Segmentation based features for wide-baseline multi-view reconstruction

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Contents

- Motivation
- Existing methods
- SFD: Segmentation based feature detector
- Results and Evaluation of feature detectors
- Application to sparse and dense reconstruction
- Conclusion

Applications

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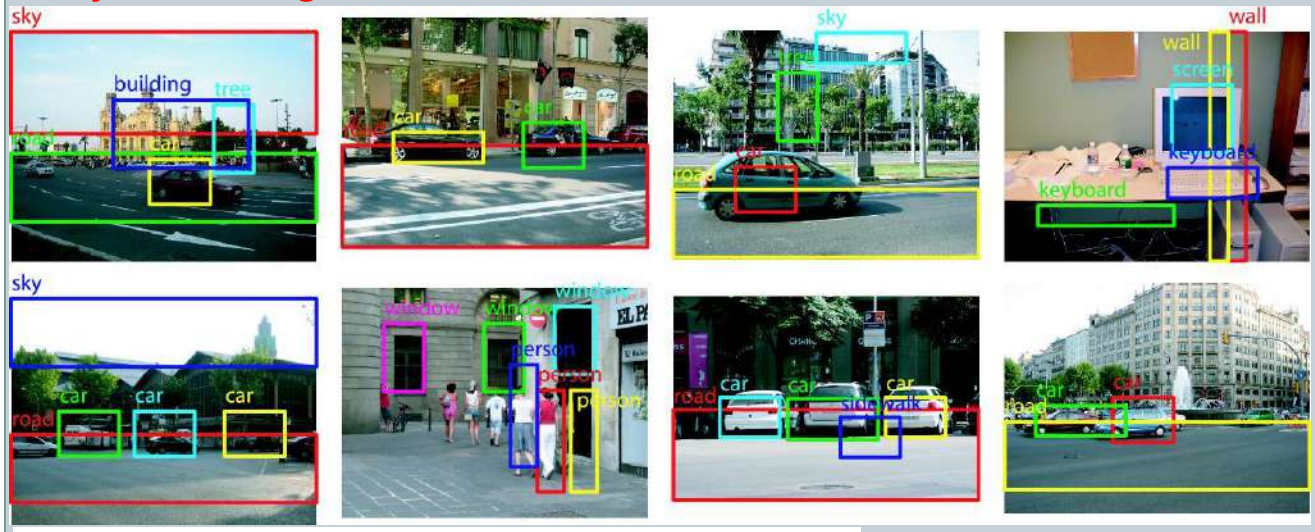
Object Recognition



