

Qian-shan Li, Rong Xiong, Shoudong Huang, Yi-ming Huang, 2015.
Building a dense surface map incrementally from semi-dense point cloud
and RGB images. *Frontiers of Information Technology & Electronic
Engineering*, **16**(7):594-606. [doi:10.1631/FITEE.14a0260]

Building a dense surface map incrementally from semi-dense point cloud and RGB images

Key words: Bionic robot, Robotic mapping, Surface fusion

Contact: Qian-shan Li

E-mail: liqianshan@zju.edu.cn

 ORCID: <http://orcid.org/0000-0003-0370-7100>

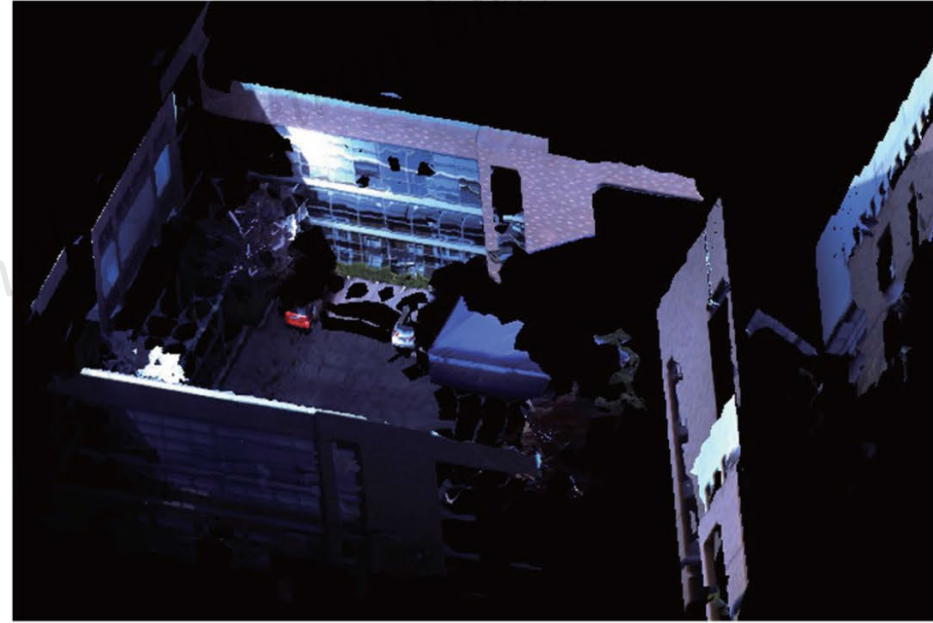
Introduction

- Most bionic robots can use only small light-weight laser scanners and cameras to acquire semi-dense point cloud and RGB images.
- We propose a method to generate a consistent and dense surface map from semi-dense point cloud and RGB images, which incrementally generates textured surfaces from newly observed point cloud and fuses them into the whole dense surface map.
- Our method works well in both indoor and outdoor semi-structured environments where there are regularly shaped objects.

