Motion Magnification

Liu, Ce, et al. "Motion magnification." *ACM transactions on graphics (TOG)* 24.3 (2005): 519-526.

ISL

안재원

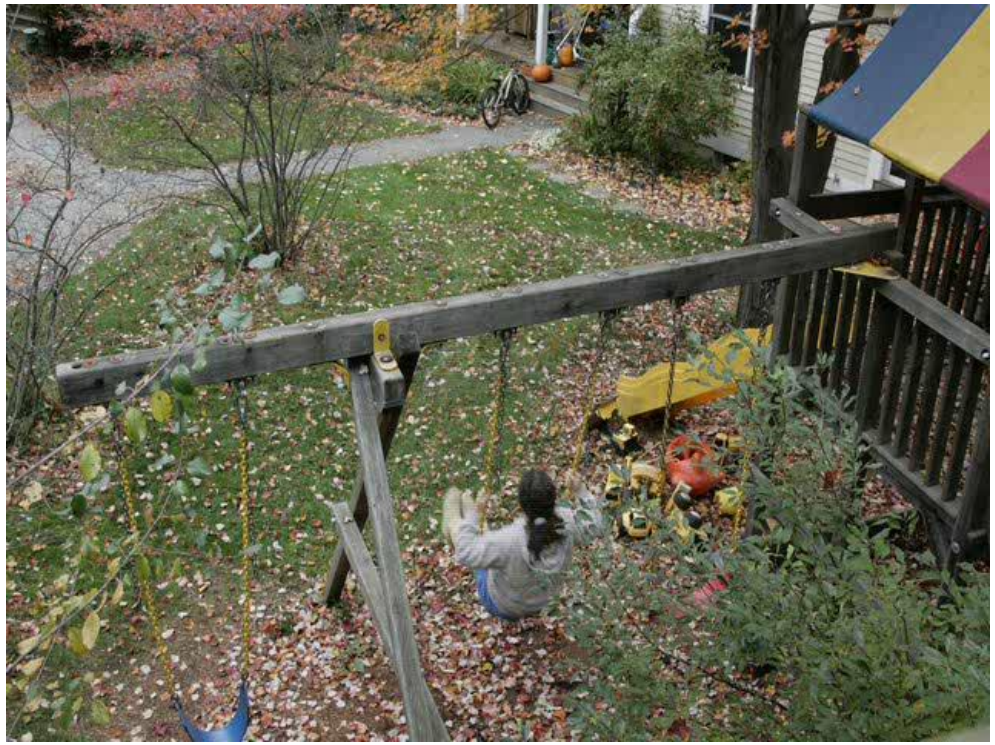
INDEX

- Motion Magnification
- Video Registration
- Layer-based motion analysis

01

Motion Magnification

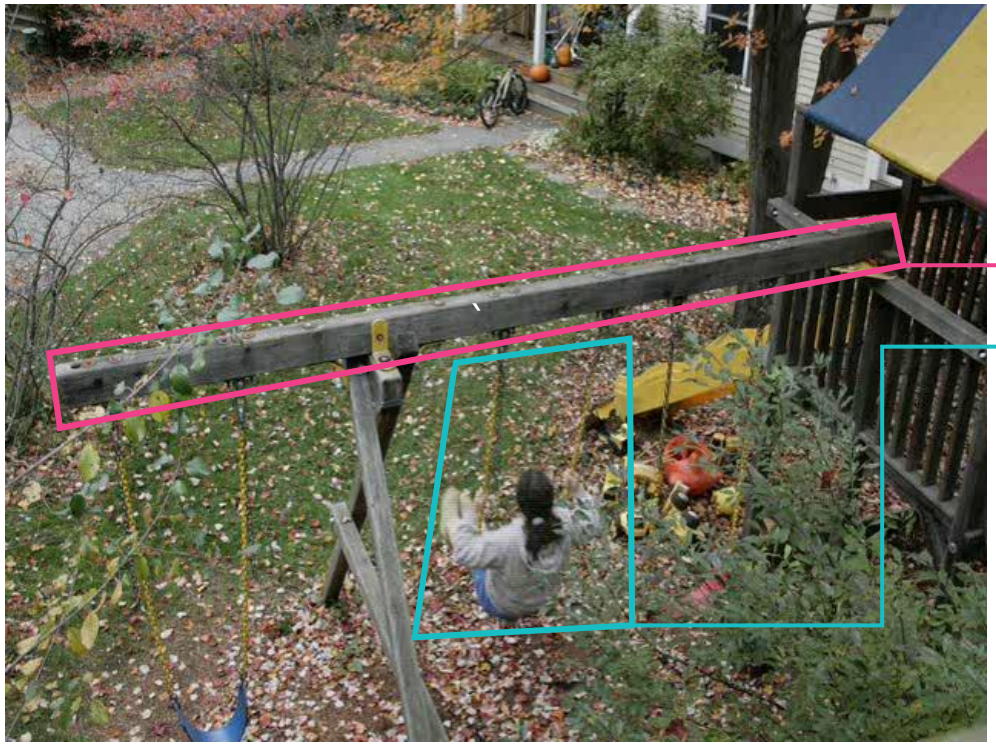
Intro