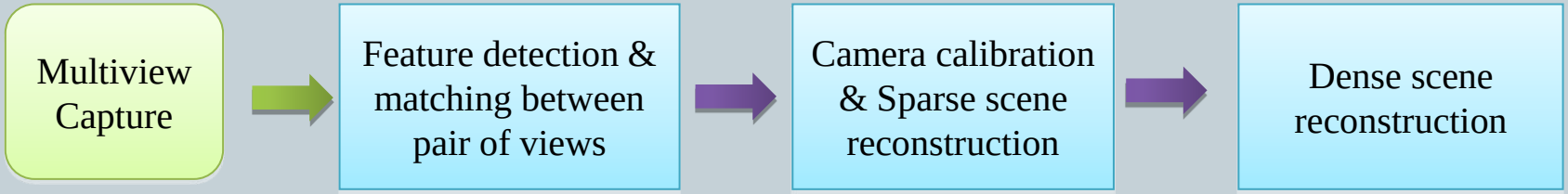
Surveillance

Film

Broadcast

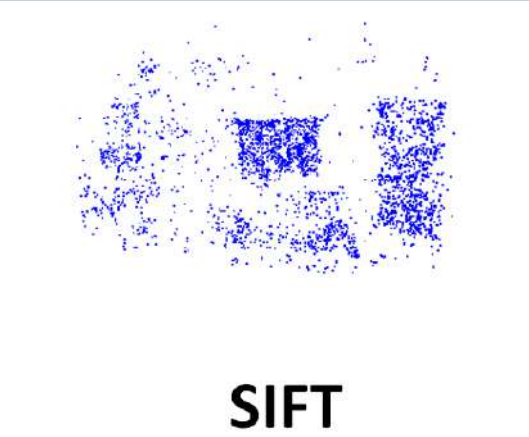
Key application

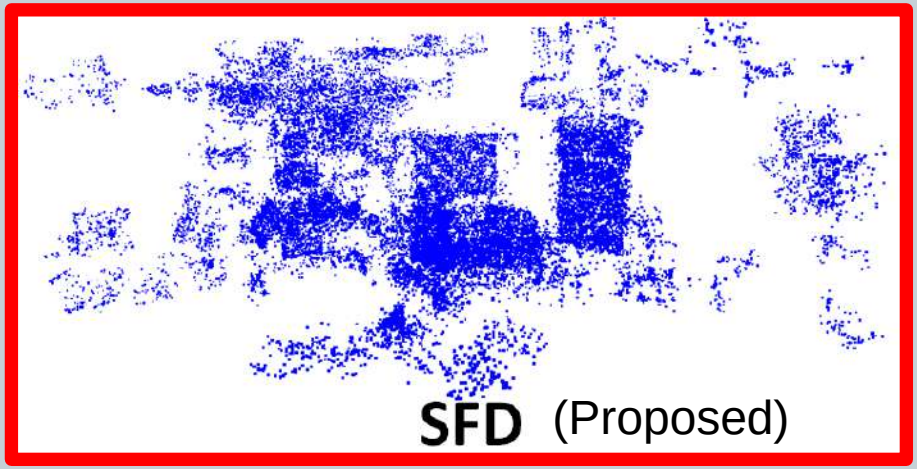
Sparse and Dense scene reconstruction



Key application

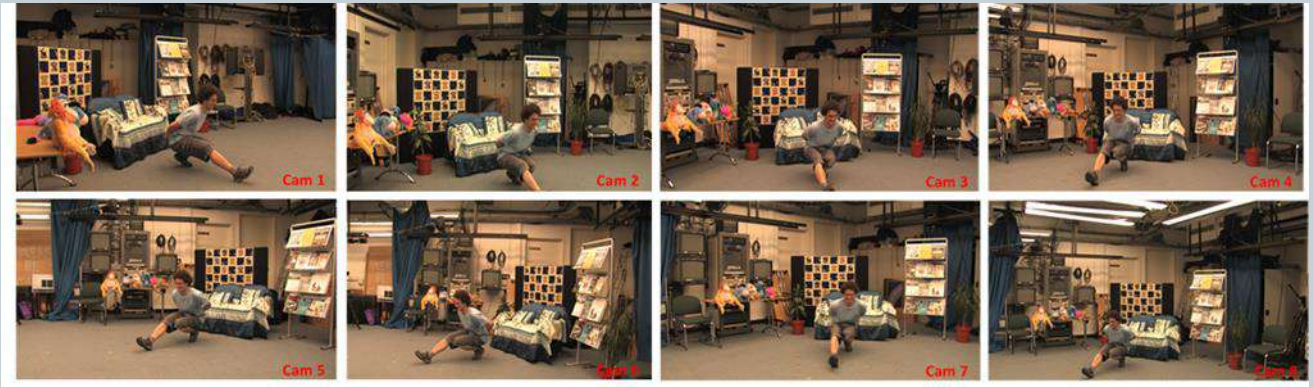
Sparse scene reconstruction

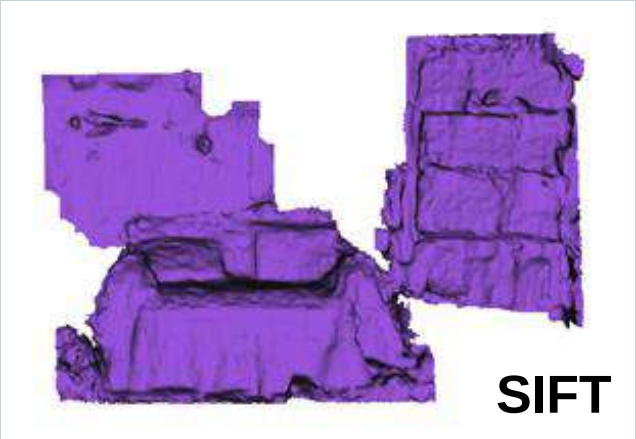


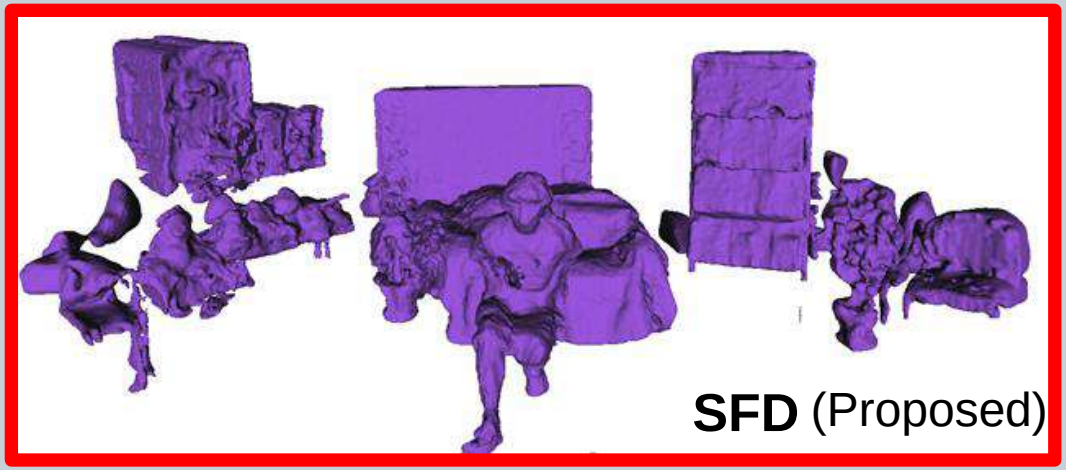


Key application

Dense scene reconstruction







Why SFD?

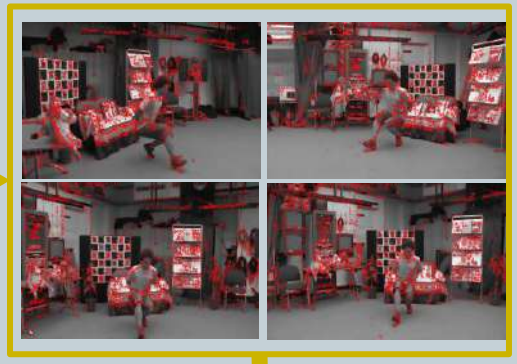
- Large number of features and matches
- Good scene coverage
- Improved accuracy
- Order of magnitude increase in reconstructed points.

SFD for dense reconstruction

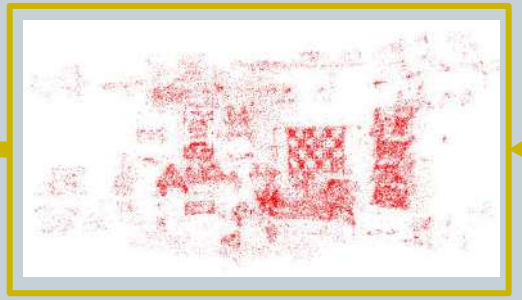
Original images

Segmented images

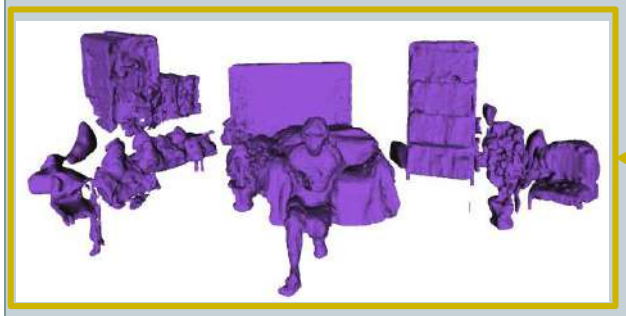
Features



Feature matches



Sparse reconstruction



Dense reconstruction

SFD Algorithm

Over-segmentation:

Original image

Watershed segmentation

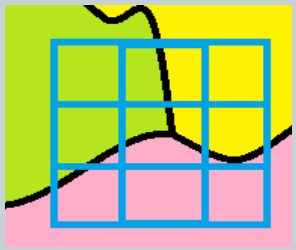
Region boundaries represent lines corresponding to local maxima of the image function

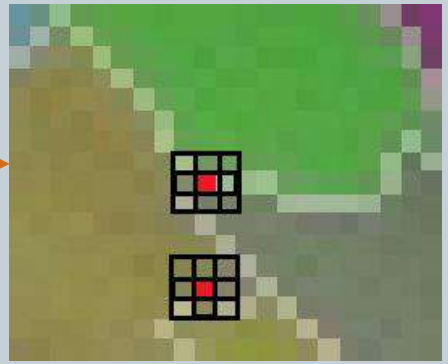
SFD Algorithm

Feature Detection:

Odzemok segmented image

Feature Illustration

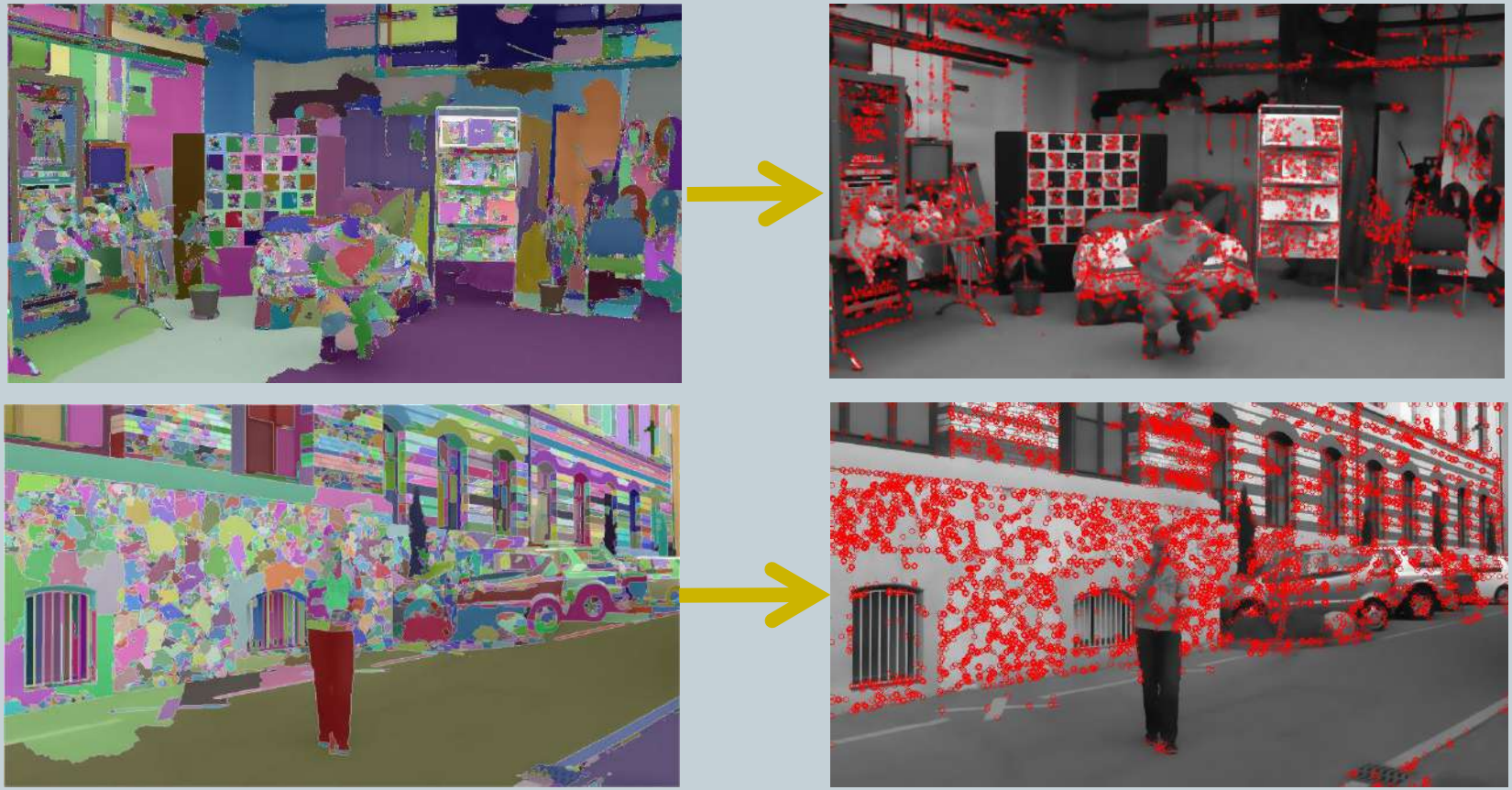




Feature examples

SFD Algorithm

Feature Detection:



