Localization of Visual Sensor Networks

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Visual Sensor Networks

Visual Sensor Networks

A network consisting of spatially distributed smart cameras

Application

- Environmental monitoring
- Surveillance
- Tracking

When we consider the data fusion and sensor allocation…

The information of the location **(Localization)** is needed

Work on Network Localization

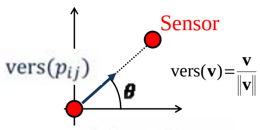
Localization

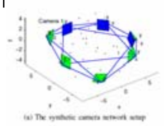
Determining the **relative poses of each sensor** in the network

Work on network localization

Categorized according to the measurements

- Beacons or Anchors [3]
  Measure location
- Angle-of-arrival [5]
  Measure direction of the position
- Cameras [6]
  Distributed pose estimation algorithm
  Assume the scene is static

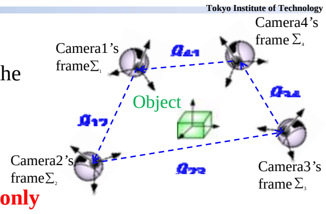




Objective of the Research

Objective of the research

Estimating the relative poses of the cameras (Localization) in Visual Sensor Networks



Characteristics

- Use **image measurements only**
- Communicate among **neighboring cameras only** (distributed)

  → Same characteristics as [6]
- Real-time localization (apply for **dynamic** scene) New!

Related work

- Passivity-based Cooperative Estimation [7]

  Averaging the poses ⇨ **Uniquely determine** the poses

Definition of Localization

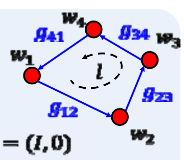
Definition 1 (Localized network) [6]

A network is said to be localized if there is a set of relative transformations g_{ij} such that, when the reference frame of the first node is fixed to g_1, the other absolute poses g_i are uniquely determined.

Proposition 1 [6]: The following are equivalent

1. The network is localized
2. For any cycle $l = \{w_1, \cdots, w_n, w_1\}, w_m \in V, n > 1$

   The transformation along the cycle is $g_l = (I, 0)$
3. **There exist a set of absolute poses g_i such that $g_{ij} = g_i^{-1} \circ g_j$**



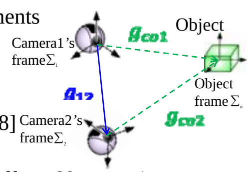
○ **Localization constraints**

Scenario

1. Get the relative pose from the measurements

   Kinematic relationship: $g_{12} = g_{co1} g_{co2}^{-1}$

   Estimated by Visual Motion Observer [8]



2. The measurements are not ***consistent*** (affected by noise)

   Noisy estimates: $\tilde{g}_{ij}$ Ex.) $\tilde{g}_{ij} \neq \tilde{g}_{ji}^{-1}$
3. Determine the poses which satisfy the localization constraints

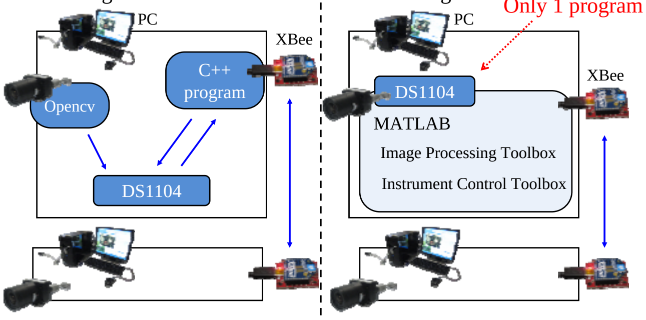
$$\min_{j \in N_i} \sum_{i \in V} \varphi(\bar{g}_{ij}^{-1} \tilde{g}_{ij}) \qquad \bar{g}_l = (I, 0) \quad \text{Cycle: } l$$

Estimation problem — Localization constraints

$$\varphi(g_1^{-1} g_2) = \|p_1 - p_2\|^2 + \frac{1}{2}\|R_1 - R_2\|_F^2 \qquad g_1 = (p_1, R_1)$$

Plan of Experiment Settings

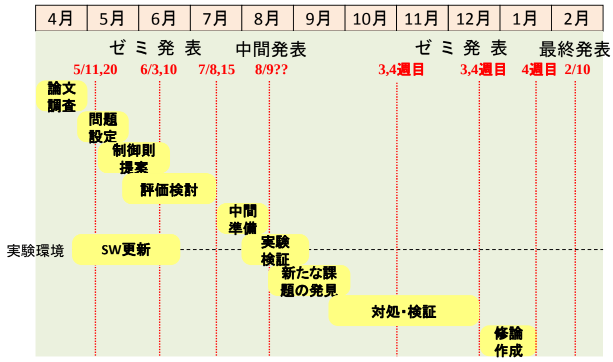
Old Settings | New Settings



- Need 3 programs at same time

- Decrease of computational load
- Decrease of sampling time

年間スケジュール



References

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[4] N. Trwmy, X. S. Zhou, K. X. Zhou and S. I. Roumeliotis, “3D Relative Pose Estimation from Distance-only Measurements,” *Proc. of the 2007 IEEE/RSJ International Conference on Intelligent Robots and Systems*, pp. 1071-1078, 2007.

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