PTAM Paper Review

Georg Klein, David Murray, 2007, ISMAR,
Parallel Tracking and Mapping for Small AR Workspaces

유 용길

목차

Introduce

- Parallel Tracking And Mapping.

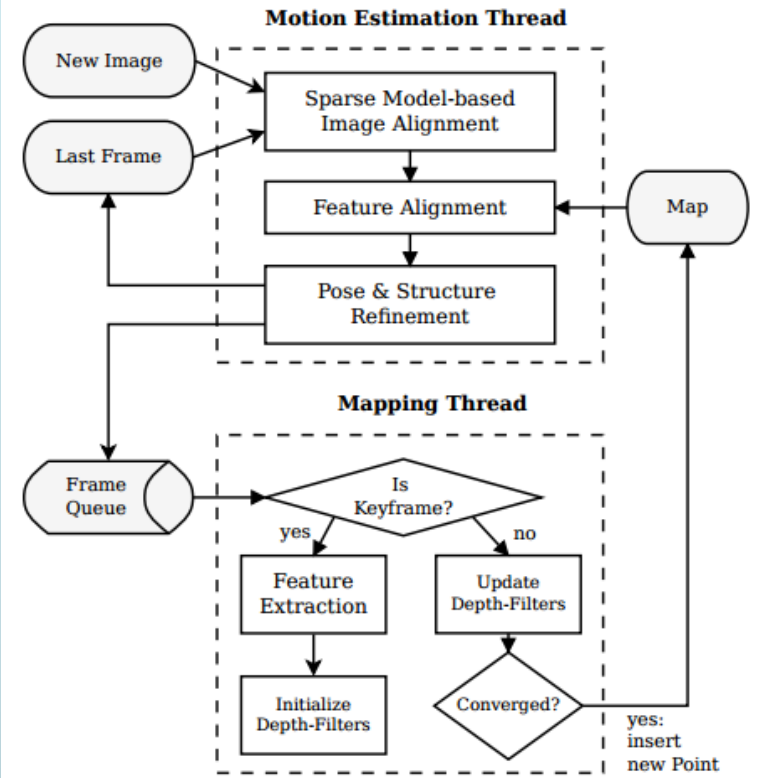
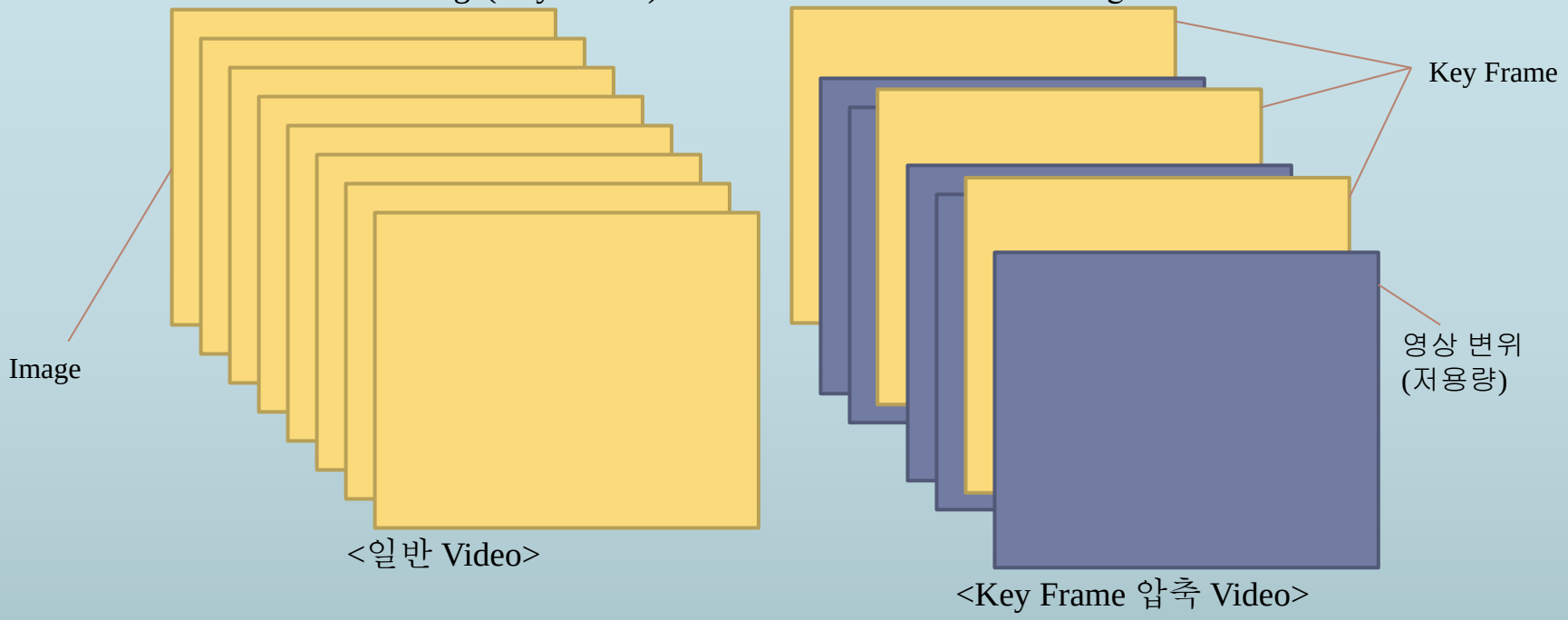