Evaluation: Datasets

Juggler (6 moving)

Odzemok
(6 static, 2 moving)

Cathedral (8 static)

Evaluation: Datasets

Merton

Valbonne

Rossendale

Evaluation: Features and Matches

Outdoor- Dynamic

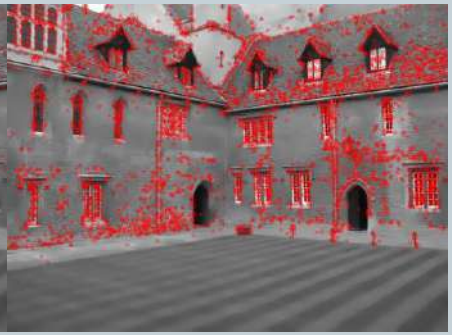
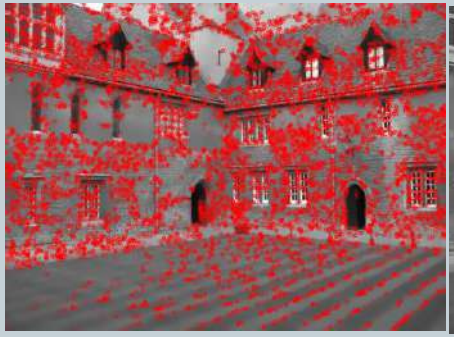
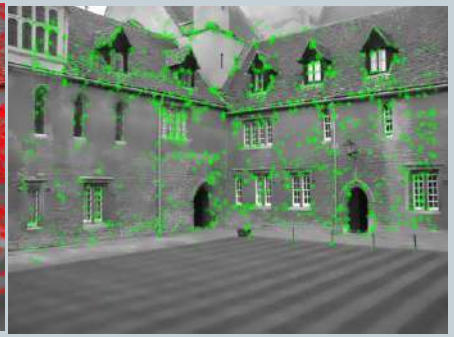
MSER | SIFT | SFD with Watershed | Matches

Evaluation: Features and Matches

Outdoor - Static

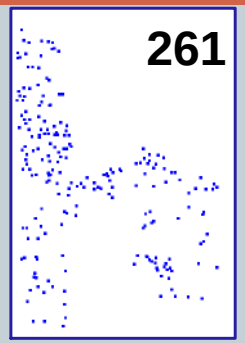
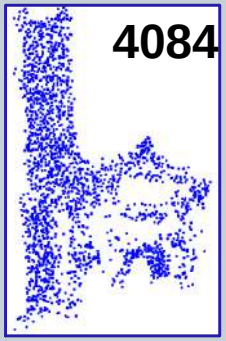
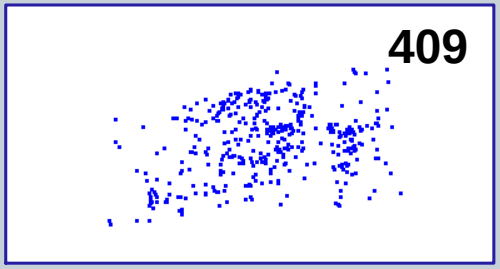
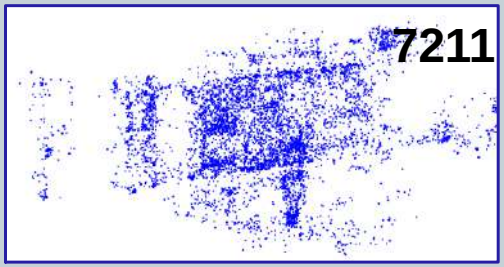
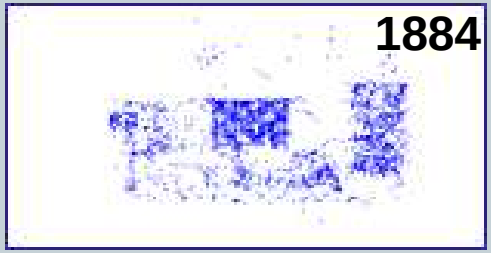
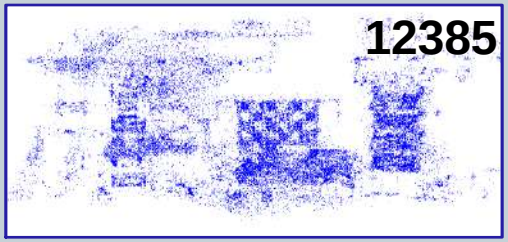




