

Segmentation based features for wide-baseline multi-view reconstruction



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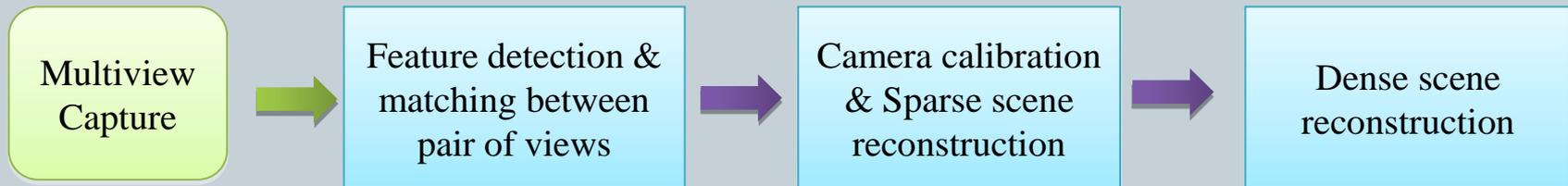
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- Motivation
- Existing methods
- SFD: Segmentation based feature detector
- Results and Evaluation of feature detectors
- Application to sparse and dense reconstruction
- Conclusion

Key application

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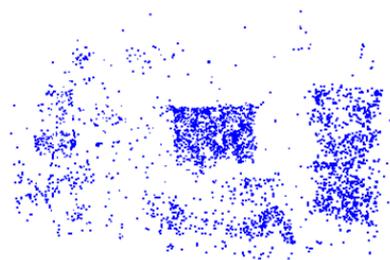
Sparse and Dense scene reconstruction



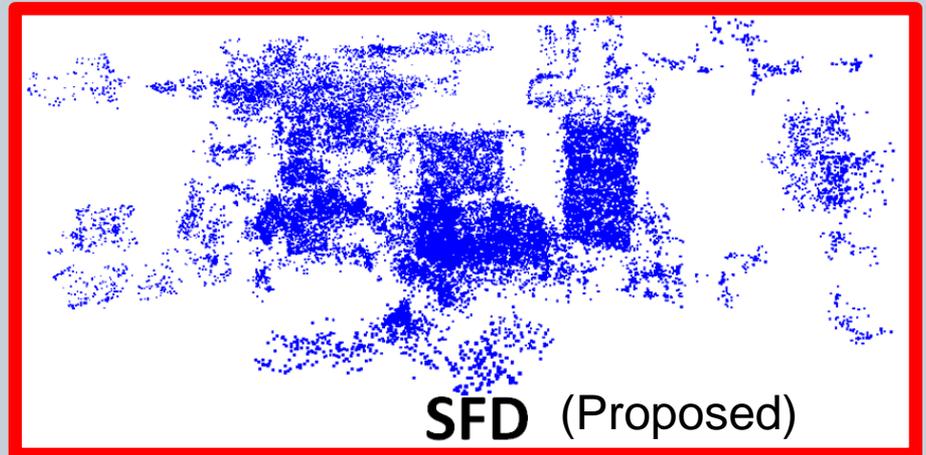
Key application

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Sparse scene reconstruction



SIFT



SFD (Proposed)

Key application

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Dense scene reconstruction



Why SFD?

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

SFD for dense reconstruction

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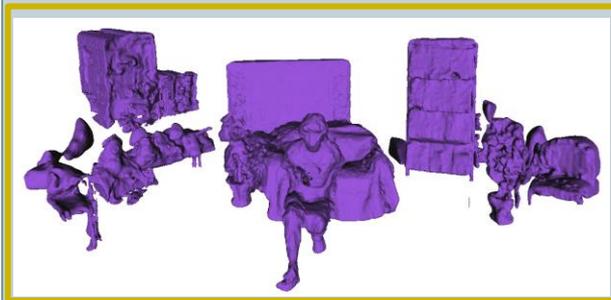
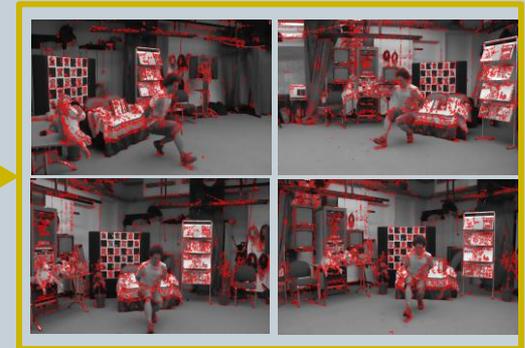
Original images



