Estimation of correspondent trajectories in multiple overlapping synchronized videos using correlation of activity functions

Thierry Malon, Sylvie Chambon, Vincent Charvillat, Alain Crouzil
IRIT, Université de Toulouse, CNRS, Toulouse, France
thierry.malon@irit.fr

ICIP 2019
IEEE International Conference on Image Processing
22-25 September 2019
Taipei . Taiwan

Context

Large collection of videos with overlapping fields of view

- **Multiple views of a scene**
  - → More and more devices allowing to record videos
  - → Easy to find multiple views of a scene from **different viewpoints**
- **In a video-surveillance scenario**
  - → Some views may **reveal more details and hints** than others
  - → Need to easily navigate in large collection of videos

Trajectory querying

- Allowing the user to navigate from a current video to other videos
  - → **drawing a query** on the video frame corresponding to a searched trajectory
  - → automatically switching to the video that ***best sees*** this trajectory

The approach

Main principle [1]

- Two regions of two videos systematically and simultaneously both occupied at the same times by objects of the same category correspond to each other

- Corresponding regions in different view have correlated **activity functions** (occupation rate over time)
  - → The query trajectory is reformulated using these correspondences
  - → Reformulated trajectories are assigned a **reformulation score**
  - → Views are ranked using a **visibility score**

Left: a query trajectory in red drawn by a user.
Reformulated trajectories in other views are shown in blue.

Reformulation score

$$\underset{(i'_1,\ldots,i'_M)}{\operatorname{argmax}} \frac{\frac{1}{M}\sum_{k=1}^{M} \mathcal{C}(c_{i_k}^{V_1}, c_{i'_k}^{V_2})}{1+\sum_{k=1}^{M-1} \max(0, ||\mathbf{i}'_k - \mathbf{i}'_{k+1}|| - 1)}$$

(V_1, V_2)

- Numerator: ensures **good correspondences** between cells crossed by the query trajectory and cells from the reformulated trajectory
- Denominator: **penalizes discontinuity** of the reformulation

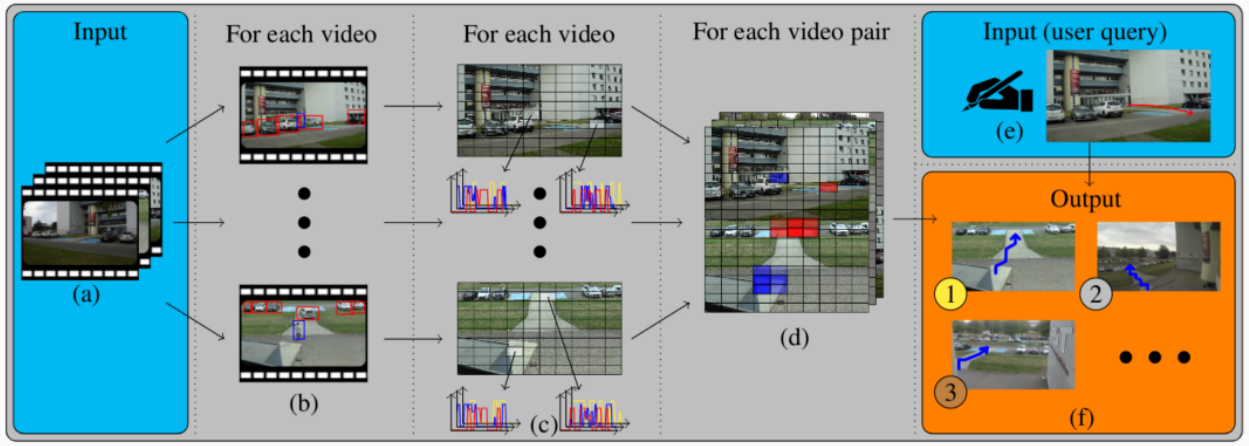
Visibility score

- The longer the length of the reformulated trajectory, the more details can be seen

Visibility Score =
Reformulation Score × Trajectory Length

→ **Switch** to the video with the **highest visibility score**

General pipeline



General overview of the approach: (a) Collection of videos as input, (b) detection of objects and categories, (c) functions of activity computing, (d) correspondence maps computing, (e) user trajectory query, (f) video ranking based on visibility score.

Results

- Experiments on the ToCaDa dataset [2]

Best views ranking. 1st column: three trajectory queries are drawn in red, respectively for categories human, moto and car. 2nd to 4th columns: the top 3 views that offer a high visibility score are returned in descending order. 5th column: an overlapping view with a low rank.

References

[1] Detmold, H., Van Den Hengel, A., Dick, A., Cichowski, A., Hill, R., Kocadag, E., Falkner, K., Munro, D.S.: Topology estimation for thousand-camera surveillance networks. In: ACM/IEEE International Conference on Distributed Smart Cameras (2007)

[2] Malon, T., Roman-Jimenez, G., Guyot, P., Chambon, S., Charvillat, V., Crouzil, A., Péninou, A., Pinquier, J., Sèdes, F., Sénac, C.: Toulouse campus surveillance dataset: scenarios, soundtracks, synchronized videos with overlapping and disjoint views. In: ACM Multimedia Systems Conference (2018)