MSER | SIFT | SFD with Watershed | Matches

Evaluation: Sparse reconstruction

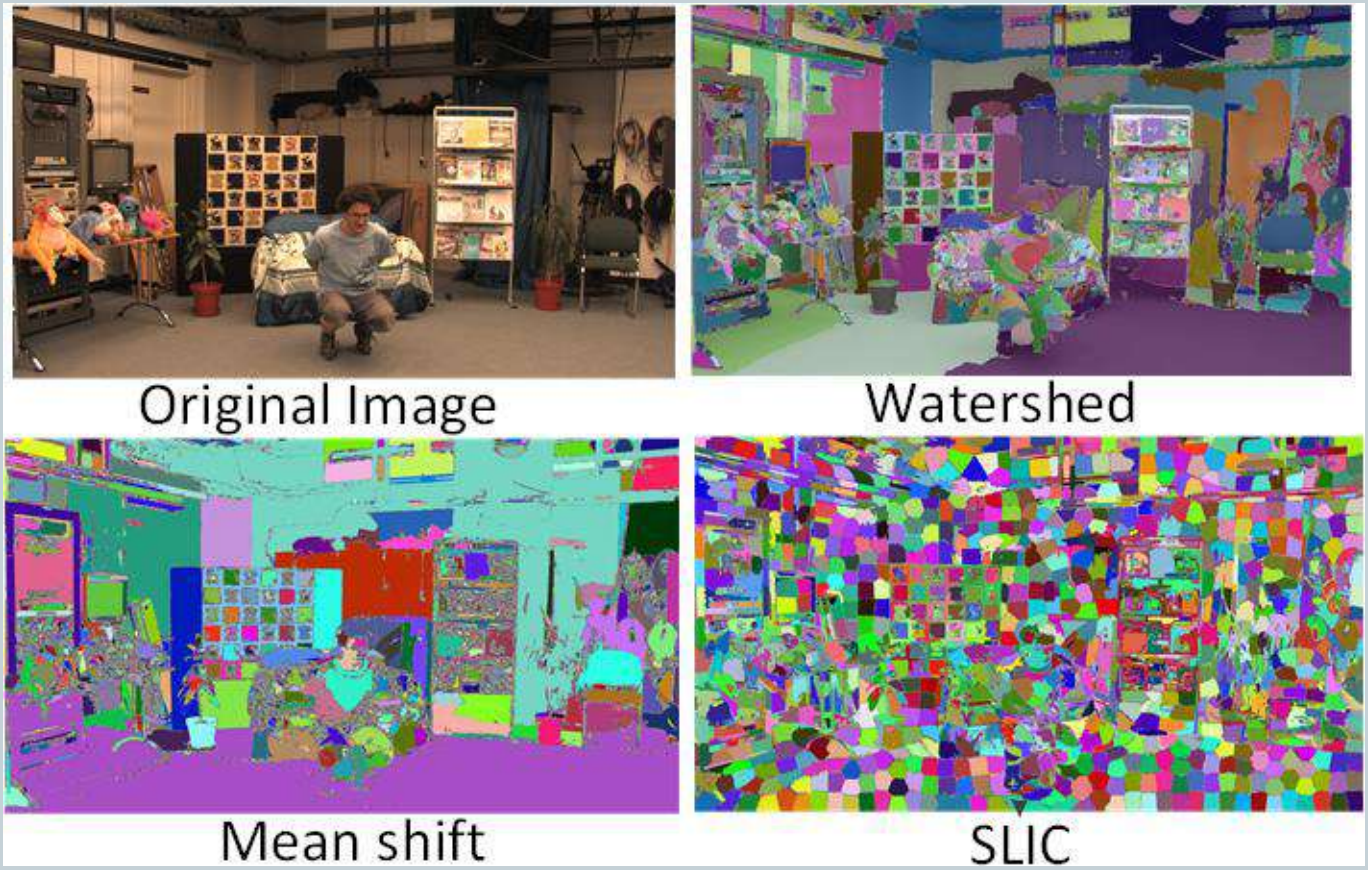
SIFT	Original	SFD
		
		
		

Some more results

Segmentation based feature detector for wide-baseline multi-view reconstruction

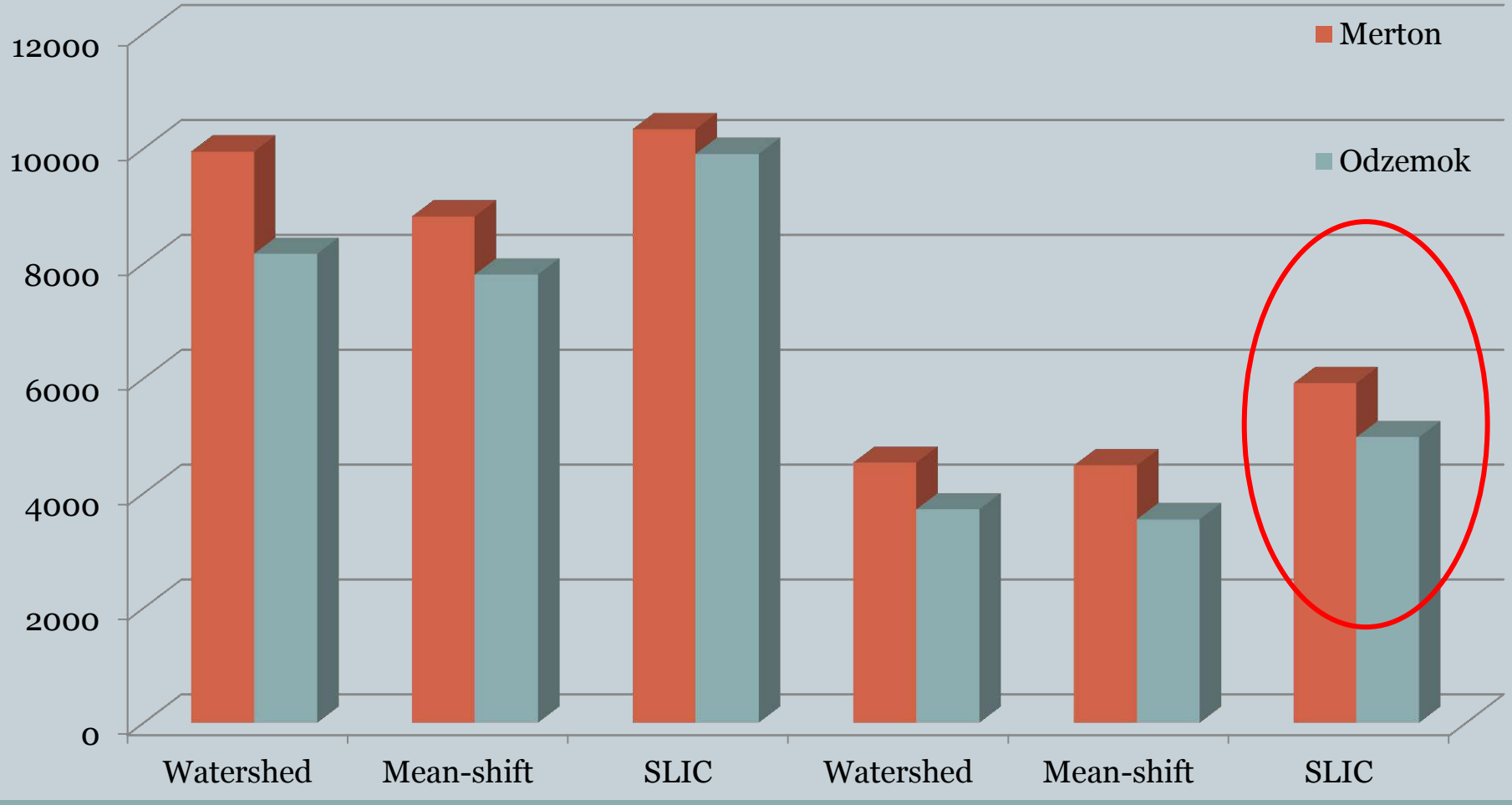
Paper ID: 4

Evaluation: Over-segmentation



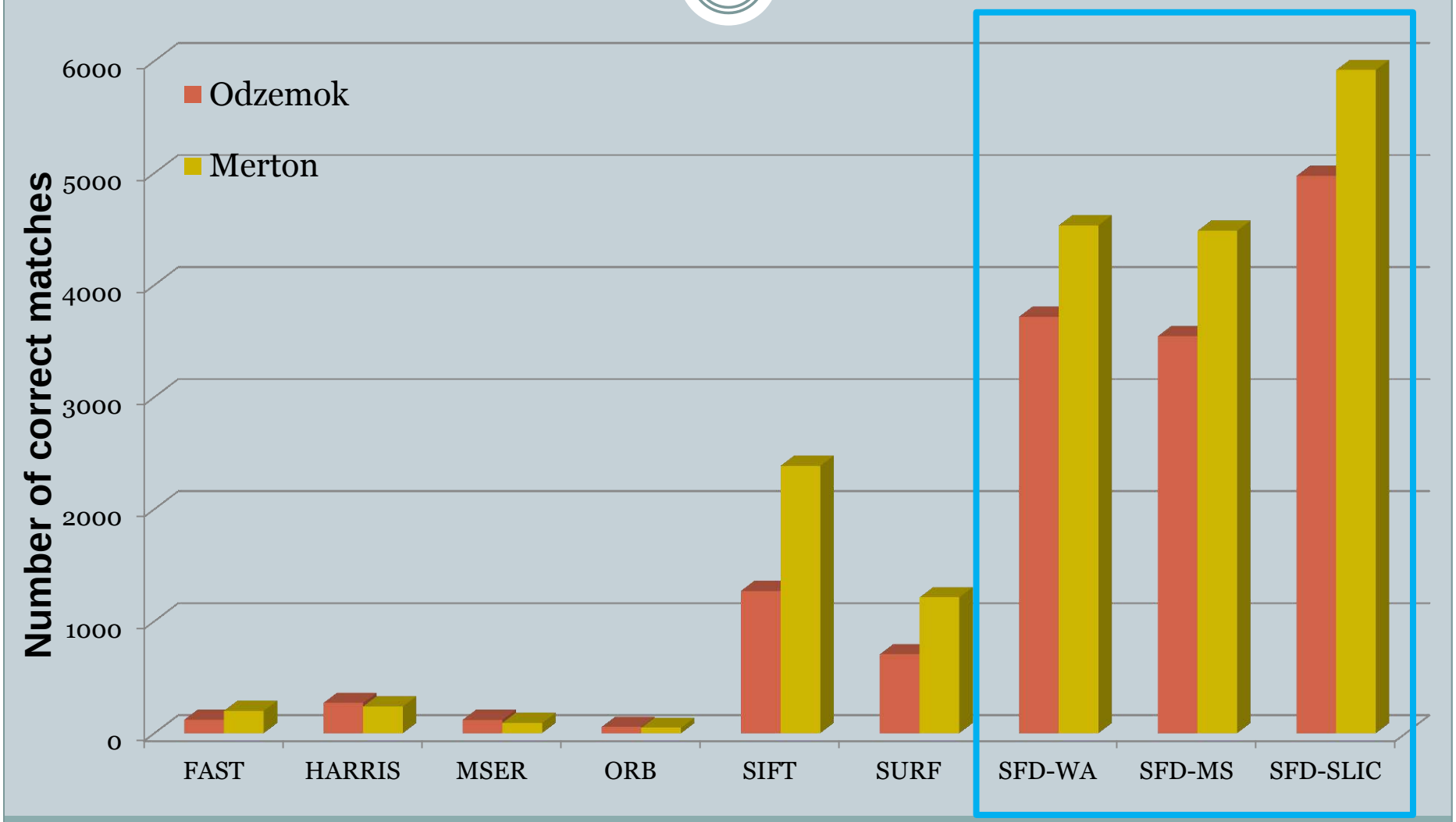
SFD: Independent of segmentation technique

