

Motion segmentation with pairwise matches and unknown number of motions

Federica Arrigoni¹, Luca Magri², Tomas Pajdla³





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



Robust voting

Two-frame segmentation: Motion segmentation is solved independently on different image pairs, by fitting an unknown number of fundamental matrices to correspondences using T-linkage [1].

Two-frame

seamentation

Multi frame segmentation: builds upon [2] to deal with an unknown number of motions

Permutation synchronization: consider a graph where each vertex corresponds to one image pair. An edge is drawn between two vertices each time the associated pairs have one image in common.



For each edge, a permutation is computed solving a linear assignment problem [3]. For all the vertices permutations are synchronized via [4,5] with unknown number of motions.

Robust Voting: for each point in each image, several putative labels are available: the most frequent label is chosen. Outlier/missing labels are ignored.



Assumptions: in input a set of two-frame matches



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

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

				Our Method			Mode		Synch	
Dataset	d	п	р	Motions	Error[%]	Classified[%]	Error[%]	Classified[%]	Error[%]	Classified[%]
Pen	2	6	4550	1	1.55	89.08	0.58	80.07	0.82	83.23
Pouch	2	6	4971	1	1.39	60.79	3.79	65.34	4.15	69.89
Needlecraft	2	6	6617	1	1.80	67.07	0.83	72.81	1.04	76.76
Biscuits	2	6	13158	1	1.12	90.42	0.47	84.47	0.51	87.28
Cups	2	10	14664	1	2.05	71.31	0.56	65.42	1.01	69.82
Tea	2	10	32612	1	0.69	85.21	0.29	81.70	28.12	52.21
Food	2	10	36723	1	0.78	82.34	0.36	76.19	0.56	80.66
Penguin	2	6	5865	1	1.36	66.60	0.76	69.17	44.21	46.97
Flowers	2	6	7743	1	1.51	75.50	1.23	73.65	1.62	77.28
Pencils	2	6	2982	1	3.09	51.01	3.80	65.33	27.53	40.44
Bag	2	7	6114	1	2.78	52.91	1.52	57.95	25.92	54.27
Bears	3	10	15888	1	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. **CVPB 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