Motion Estimation of a Moving Range Sensor
by Image Sequences and Distorted Range Data

Atsuhiko Banno  Kazuhide Hasegawa  Katsushi Ikeuchi

For a large scale object, scanning from the air is one of the most efficient methods of obtaining 3D data. In the case of large cultural heritage objects, there are some difficulties in scanning them with respect to safety and efficiency. To remedy these problems, we have been developing a novel 3D measurement system, the Floating Laser Range Sensor (FLRS), in which a range sensor is suspended beneath a balloon. The obtained data, however, have some distortion due to the intra-scanning movement. In this paper, we propose a method to recover 3D range data obtained by a moving laser range sensor; this method is applicable not only to our FLRS, but also to a general moving range sensor. Using image sequences from a video camera mounted on the FLRS enables us to estimate the motion of the FLRS without any physical sensors such as gyros and GPS. At first, the initial values of camera motion parameters are estimated by perspective factorization. The next stage refines camera motion parameters using the relationships between camera images and the range data distortion. Finally, by using the refined parameter, the distorted range data are recovered. We applied this method to an actual scanning project and the results showed the effectiveness of our method.

Publication

The Flow of our algorithm

The comparisons between the Cyrax2500’s data (the correct data) and (a) the original distorted data, (b) the initial recovered data by the factorization and (c) the recovered data by our proposed method: Each pair is aligned by an ICP algorithm. The green region indicates where the distance of corresponding point pair is less than the threshold (in this case 6.0 cm), that is, the match region. Note that the green region is expanded after the refinement in (c).