Evaluation: Over-segmentation

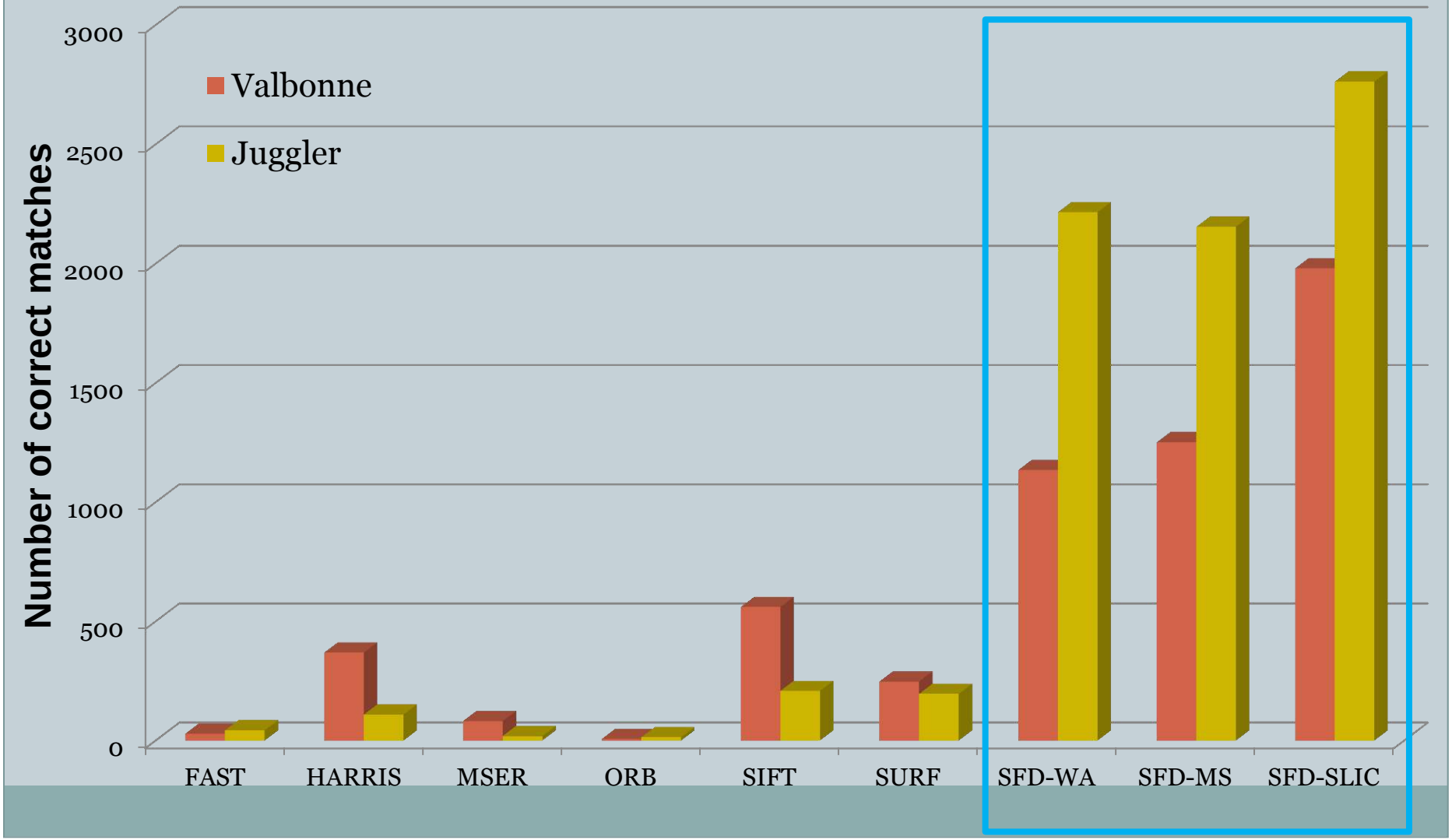


Evaluation: Over-segmentation

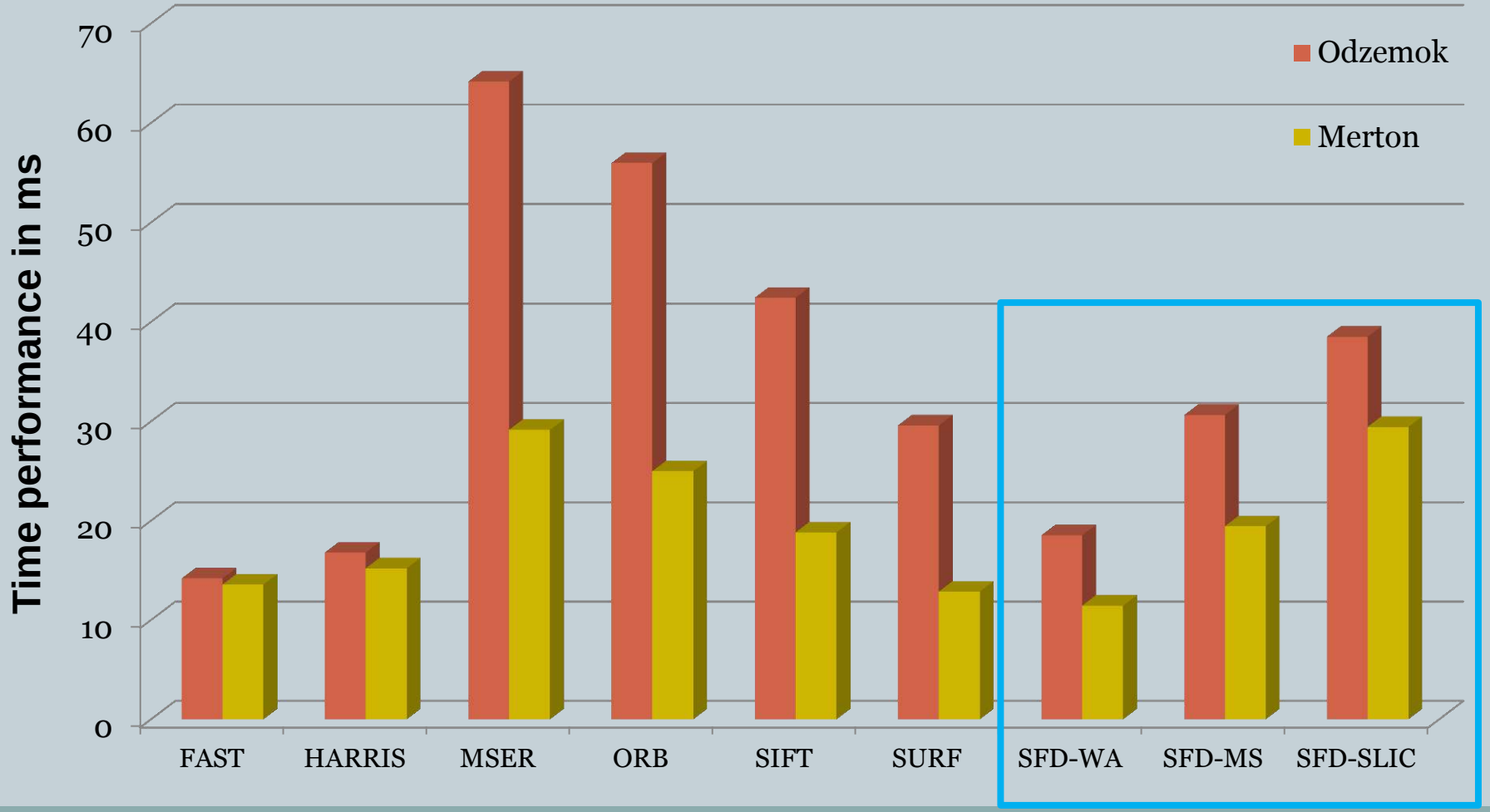
Evaluation: Matches



