3D Reconstruction of Unit 3 Primary Containment Vessel Interiors at Fukushima Daiichi Nuclear Power Station Using Structure from Motion

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Abstract

The 3D interior structure can be reconstructed from image sequences captured by underwater robot for internal inspection of Unit 3 Primary Containment Vessel (PCV) based on Structure from Motion (SfM) technique. This recovered structure provides a better understanding of PCV interior environment and information on how best to retrieve fuel debris.

1. Introduction

To advance the plant's cleanup, fuel and other debris submerged in the coolant must be located and mapped. In July 2017, an underwater robot was sent to Unit 3 reactor for investigation [1]. The video of interior environment was recorded. We use this video to reconstruct the 3D structure of Unit 3 PCV interiors based on SfM technique.

2. Method

It is impossible to generate a 3D model of the whole scene in one go due to the huge size of the video. Moreover, the scene continuity is interrupted by floating particle noise. Thus, we propose following steps to reconstruct the 3D model.

2-1. Whole video segmentation

The whole video is divided into several clips based on the scene. The scene filled with floating particles are removed from the video.

2-2. Image extraction

Better quality images are extracted from each clip at three frames per second. The extracted images can keep the view is continuous also certain view disparity for 3D reconstruction.

2-3. Chunk 3D model generation

Extracted images of each clip are utilized to generate chunk 3D model by PhotoScan [2]. Furthermore, the relative trajectory of robot can be estimated.

2-4. Merging into whole 3D model

Separated chunks are merged together as a whole 3D model. Each location of chunk model is determined by arranging the whole robot trajectory as a smooth one. Figure 1 shows a Unit 3 interior model by merging two chunks.

3. Conclusion

The 3D model of PCV interior can be recovered by SfM technique using only image sequences taken by the robot. This reconstructed 3D model may give a better understanding on interior environment of PCV.

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References

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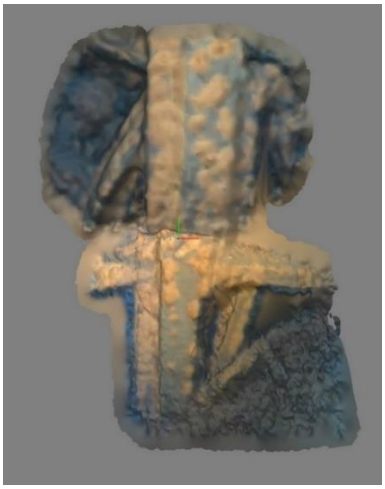

Figure 1. An example of part of Unit 3 PCV interior 3D model