Motion Magnification

01

Intro



Small motion → Magnification → Big motion

Big motion

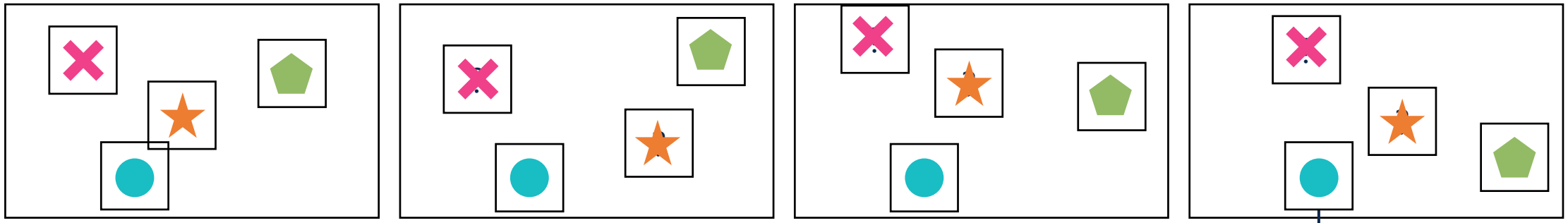
- Motion magnification flow

Video Registration → Layer-based motion analysis → Render video

02

Video Registration

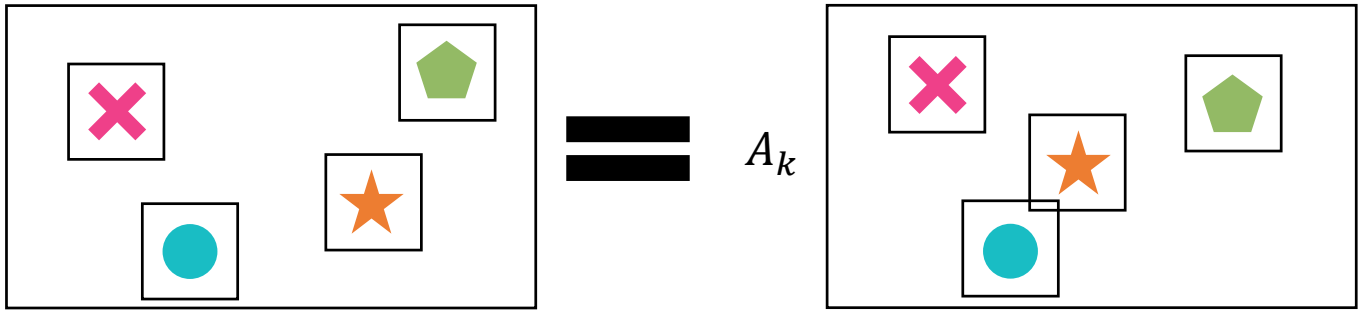
Reference frame



- SSD를 이용해 각 Feature를 matching한다.