Fig. 1: Tracking and mapping pipeline

<SVO: Fast Semi-Direct Monocular Visual Odometry>
(Christian Forster, Matia Pizzoli, Davide Scaramuzza, ICRA 2014)

Introduce

- Monocular Visual SLAM using Key Frame.
  - Single Camera.
  - Key Frame.
    - 일반 Video
      - Image + Image + Image … → 대용량 File
    - Key Frame 압축 Video
      - Image(Key Frame) + 영상 변위 + 영상 변위 + Image + … → 압축 File



<일반 Video>

<Key Frame 압축 Video>

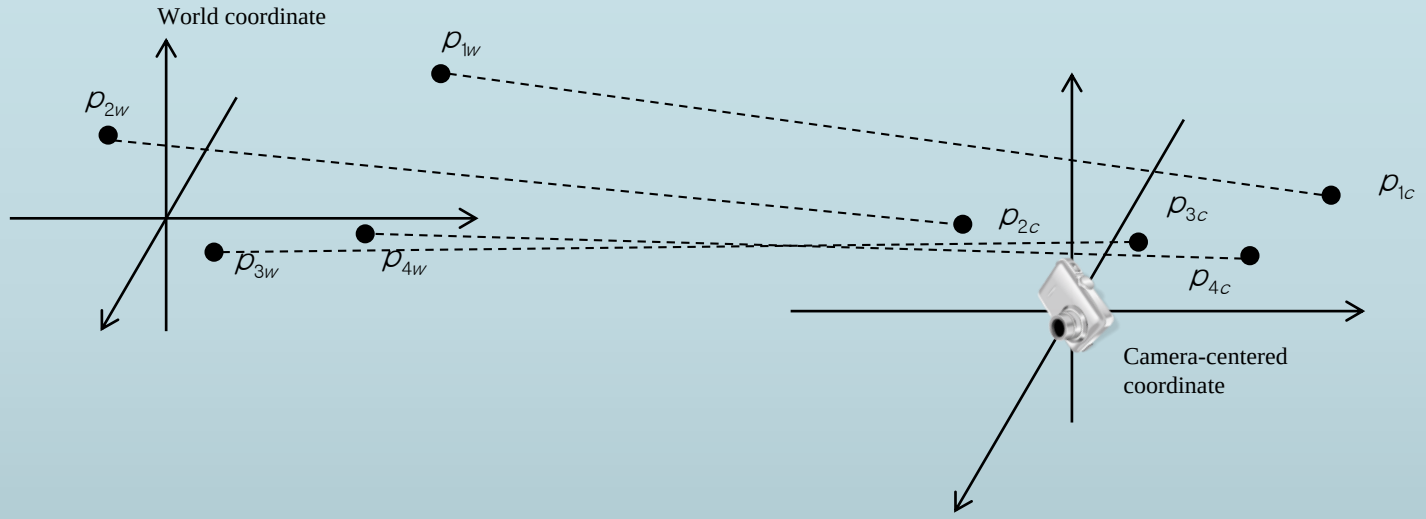
Map

- Map = Key Frame + Point.