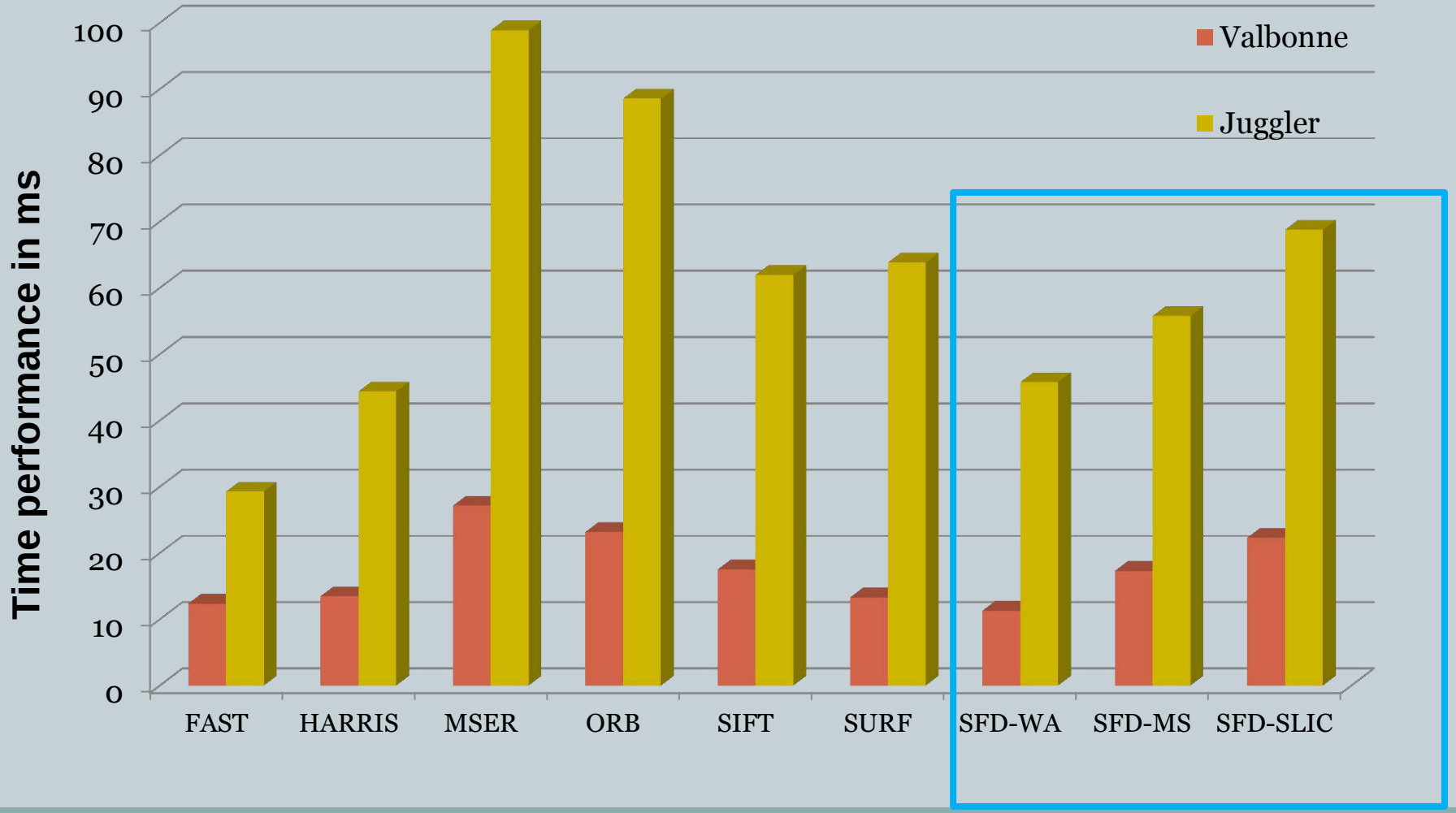
Evaluation: Matches



Evaluation: Time performance



Evaluation: Time performance

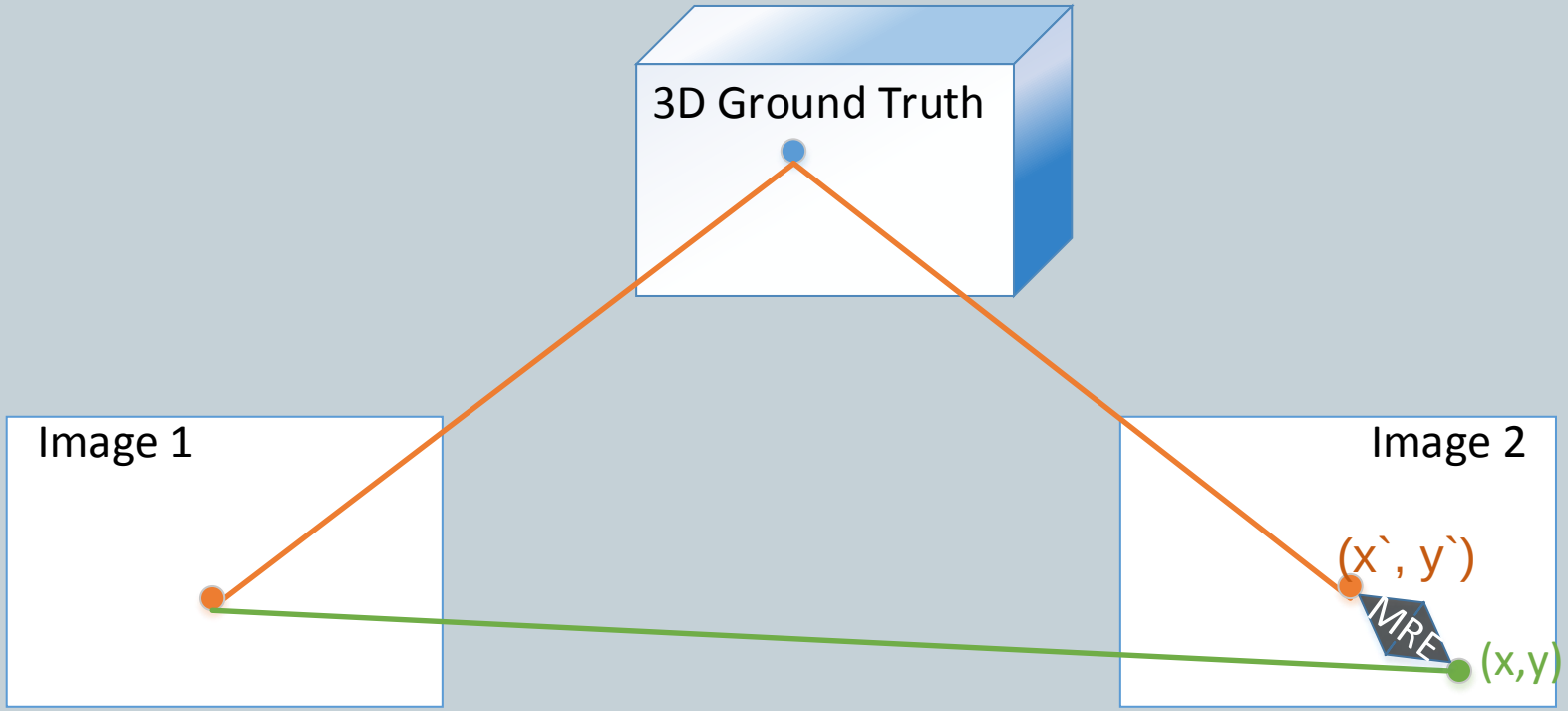


Mean re-projection error (MRE)

