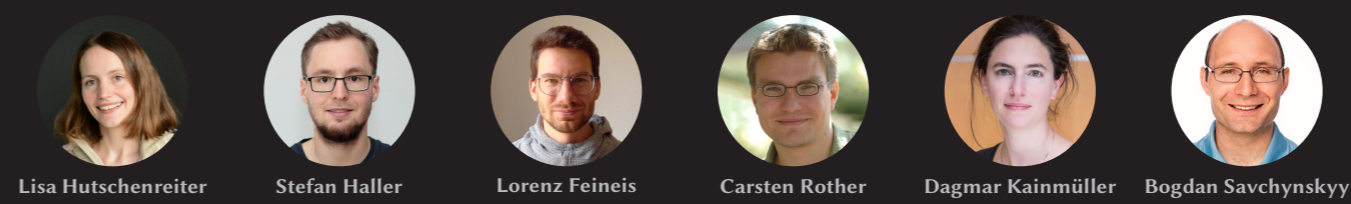
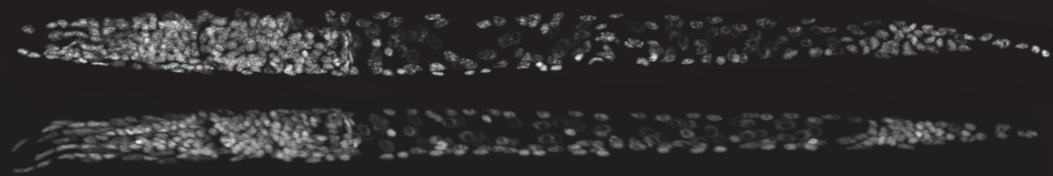


Fusion Moves for Graph Matching



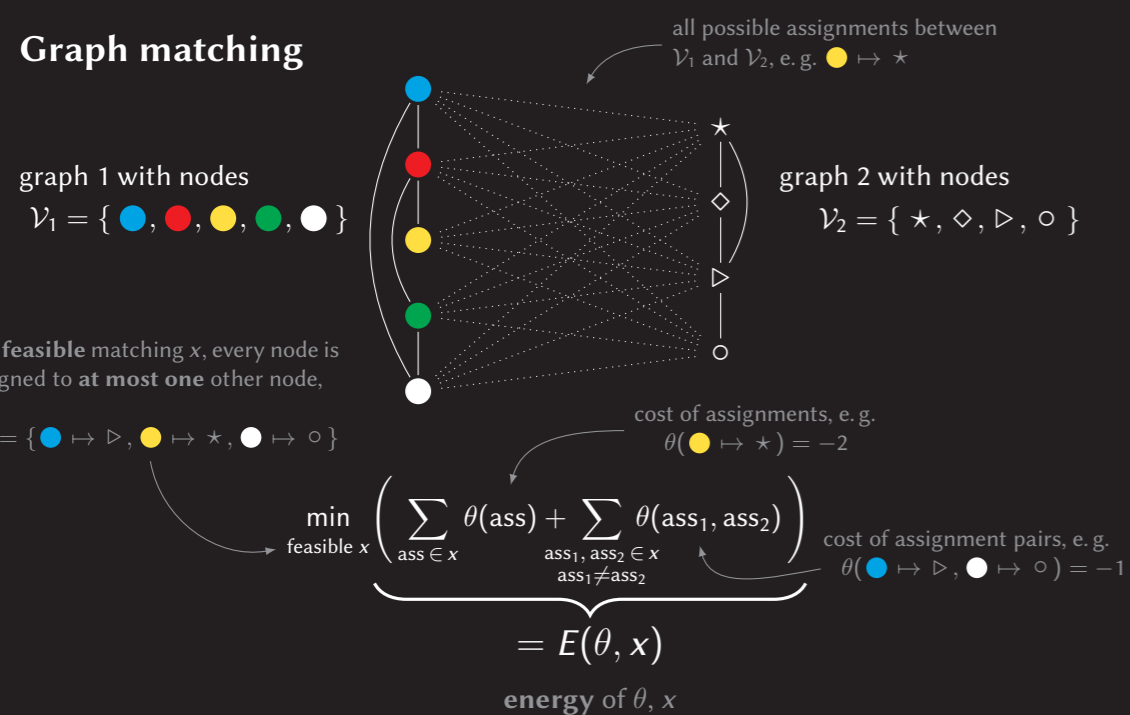
Motivation: *C. elegans* matching

- 3d images of about 300 individuals of *C. elegans* at same stage of development
- **Goal:** matching all individuals to each other