Examples of semi-dense models and dense models



Semi-dense colored point cloud gathered by a 2D laser scanner

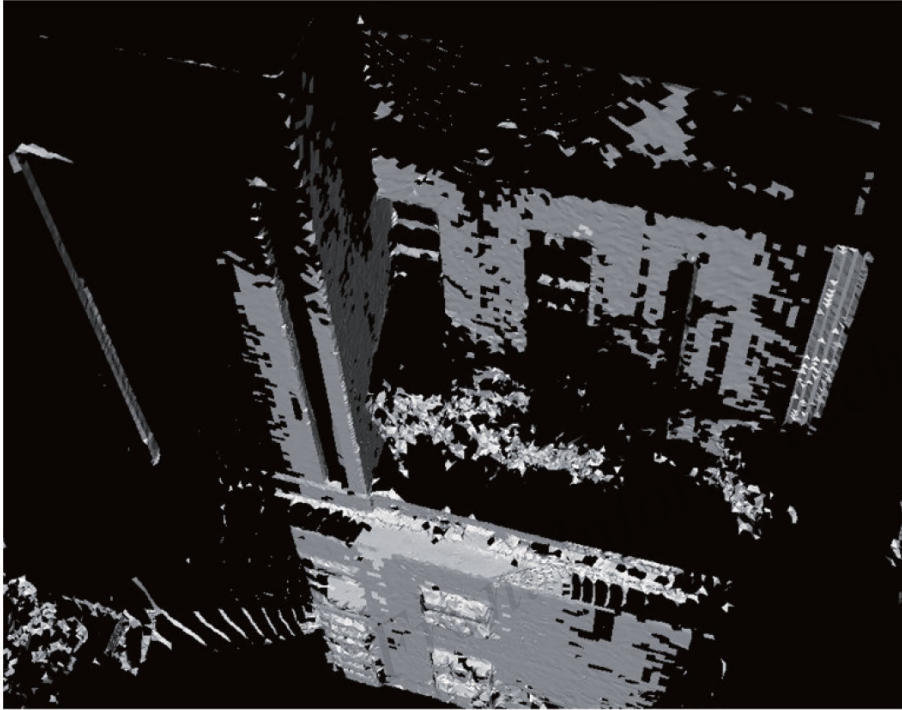


Dense textured triangular surface mesh generated by our method

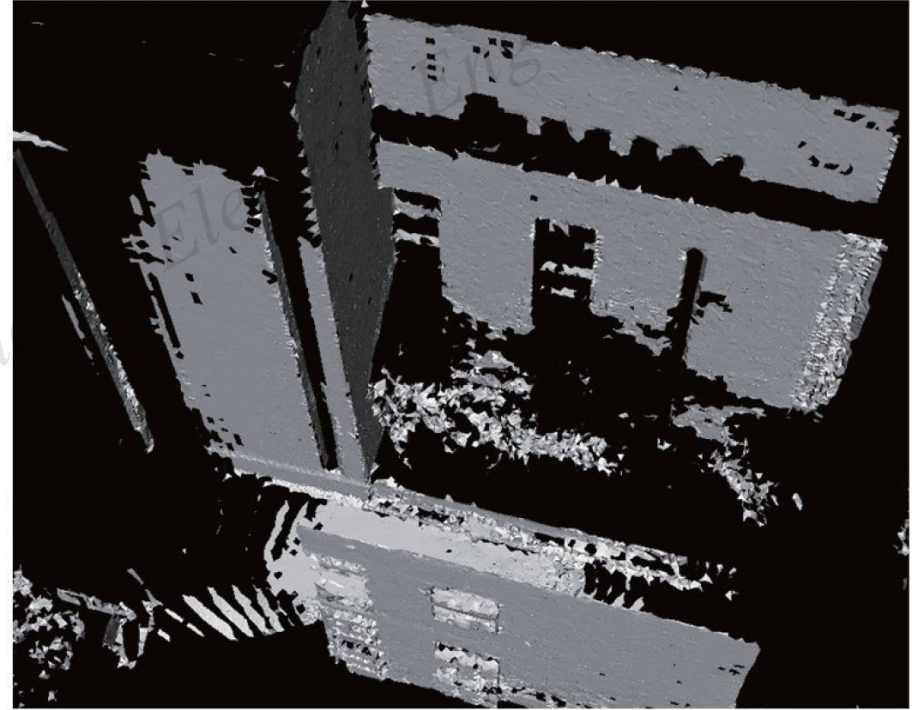