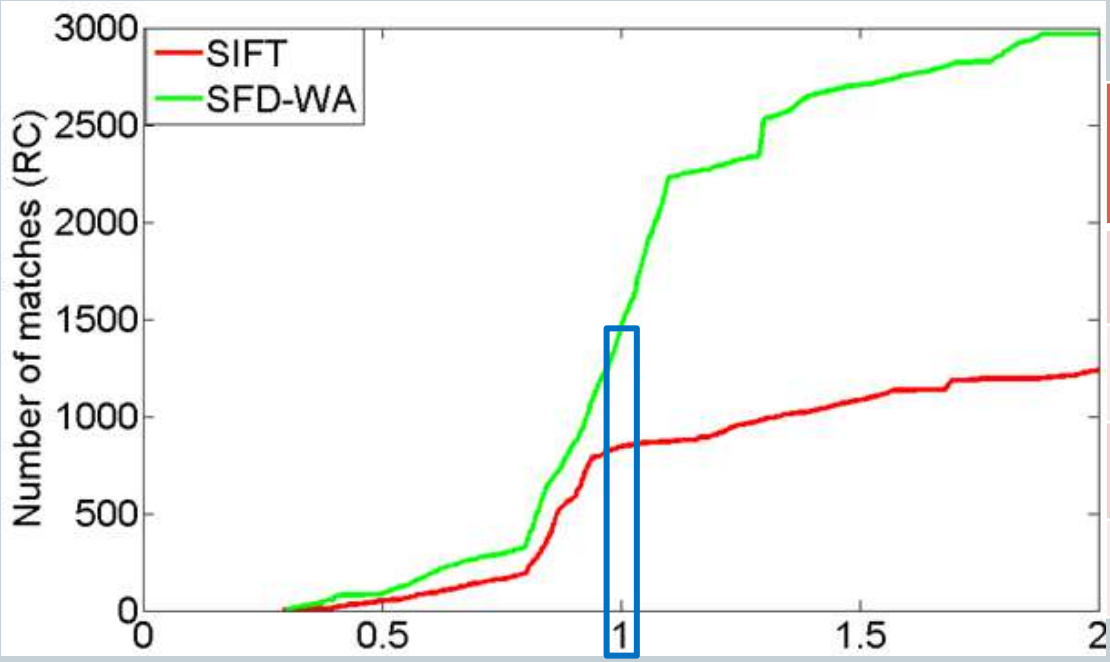
Mean re-projection error (MRE) is calculated for Odzemok dataset for various detectors

$$MRE = \frac{\sum_0^N \sqrt{(x - x')^2 + (y - y')^2}}{N}$$

N is the number of feature matches



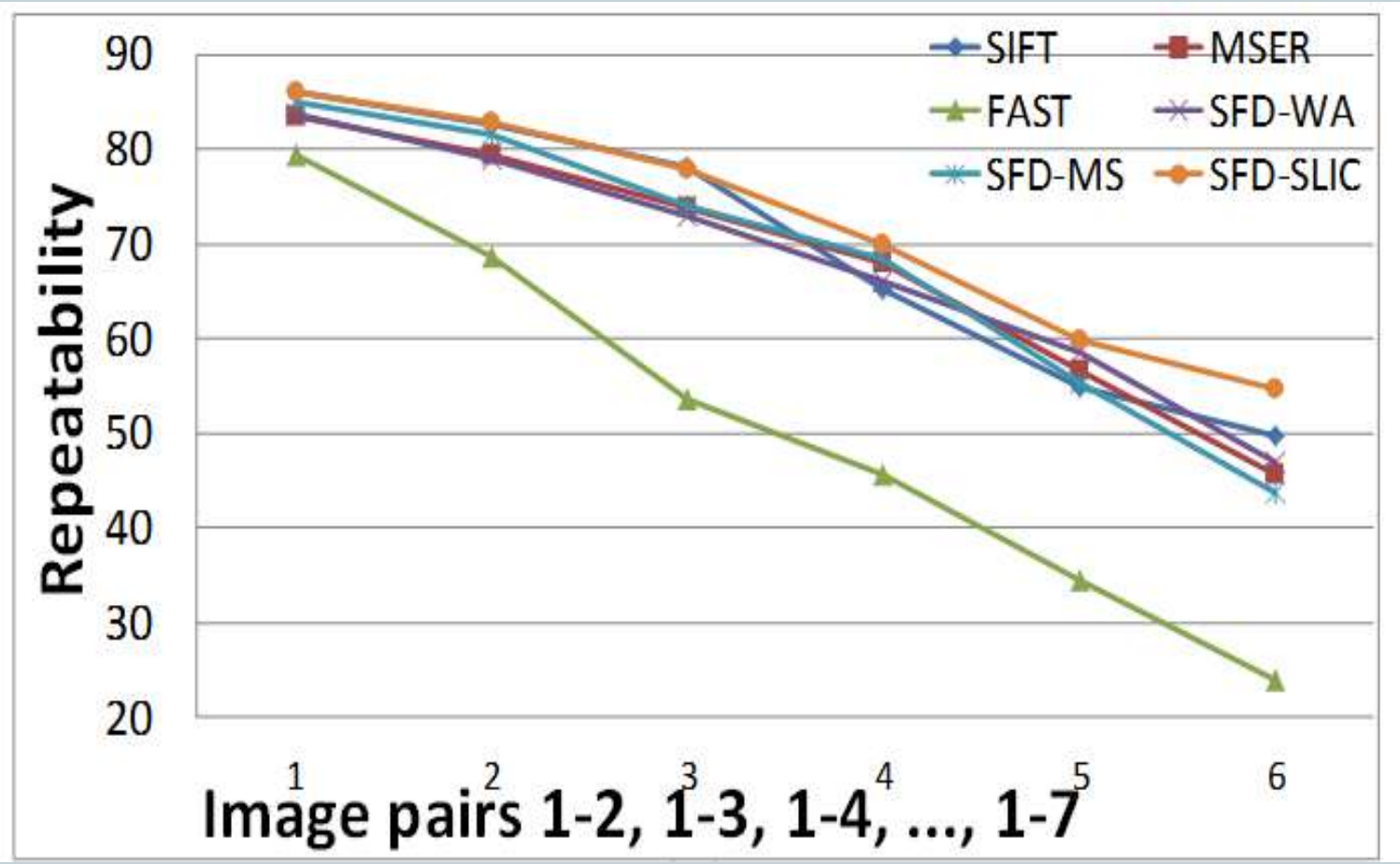
Accuracy (MRE) Evaluation of SFD



Feature Detector	Descriptor	RC	MRE
SFD	SIFT	3717	1.351
SIFT	SIFT	1269	1.175
MSER	SIFT	119	1.390
FAST	BRIEF	121	1.483

