**P1A-08** Detecting Changes in 3D Structure of a Scene from Multi-view Images Captured by a Vehicle-mounted Camera  
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**Goal:** Estimate large-scale structural changes of a city from their two image sequences captured at different times

**Background:** Difficulty with dense depth estimation (i.e., multi-view stereo) from images captured by a ground vehicle

**Idea:** Estimate only the probability of a depth change at each pixel without explicitly estimating the depths

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**Motivation**

- **Visualize the damages and the recovery/reconstruction processes of the tsunami affected-areas**
  - Since mid-April 2011
  - 2 to 3 months apart
  - 25 million images
  - Every 2m
  - 20 TB (as of Dec. 2012)

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**Dense 3D reconstruction from ground vehicle images**

- A lot of missing parts tend to be missing
- The differentiation of two reconstructions does not give good results

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**Estimation of relative camera poses**

- Perform SFM independently for each of the two sequences
- Roughly align the two reconstructions based on GPS data
- Reestablish the correspondences of feature points by incorporating a distance constraint
- Perform bundle adjustment over the two sequences

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**Detection of temporal changes of a scene**

- **Goal:** Estimate the large-scale structural changes of a city.

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**Experimental results**

- The proposed method outperforms the MVS-based methods

  **Proposed method**
  - Disparity space: 128 blocks ($r = 128$)
  - No prior on the probability of scene changes $p_{\text{inc}} = 0.5$

  **MVS-based methods**
  - The structures of a scene is reconstructed based on MVS
  - Then, they are differentiated to detect scene changes

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**Conclusion**

- The proposed method estimates the probability of the structural changes independently at each pixel by integrating the estimated depth densities.
- Experimental results show that the proposed method outperforms the MVS-based methods.

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**Change detection dataset**

- The dataset used in this study are available from our web site
  - [http://wwwvision.is.tohoku.ac.jp/~us/download/](http://wwwvision.is.tohoku.ac.jp/~us/download/)
    - Images of two different city streets
    - Data of each street consists of two image sequences captured at different times, the estimated camera poses, and several hand-labeled ground-truths