Pose Estimation of Omnidirectional Multi-camera System Using Feature Tracking and GPS Data

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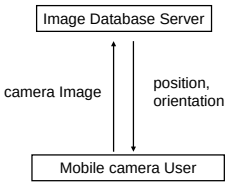
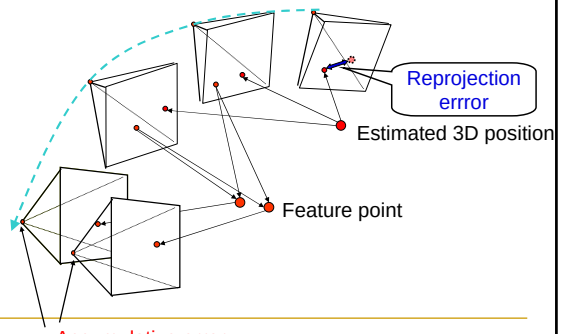
Acquisition of Image Data with Global Position and Orientation Information

Images with global positions



Localization of mobile camera users

Conventional Camera Pose Estimation Method



Accumulative error

Our Approach

OMS : Ladybug (Point Grey Research)

RTK-GPS (Nikon LogPak II)

Camera Pose estimation based on feature tracking

- Using omnidirectional multi-camera system (OMS)
- Using GPS position data

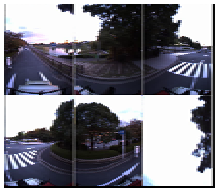
Segway (Segway LOC)

Acquisition of Images using OMS

OMS : Omnidirectional Multi-camera System

Ladybug (Point Grey Research)

- 6 XGA camera units
- 15 fps video
- 75% full spherical view



input videos

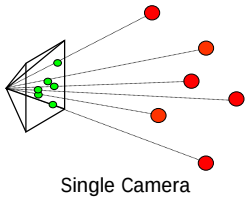
panoramic video

Calibration

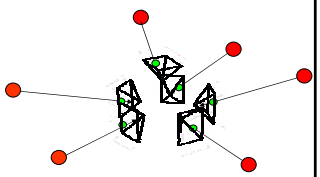
- lens distortion・camera pose
- limb darkening・color balance

Estimation of Camera Path of OMS

OMS pose is restrained by the surrounding feature point.



Single Camera

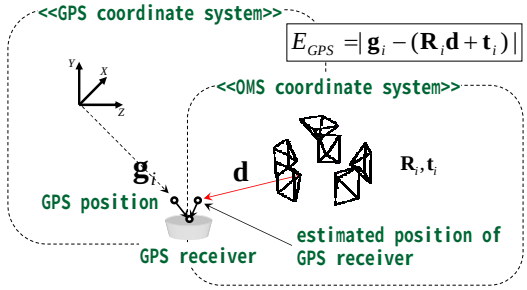


OMS

: estimated 3-D position

: detected 2-D position

Geometric Relation Between Camera and GPS Receiver



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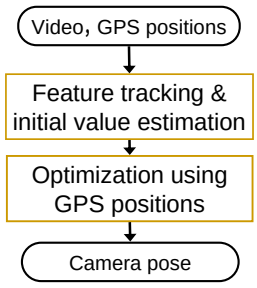
Procedure of Proposed Method



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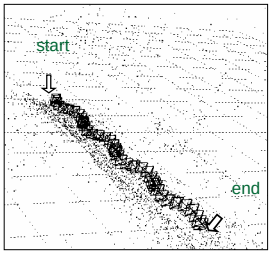
Evaluation Using Synthetic Data

To evaluate accuracy of only the optimization process



Given Data (900 frames)

- GPS positions (σ =30mm, 1Hz)
- Tracked feature positions (σ =1.6mm+ quantization error)
- Distance between camera and GPS receiver : 300mm

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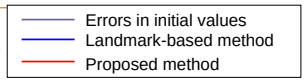
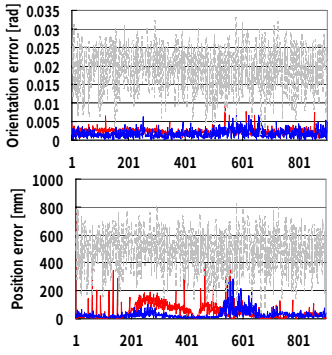
Evaluation Result



Landmark-based Method
Average orientation error:
0.0019 [rad]
Average position error:
47.5 [mm]

Proposed Method
Average orientation error:
0.0023 [rad]
Average position error:
30.7 [mm]



Experiment for Real Environments

To confirm availability of the propose method including the feature tracking process

Camera path

Inputs

- 7800 frame images
- GPS position (σ =30mm)
- Distance between OMS and GPS (300mm)

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Result of Feature Tracking

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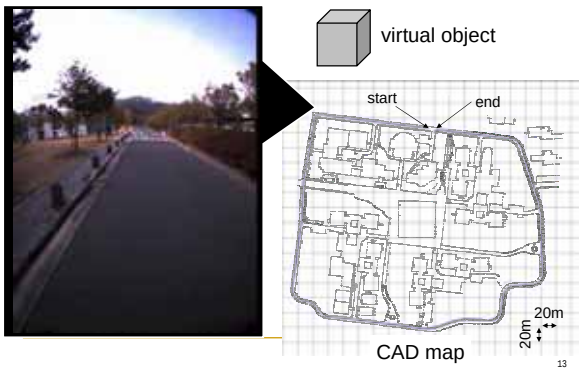
Match Move Using Estimated Pose



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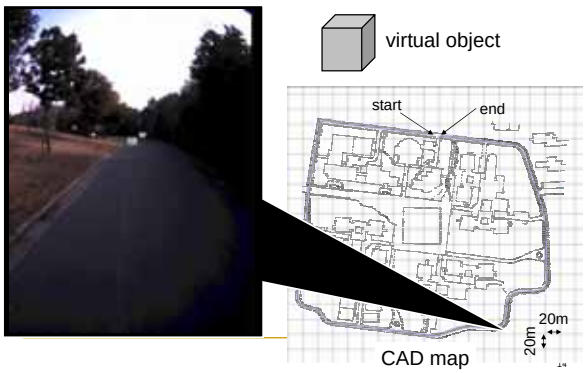
Match Move Using Estimated Pose



Summary

- We proposed Camera Pose estimation method
  - Using omnidirectional multi-camera system (OMS)
  - Using GPS position data
- Result
  - Same order precision as a landmark-based method
  - Good performance for real environments

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