Re-projection error of SIFT and SFD-WA for Odzemok

Evaluation: Repeatability

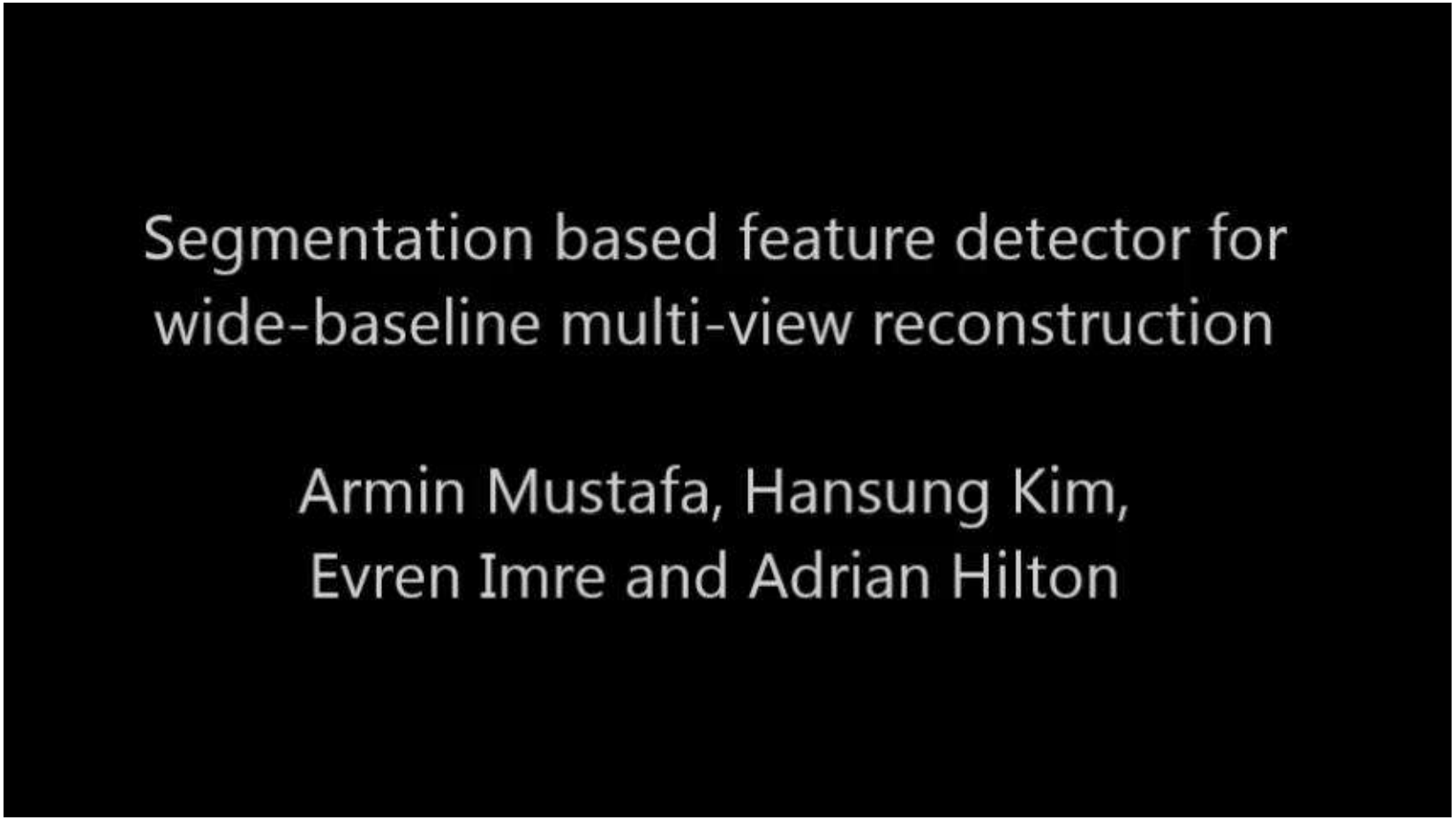


Repeatability with camera 1 to all other views (15-120 degree baseline).

Conclusions

- Novel feature detector for wide-baseline matching
- A comprehensive performance evaluation for feature matching and time performance
- Ground truth accuracy evaluation
- Further plans include evaluating the utility of SFD features in applications such as camera tracking and object recognition.

Thank you!



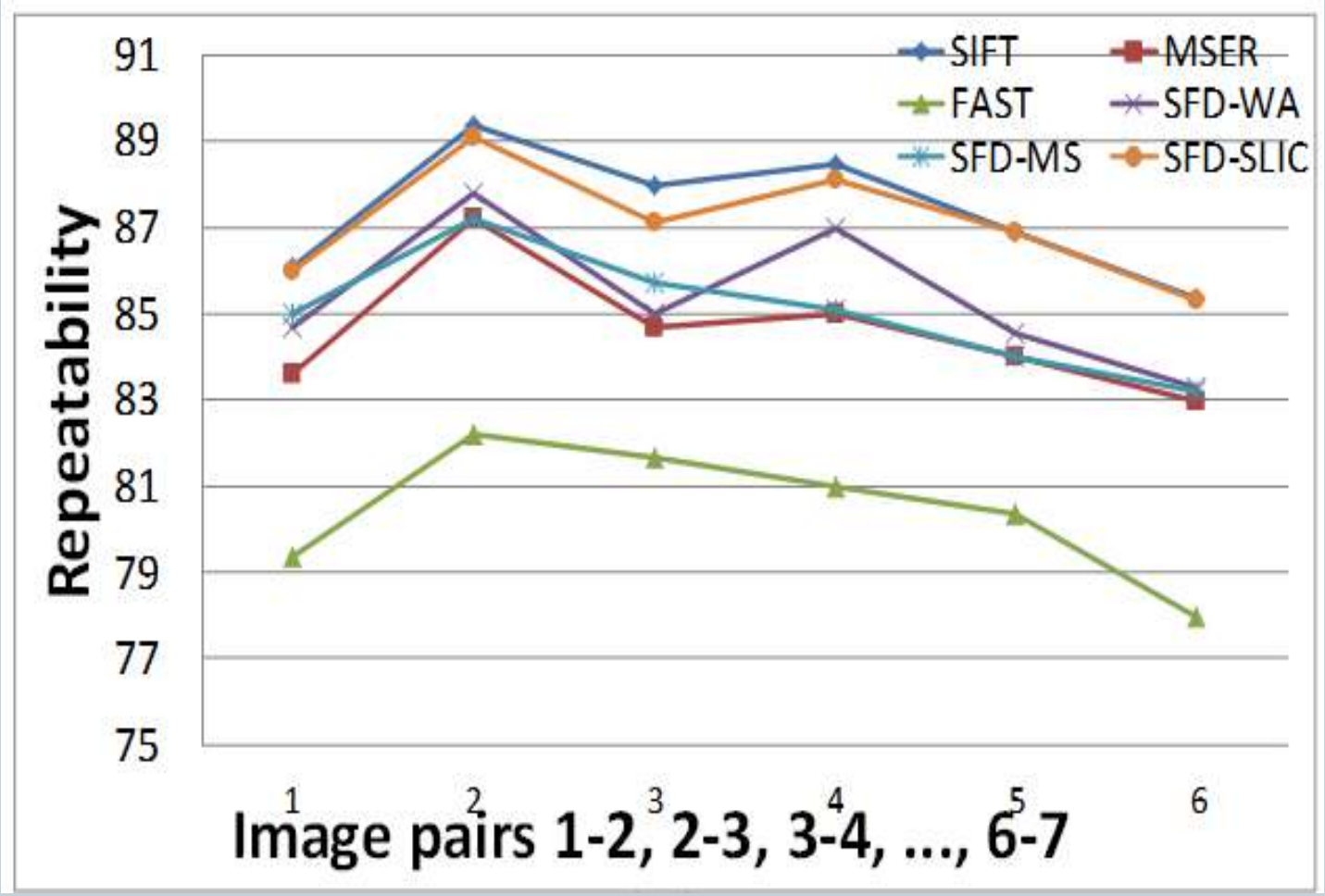
Questions??

Accuracy Evaluation of SFD with Harris and Uniform Sampling

- Uniform grid sampling is performed by locating features at points of maximum gradient magnitude with a 13X13 grid
- Experimented on Odzemok dataset

FD	Descriptor	Features	RC
SFD	SIFT	13881	3717
Uniform Sampling	SIFT	12284	33
Harris	SIFT	13158	145

Evaluation: Repeatability



Repeatability between adjacent views (15-30 degree baseline)