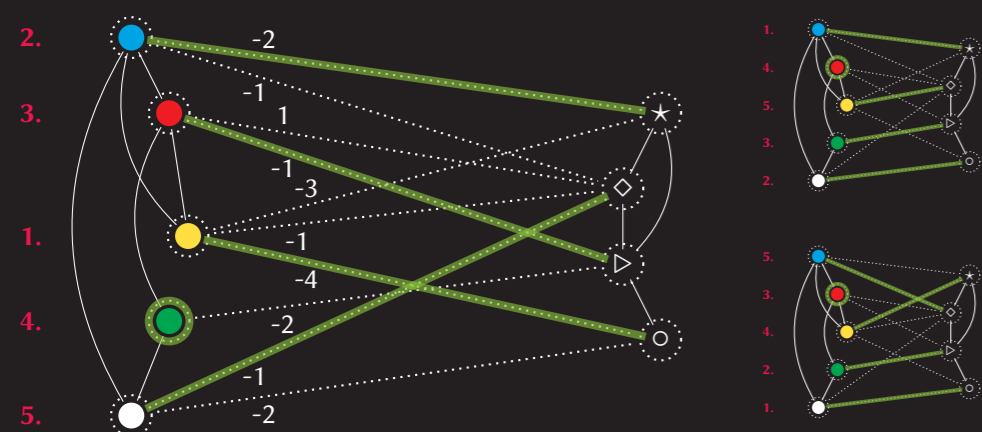


F. Long, H. Peng, X. Liu, S. Kim, and E. Myers: A 3d digital atlas of *C. elegans* and its application to single-cell analyses. *Nature methods*, 2009

Graph matching



Randomized greedy heuristic



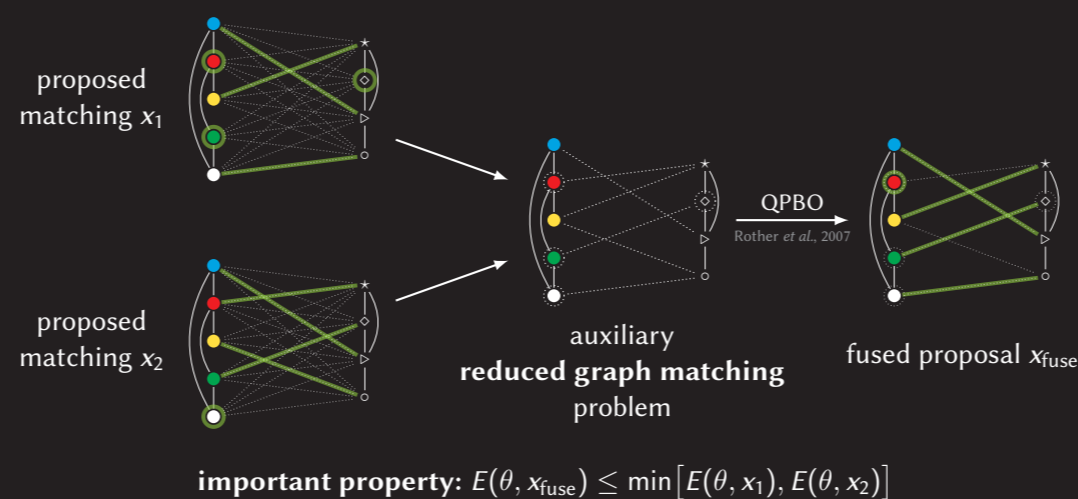
What we propose for graph matching

- graph matching solver
- dual updates: $\theta \rightarrow \hat{\theta}$
 - by block-coordinate ascent, similar to Swoboda *et al.*, 2017
 - modified for speed
 - + proposal generation method
 - randomized greedy heuristic
 - + fusion moves
 - inspired by Lempitsky *et al.*, 2010

P. Swoboda, C. Rother, H. Abu Alhaija, D. Kainmüller, B. Savchynskyy: A study of Lagrangean decompositions and dual ascent solvers for graph matching. *CVPR '17*

