Video Reflection Removal

Amgad Ahmed, Suhong Kim & Mohamed Hefeeda
NSL Lab, SFU

Problem:

Videos are often taken behind a reflective surface causing undesired reflections to exist. We design an algorithm to separate reflection from the background.

Applications:

1. Photography
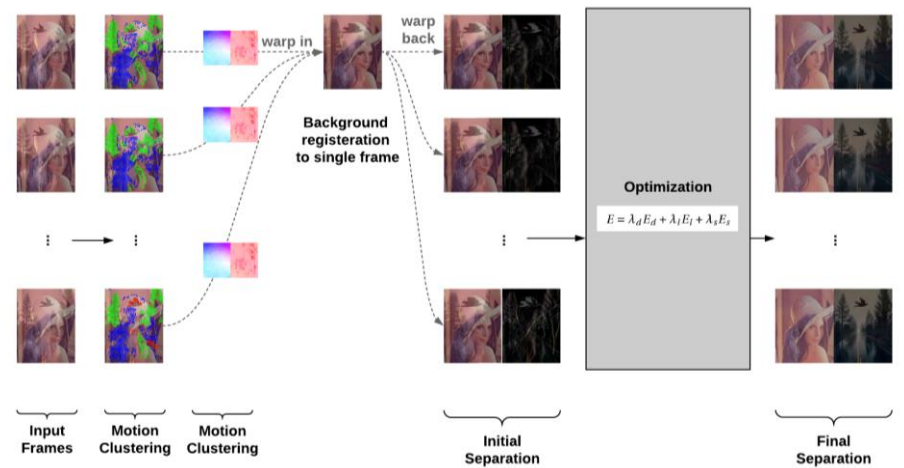2. Self-driving cars
3. Pre-processing of CV tasks

Our Approach:

Utilize motion information in the video:

(i) Feature tracking and segmentation
(ii) Background registration
(iii) Background initial estimation
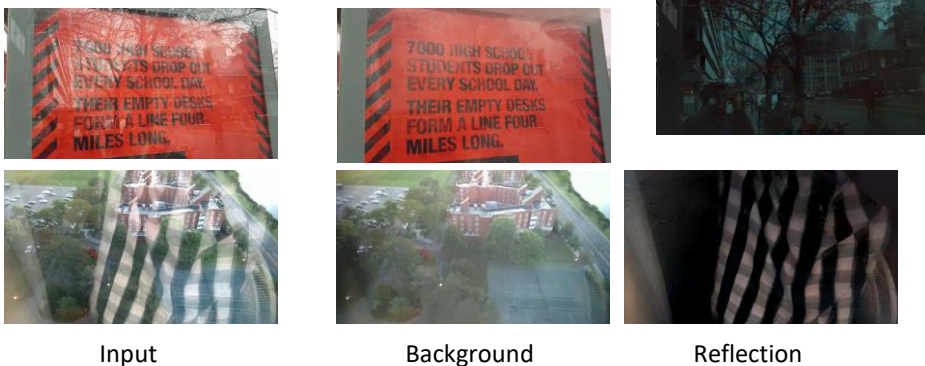(iv) Reflection initial estimation
(v) Optimization

$$E_d = \sum_{t=1}^{N}(||B_t - W_{t,p}^B \cdot B_p||_1 + ||R_t - W_{t,p}^R \cdot R_p||_1)$$

$$E_l = \sum_{t=1}^{N}(M_t^B \cdot |\nabla B| + M_t^R \cdot |\nabla (I_t - B_t)|)$$

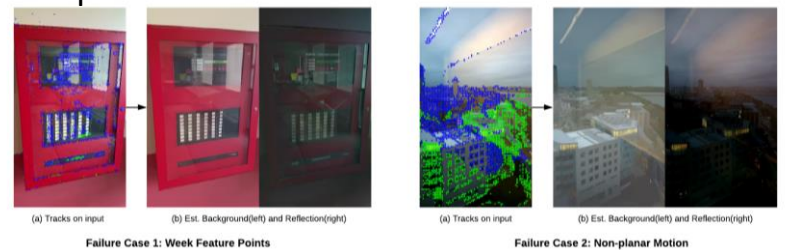$$E_s = \sum_{t=1}^{N}(|\nabla B_t| + \nabla (I_t - B_t)|)$$

Results:

| Input | Background | Reflection |

Limitations:

Since our approach relies on motion segmentation at the initial stage, it might fails if we got incorrectly clustered feature points in some cases.

Solution 1: User Assistance

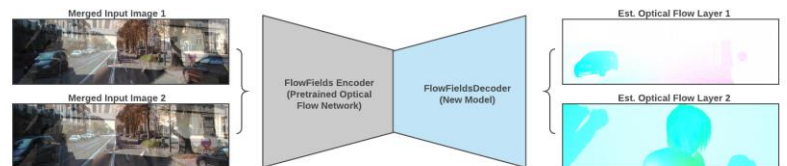Designing a user friendly GUI for annotating and tracking weak features.

- Week feature points -> Get more features from a user
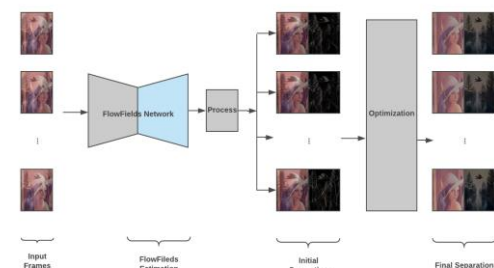- Non-planar motion   -> Refine clustering by a user

User Annotated Feature Points

Solution 2: Enhanced Flow-Fields

We can estimate motion field estimation with deep neural network, and then plug it into our pipeline.

(a) Deep Neural Networks estimating two-layered flow fields

(b) Modified pipeline

More information: http://nsl.cs.sfu.ca