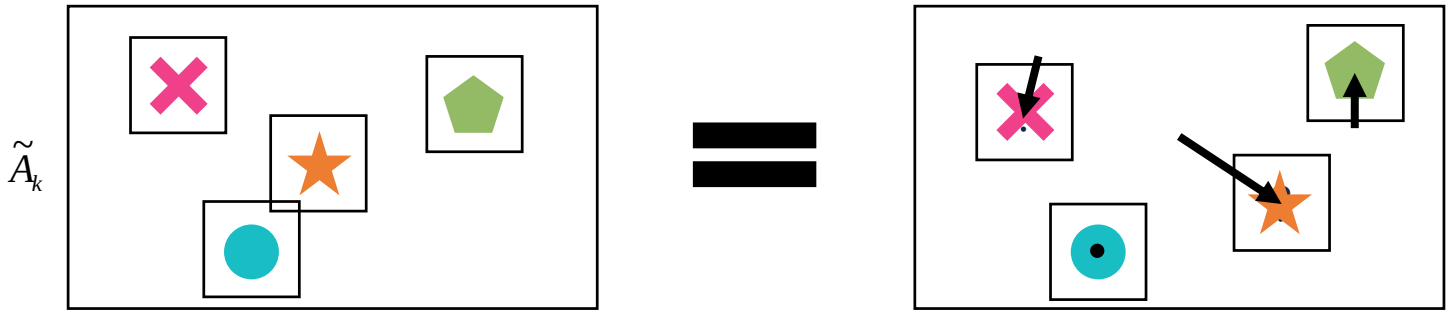
$$\sum \left(\boxed{\times} - \boxed{?} \right)^2$$

- Reference frame과 각 Frame(k)간의 Global affine matrix를 구한다.



Video Registration

Reference frame



- 각 Feature가 Stable feature일 확률을 계산.

$$\Pr_{nk} = \exp\left\{-\left\|A_k\left[x_{nk}\ y_{nk}\ 1\right]^T - \left[v_{nk}^x\ v_{nk}^y\right]^T\right\|^2 / \left(2\sigma_k^2\right)\right\} \qquad \sigma_k = \frac{1}{n}\sum_n \left\|A_k\left[x_{nk}\ y_{nk}\ 1\right]^T - \left[v_{nk}^x\ v_{nk}^y\right]^T\right\|^2$$

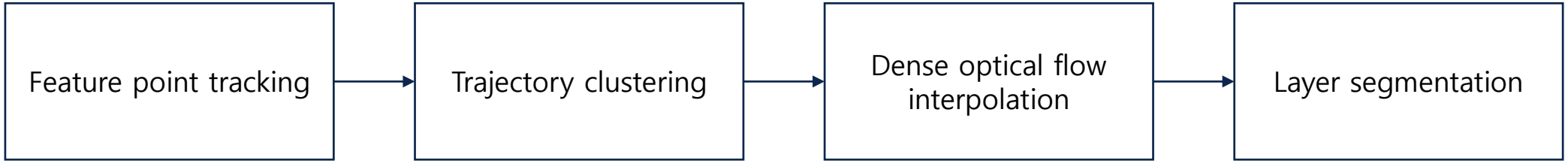
- 다음의 조건을 만족하는 Feature는 Stable feature.

$$\Pr_n > \alpha \cdot \max_i \Pr_i \qquad \Pr_n = \prod_k \Pr_{nk}$$

03

Layer-based motion analysis

Feature point tracking



- SSD Feature matching의 문제

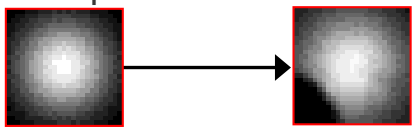
Stable feature

03

Layer-based motion analysis

Feature point tracking(Expectation-maximization algorithm)

