# Motion segmentation with pairwise matches and unknown number of motions 

UNIVERSITÀ
DI TRENTO


POlitecnico
DI MILANO

Federica Arrigoni ${ }^{1}$, Luca Magri², Tomas Pajdla ${ }^{3}$



Aim: classifying points in multiple images based on the 3D moving object they belong to, when the number of motions is unknown


Assumptions: in inputa set of two. frame matches


Despite poorly studied, this strikes a good trade-off between realistic assumptions and feasibility

O Idea: robustly combine partial results independently obtained from pairs of images


## Challenges:

- Ambiguity: the same motion may be given a different label in different pairs;
- Noise: each two-frame segmentation may contain errors

Experiments: demonstrate betere or comparable accuracy than SotA methods (Mode [2], Synch[6]) without knowing the number of 3D motions.

| Dataset | d | $n$ | $p$ | Our Method |  |  | Mode |  | Synch |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Motions | Error[\%] | Classified[\%] | Error[\%] | Classified[\%] | Error[\%] | Classified[\%] |
| Pen | 2 | 6 | 4550 | $\checkmark$ | 1.55 | 89.08 | 0.58 | 80.07 | 0.82 | 83.23 |
| Pouch | 2 | 6 | 4971 | $\checkmark$ | 1.39 | 60.79 | 3.79 | 65.34 | 4.15 | 69.89 |
| Needlecraft | 2 | 6 | 6617 | $\checkmark$ | 1.80 | 67.07 | 0.83 | 72.81 | 1.04 | 76.76 |
| Biscuits | 2 | 6 | 13158 | $\checkmark$ | 1.12 | 90.42 | 0.47 | 84.47 | 0.51 | 87.28 |
| Cups | 2 | 10 | 14664 | $\checkmark$ | 2.05 | 71.31 | 0.56 | 65.42 | 1.01 | 69.82 |
| Tea | 2 | 10 | 32612 | $\checkmark$ | 0.69 | 85.21 | 0.29 | 81.70 | 28.12 | 52.21 |
| Food | 2 | 10 | 36723 | $\checkmark$ | 0.78 | 82.34 | 0.36 | 76.19 | 0.56 | 80.66 |
| Penguin | 2 | 6 | 5865 | $\checkmark$ | 1.36 | 66.60 | 0.76 | 69.17 | 44.21 | 46.97 |
| Flowers | 2 | 6 | 7743 | $\checkmark$ | 1.51 | 75.50 | 1.23 | 73.65 | 1.62 | 77.28 |
| Pencils | 2 | 6 | 2982 | $\checkmark$ | 3.09 | 51.01 | 3.80 | 65.33 | 27.53 | 40.44 |
| Bag | 2 | 7 | 6114 | $\checkmark$ | 2.78 | 52.91 | 1.52 | 57.95 | 25.92 | 54.27 |
| Bears | 3 | 10 | 15888 | $\checkmark$ | 3.48 | 68.21 | 4.82 | 73.65 | 38.95 | 74.59 |

## References:

[1] Magri, Fusiello. T-linkage: a continuous relaxation of J-linkage for multi-model fitting. CVPR 2014
[2] Arrigoni, Padja. Robust motion segmentation from pairwise matches. ICCV 2019 [3] Kuhn. The Hungarian method for the assignment problem. Naval Research Logistics Quarterly 2. 1995
[4] Maset, Arrigoni, Fusiello. Practical and efficient multi-view matching. ICCV 2017 [5] Tron, Zhou, Esteves, Daniilidis. Fast multi-image matching via density-based clustering. ICCV 2017
6] Arrigoni, Padja. Motion segmentation via synchronization. ICCV workshops 2019

