimensions with an uncalibrated stereo rig? In Proceedings of the Second European Conference on Computer Vision, pages 563–578, May 1992.
- Andrea Fusiello and Luca Irsara. Quasi-euclidean epipolar rectification of uncalibrated images. Machine Vision and Applications, pages 1432–1769, May 2010.
- A. Hogue, A. German, and M. Jenkin. Underwater environment reconstruction using stereo and inertial data. In IEEE International Conference on Systems, Man and Cybernetics, pages 2372–2377, October 2007.
- B. Horn. Robot Vision. MIT Press, New York, 1986.
- A. Khamene, H. Madjdi, and S. Negahdaripour. 3-d mapping of sea floor scenes by stereo imaging. OCEANS’01 MTS/IEEE, 4:2577–2583, November 2001.
- Ali Khamene and Shahriar Negahdaripour. Motion and structure from multiple cues; image motion, shading flow, and stereo disparity. Computer Vision and Image Understanding, 90:99–127, April 2003.
- K. N. Kutulakos and Steven Seitz. What do n photographs tell us about 3d shape? In Technical Report TR680, Computer Science Dept. , U. Rochester, January 1998.
- A. Laurentini. The visual hull concept for silhouette-based image understanding. IEEE Transactions on Pattern Analysis and Machine Intelligence, 16:150–162, February 1994.
- William E. Lorensen and Harvey E. Cline. Marching cubes: A high resolution 3d surface construction algorithm. ACM SIGGRAPH Computer Graphics, 21:163–169, July 1987.
- Bruce D. Lucas and Takeo Kanade. An iterative image registration technique with an application to stereo vision. In Proceedings of the 7th international joint conference on Artificial intelligence, volume 2, 1981.
- H. Madjidi and S. Negahdaripour. Global alignment of sensor positions with noisy motion measurements. IEEE Transactions on Robotics and Automation, 21:1092–1104, December 2005.
- S.G. Narasimhan, S.K. Nayar, B Sun, and S.J. Koppal. Structured light in scattering media. Proceedings of the Tenth IEEE International Conference on Computer Vision,
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[1:420–427, October 2005.]

- S. Negahdaripour, H. Zhang, and X. Han. Investigation of photometric stereo method for 3-d shape recovery from underwater imagery. OCEANS'02 MTS/IEEE, 2:1010–1017, October 2002.
- T. Nicosevici, S. Negahdaripour, and R. Garcia. Monocular based 3-d seafloor reconstruction and ortho-mosaicing by piecewise planar representation. In Proceedings of MTS/IEEE OCEANS, volume 2, 2005.
- P. Perona and J. Malik. Scale-space and edge detection using anisotropic diffusion. IEEE Transactions on Pattern Analysis and Machine Intelligence, 12:629–639, July 1990.
- Sebastien Roy and Ingemar J. Cox. A maximum-flow formulation of the n-camera stereo correspondence problem. In Proceedings of the Sixth International Conference on Computer Vision, pages 492–499, January 1998.
- Daniel Scharstein and Richard Szeliski. A taxonomy and evaluation of dense two-frame stereo correspondence algorithms. International Journal of Computer Vision, 47:7–42, December 2002.
- L. Sendur and I. W. Selesnick. Bivariate shrinkage functions for wavelet-based denoising exploiting interscale dependency. IEEE Transactions on Signal Processing, 50:2744–2756, November 2002.
- D. N. Sidorov and ANil C. Kokaram. Suppression of moiré patterns via spectral analysis. In Proceedings of SPIE in Visual Communications and Image Processing, January 2002.
- Greg Slabaugh, Bruce Culbertson, Tom Malzbender, and Ron Schafer. A survey of methods for volumetric scene reconstruction from photographs. In Proceedings International Workshop on Volume Graphics, pages 81–100, June 2001.
- Carlo Tomasi and Takeo Kanade. Shape and motion from image streams: a factorization method - part 3 detection and tracking of point features. Technical Report CMU-CS-91-132, Computer Science Department, Pittsburgh, PA, April 1991.
- H. Zhang. Automatic sensor platform positioning and 3-d target modeling from underwater stereo sequences. PhD Thesis, December 2005.
- Zhengyou Zhang, Rachid Deriche, Olivier Faugeras, and Quang-Tuan Luong. A robust technique for matching two uncalibrated images through the recovery of the unknown epipolar geometry. Artificial Intelligence, 78:87–119, October 1995.

Index Terms

Computer Science

Image Processing
### Keywords

- 3d Reconstruction
- Underwater Stereo Images
- Uncalibrated Rectification
- Graph Cut
- Triangulation