- Point

$$p_{ic} = E_{cw} p_{iw}$$

Map Point



Camera pose and projection

$$p_{ic} = E_{cw} p_{iw}$$

- E_{cw}=Rotation + Translation

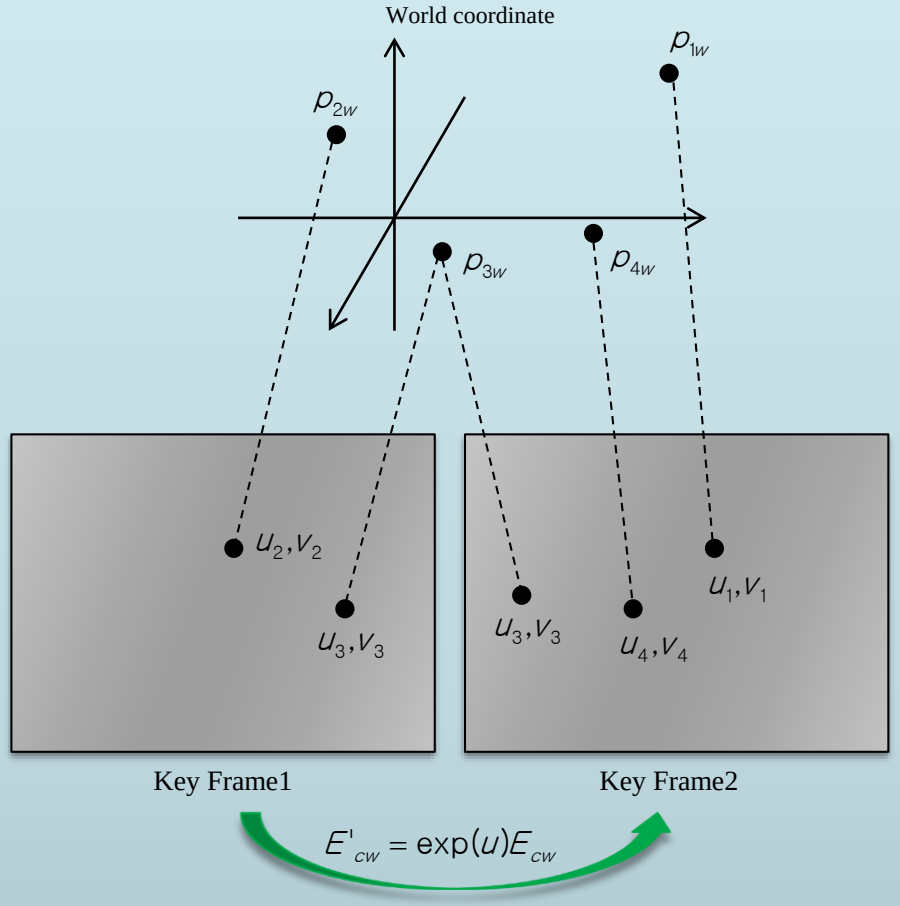
  ⇒Camera pose information

$$\begin{pmatrix} u_i \\ v_i \end{pmatrix} = Cam\,\mathrm{Pr}\,oj(E_{cw} p_{iw})$$