The device used for experiments



The result of surface resampling

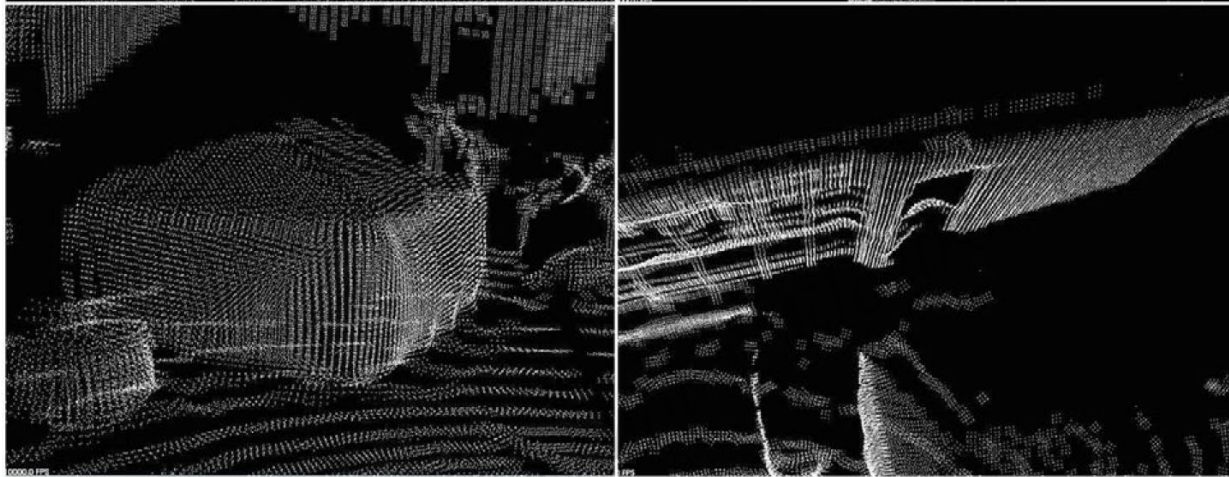


Triangulation results without surface resampling

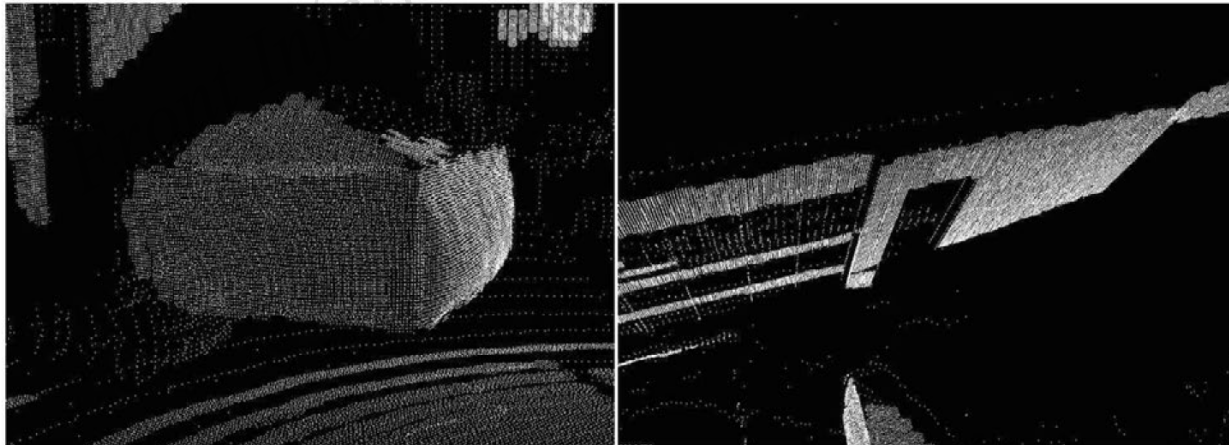


Triangulation results with surface resampling, where the surface is better preserved