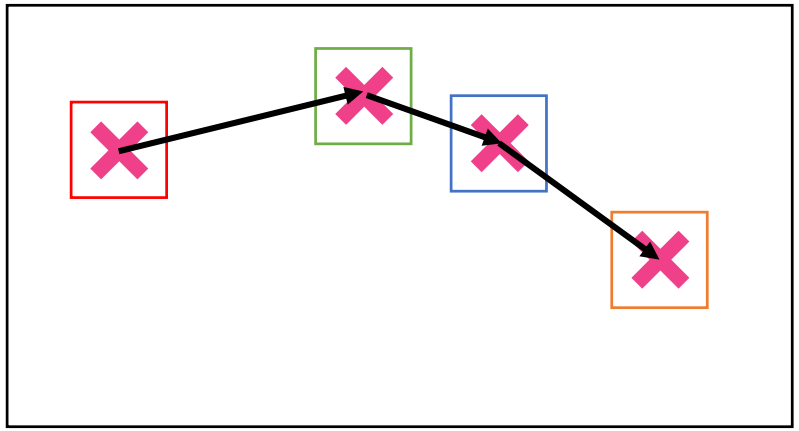
- E-step



$$\phi_n(p,q) = \exp\left\{ -\frac{p^2+q^2}{2s^2} - \frac{\sum_{k=2}^{K} \left\| B_{nk}(p,q) - B_{n1}(p,q) \right\|^2 \Pr_{nk}}{2\sigma^2 \sum_{k=2}^{K} \Pr_{nk}} \right\}$$

$$\Pr_{nk} = \exp\left\{ -\frac{SSD_{nk}}{2 \min_{1<i\le K} SSD_{ni}} - \frac{d_{nk}}{2 \min_{1<i\le K} d_{ni}} \right\}$$

- d_{nk}



03

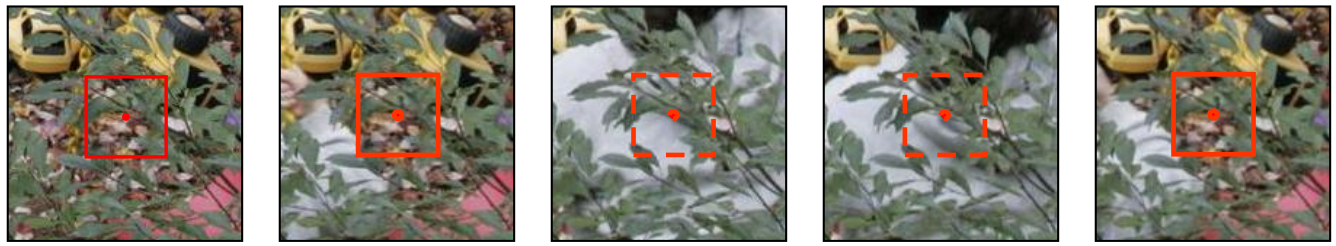
Layer-based motion analysis

Feature point tracking(Expectation-maximization algorithm)

- M-step

$$\Pr_{nk} = \exp\left\{ -\frac{SSD_{nk}}{2\min_{1<i\le K} SSD_{ni}} - \frac{d_{nk}}{2\min_{1<i\le K} d_{ni}} \right\}$$

- Removal and Interpolation(Minimizing the second derivative energy)



03

Layer-based motion analysis

Trajectory clustering

- 동일한 대상은 유사한 움직임을 보인다.