$$Cam\,\mathrm{Pr}\,oj\begin{pmatrix} x \\ y \\ z \\ 1 \end{pmatrix} = \begin{pmatrix} u_0 \\ v_0 \end{pmatrix} + \begin{bmatrix} f_u & 0 \\ 0 & f_v \end{bmatrix} \frac{r'}{r} \begin{pmatrix} \frac{x}{z} \\ \frac{y}{z} \end{pmatrix}$$

$$\left(r = \sqrt{\frac{x^2 + y^2}{z^2}}\right)$$

$$\left(r' = \frac{1}{w} \tan^{-1}\left(2r \tan\frac{w}{2}\right)\right)$$

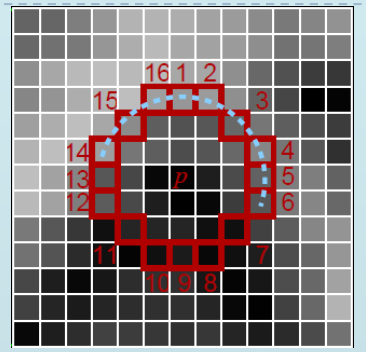


Patch search & Tracking

- Detect Point
  - Using FAST 10 Algorithm

All much brighter than p
or
All much darker than p

Number of p > 10,
Corner Pixel



- Matching Point
  - Warping Window patch
  - SSD in Window patch

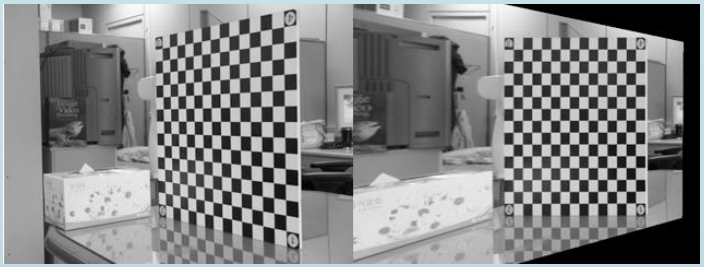
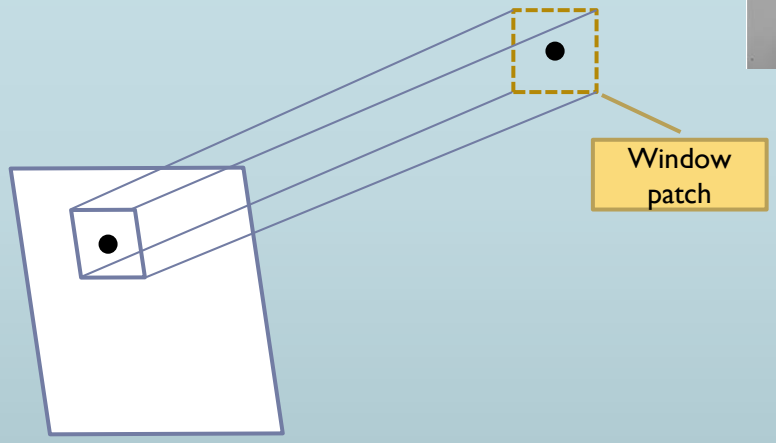
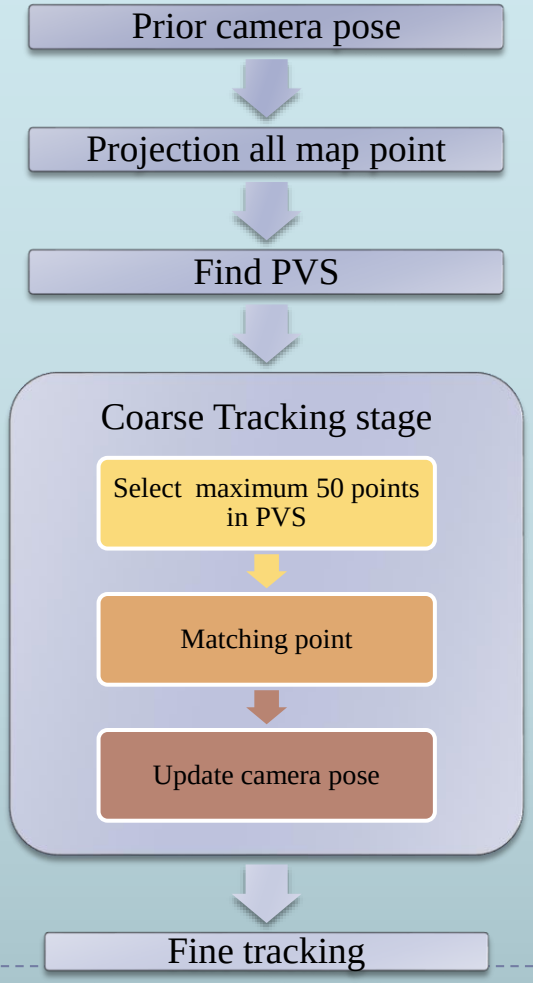