V. Lempitsky, C. Rother, S. Roth, A. Blake: Fusion moves for Markov random field optimization. *PAMI '10*

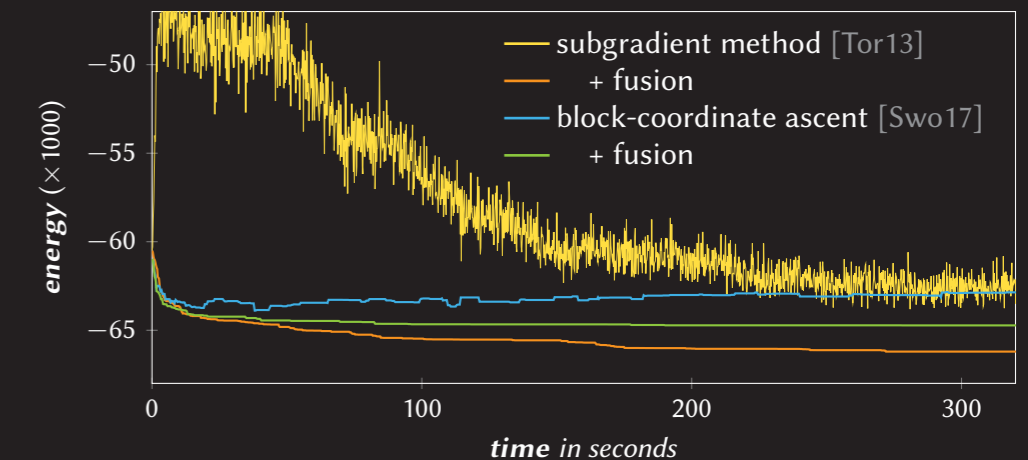
Fusion Moves



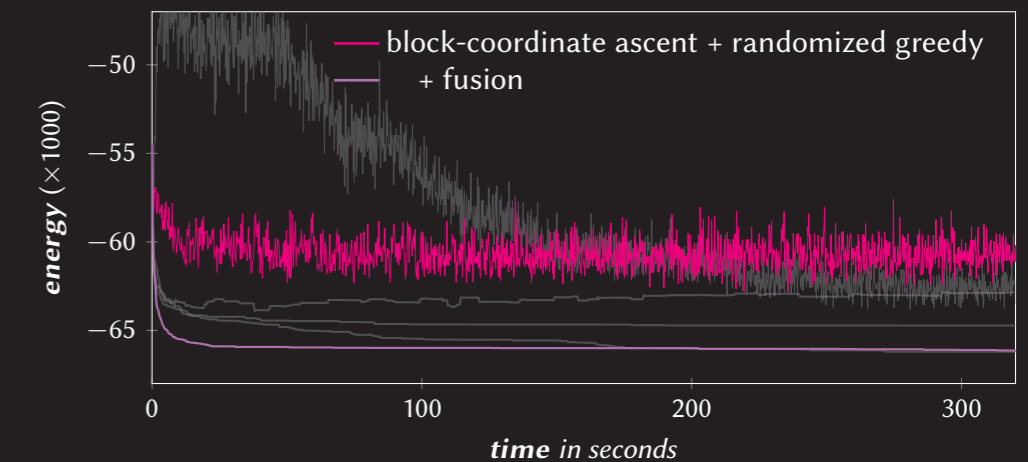
C. Rother, V. Kolmogorov, V. Lempitsky, M. Szummer: Optimizing binary MRFs via extended roof duality. *CVPR '07*

Methods for generation

Variant 1: dual solver + primitive primal heuristic + fusion moves



Variant 2: dual solver + randomized greedy + fusion moves



Performance on benchmark datasets

Percentage of instances solved to optimality; average time needed

	HBP [Zha16]	AMP [Swo17]	DD [Tor13]	our
hotel, house	0.15 s	0.2 s	0.02 s	0.01 s
motor, car	0.13 s	0.08 s	0.11 s	0.01 s
opengm	2.71 s	–	1.08 s	0.004 s
flow	–	0.13 s	1.66 s	0.06 s
worms	–	6.45 s	–	0.39 s

timeout: 1 s
timeout: 10 s

[Tor13] Torresani *et al.*: A dual decomposition approach to feature correspondence. *PAMI '13*

[Zha16] Zhang *et al.*: Pairwise matching through max-weight bipartite belief propagation. *CVPR '16*

[Swo17] Swoboda *et al.*: A study of Lagrangean decompositions and dual ascent solvers for graph matching. *CVPR '17*