ZELNIK-MANOR, L., AND IRANI, M. “Degeneracies, dependencies and their implications in multi-body and multi-sequence factorizations.”

$$\rho_{n,m} = \left| \frac{\sum_k \left(v_{nk}^x + jv_{nk}^y\right)\left(v_{mk}^x + jv_{mk}^y\right)}{\sqrt{\left(\sum_k \left(v_{nk}^x\right)^2 + \left(v_{nk}^y\right)^2\right)\left(\sum_k \left(v_{mk}^x\right)^2 + \left(v_{mk}^y\right)^2\right)}} \right|$$

03

Layer-based motion analysis

Dense optical flow interpolation

Bicubic interpolation

Motion Group 1 (Green)

Motion Group 2 (Red)

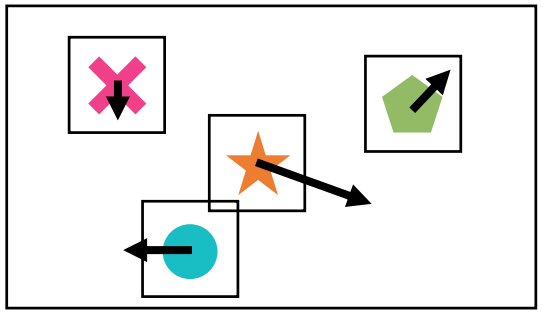
03

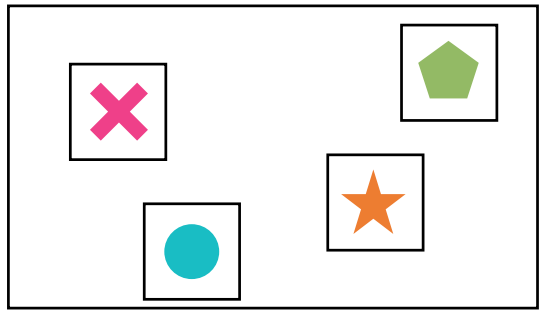
Layer-based motion analysis

Layer segmentation

- Motion likelihood

  주어진 Motion을 따라 움직였을 때 유사한 픽셀이 나오는가를 확인.





- Color likelihood

  Gaussian mixture model을 사용해 어떤 layer에 속하는지 분류

- Spatial connectivity

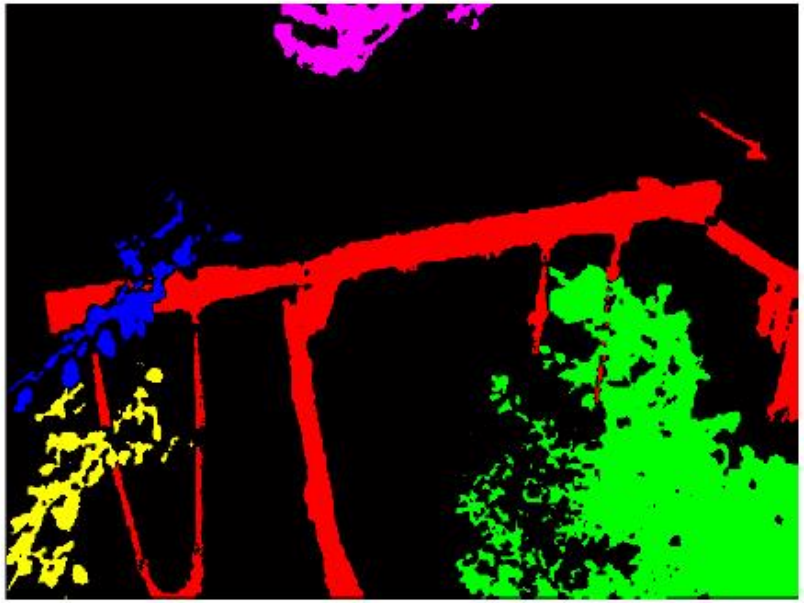
  인접한 픽셀간의 연결성 확인

BOYKOV, Y., VEKSLER, O., AND ZABIH, R. "Fast approximate energy minimization via graph cuts"

03

Layer-based motion analysis

Layer segmentation



Q & A