Image Warping



Patch search & Tracking

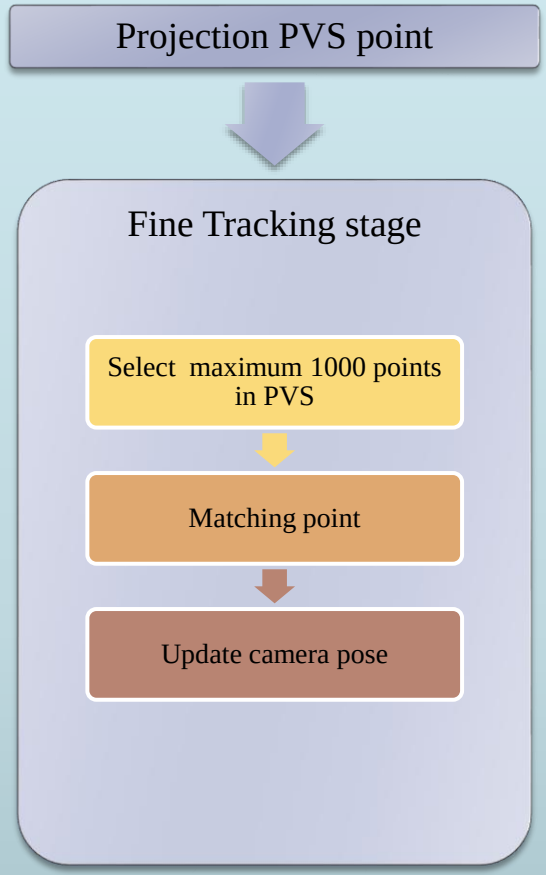
- Coarse & Fine Tracking
  - Coarse



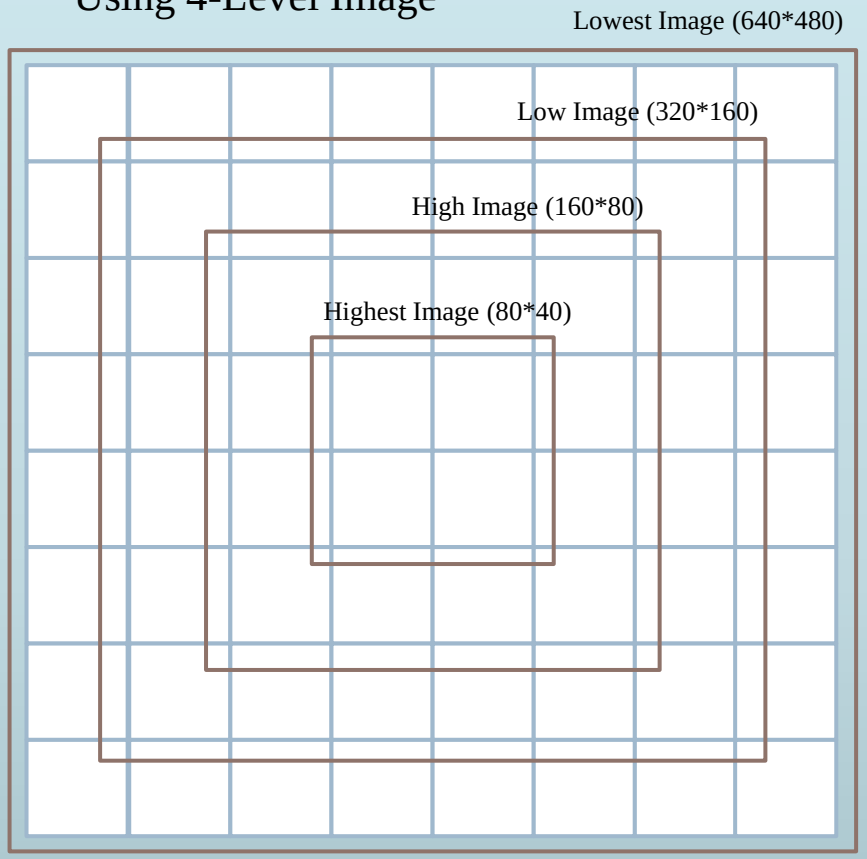
- PVS
  - Potentially visible set
  - Projected map point in image plane