The result of segmentation-based resampling

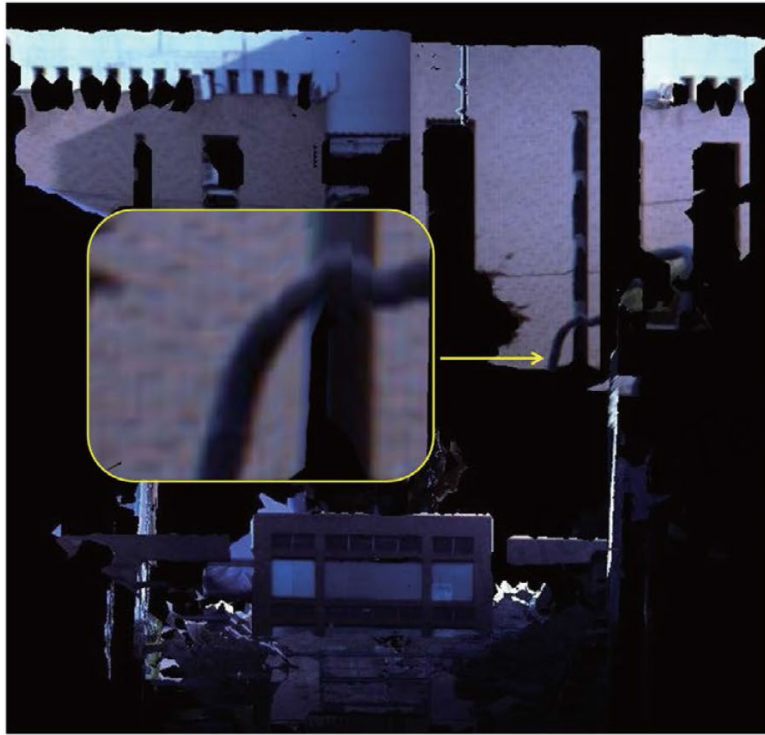


Ordinary moving least square resampling

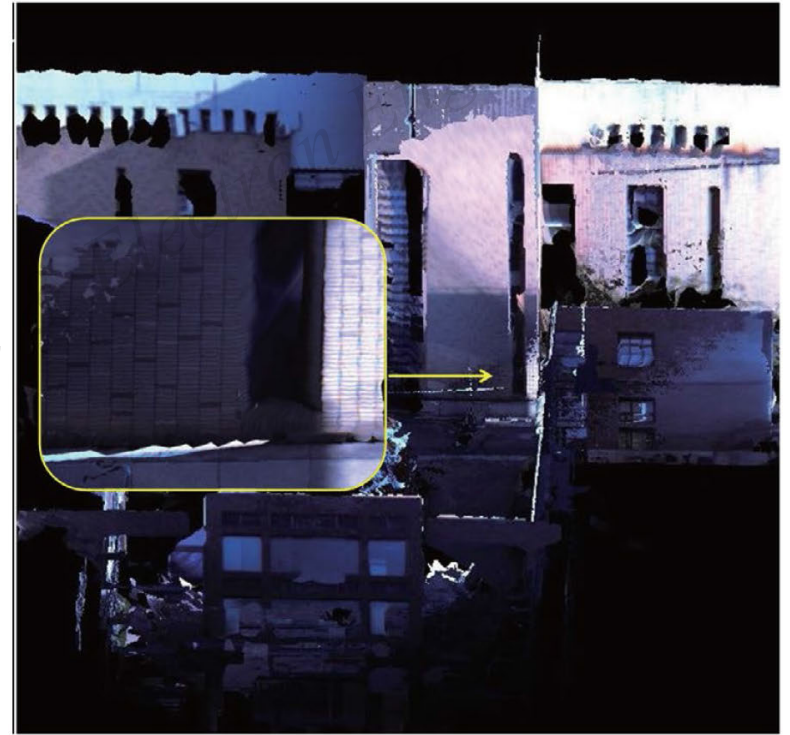


Our segmentation-based resampling

The result of texture update

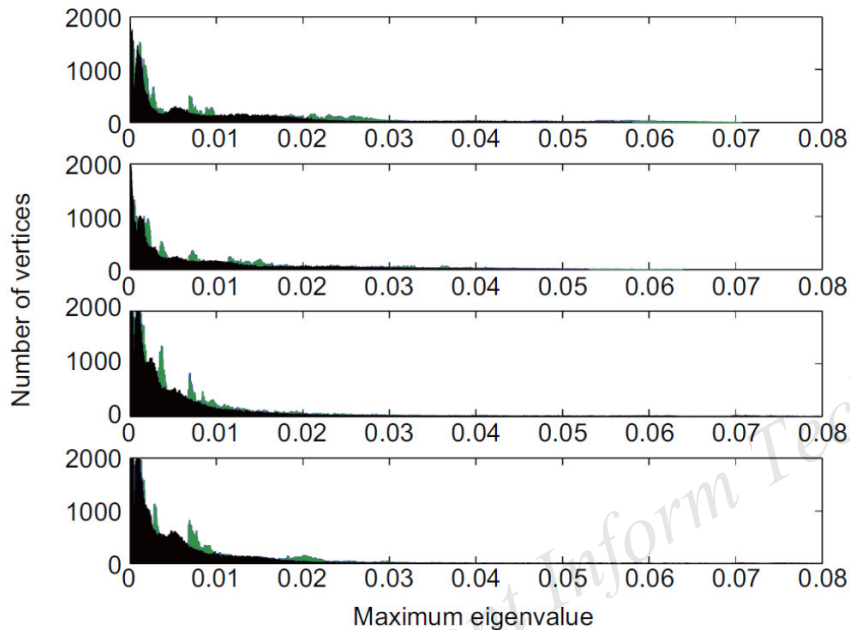


The surface observed at 10 m away

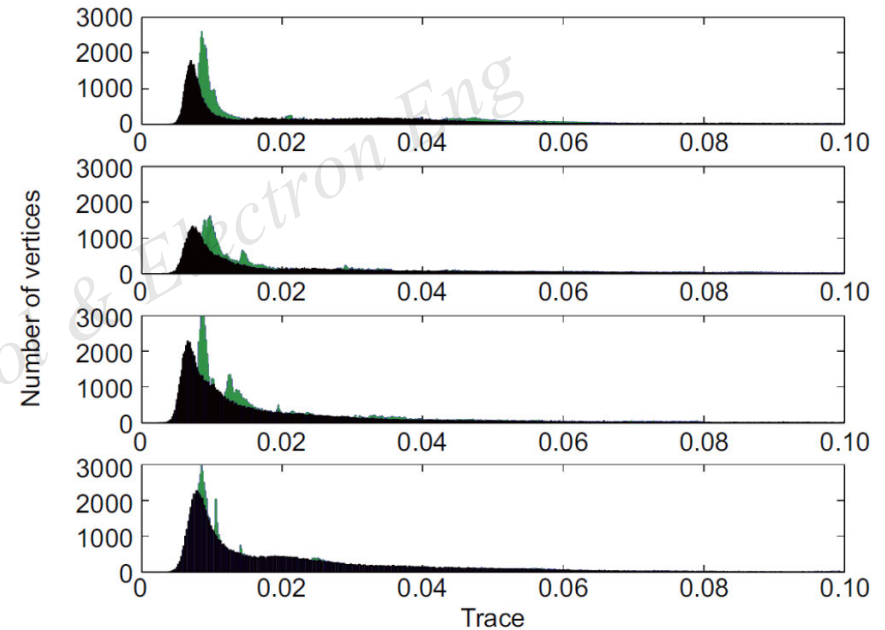


The updated surface observed at
3 m away

The reduction on vertices' uncertainties



Histograms of four frames of surface vertices on the maximum eigenvalue of squared covariances. Green: data before fusion; black: data after fusion.



Histograms of four frames of surface vertices on the trace of squared covariances. Green: data before fusion; black: data after fusion.

Conclusions

- A method is proposed to fuse a semi-dense point cloud and RGB images and generate a dense surface map. The resultant dense surface map offers rich visual and geometric information, and is an ideal representation of the environment for indoor/outdoor localization, navigation, and recognition tasks of bionic robots.
- With this method, a bionic robot can use small light-weight 2D laser scanners and RGB cameras to build and use a densely textured map.