Patch search & Tracking

- Fine

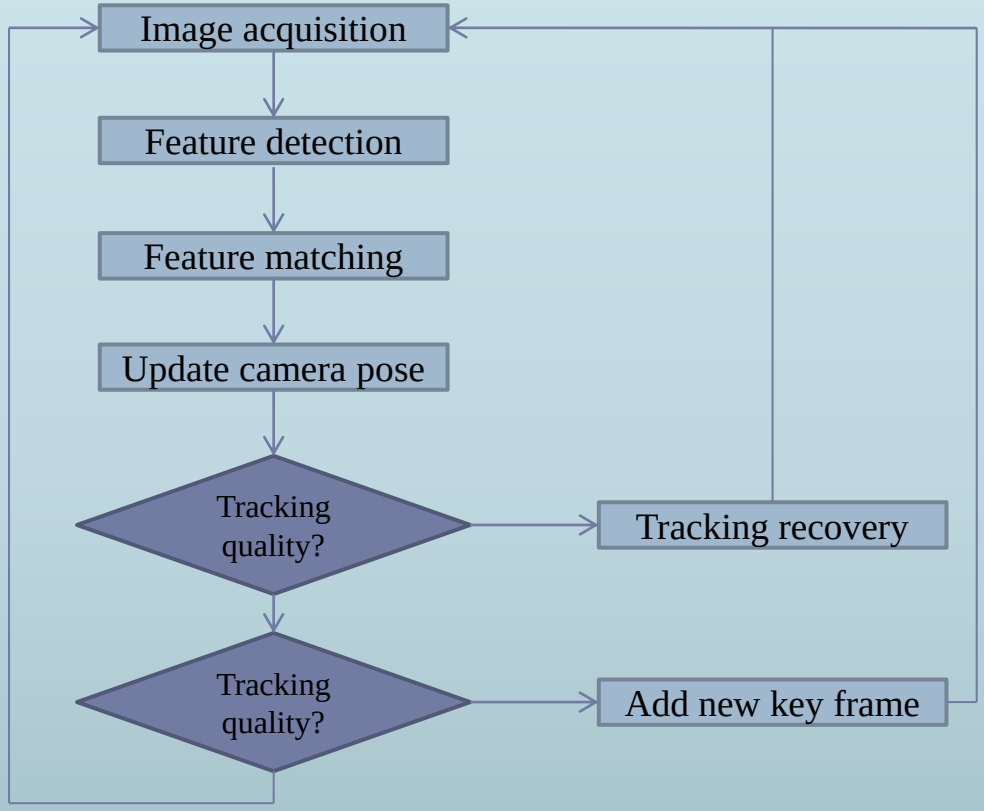


- Using 4-Level Image



Key Frame select

- Key Frame select condition
  - Tracking quality must be good.
  - Time since the last key frame was added must exceed twenty frames.
  - Camera must be a minimum distance away from the nearest key point already in map.



Conclusion

Q&A