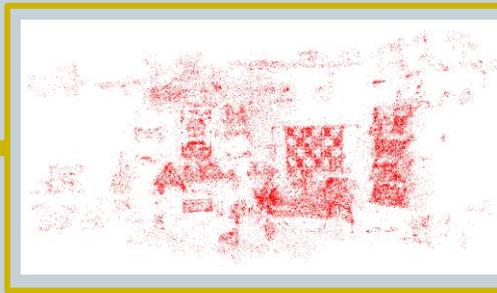
Segmented images



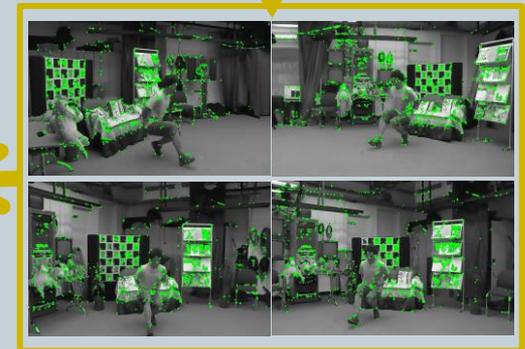
Features



Dense reconstruction



Sparse reconstruction



Feature matches

SFD Algorithm

Over-segmentation:



Original image



Watershed segmentation

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

SFD Algorithm

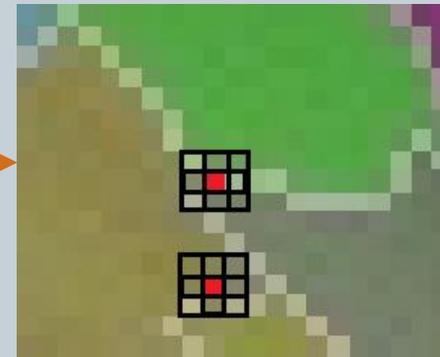
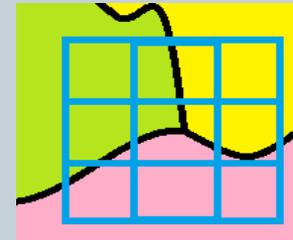
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Feature Detection:



Odzemok segmented image

Feature Illustration



Feature examples

SFD Algorithm

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Feature Detection:

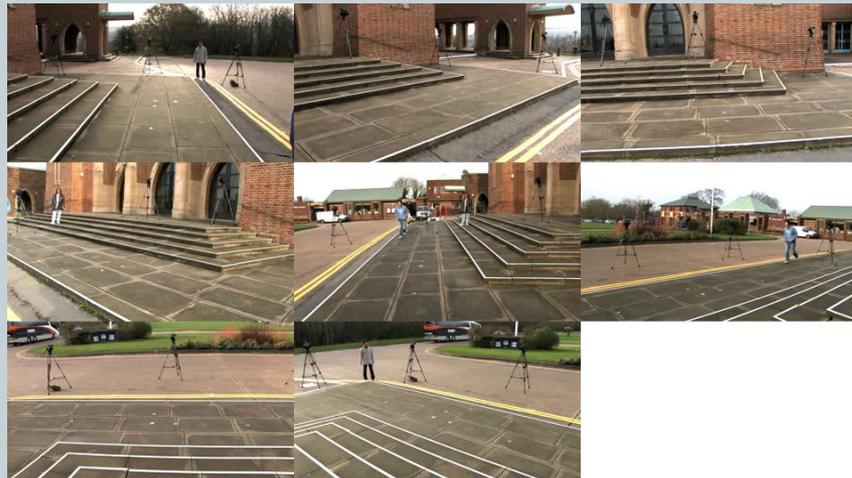


Evaluation: Datasets

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Juggler (6 moving)



Cathedral (8 static)

Odzemok
(6 static, 2 moving)

Evaluation: Datasets

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Merton



Valbonne

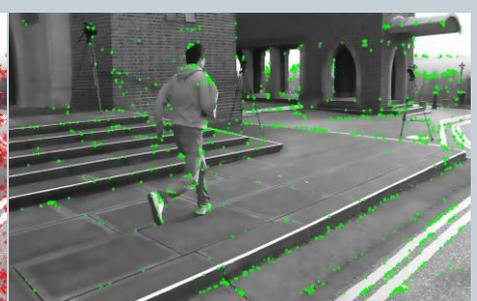
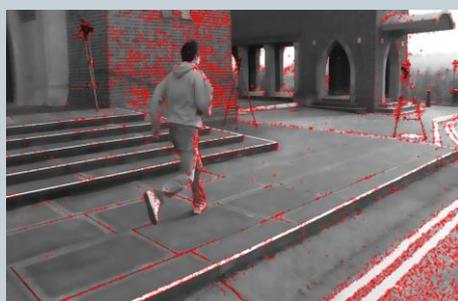


Rosendale

Evaluation: Features and Matches

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Outdoor- Dynamic



MSER

SIFT

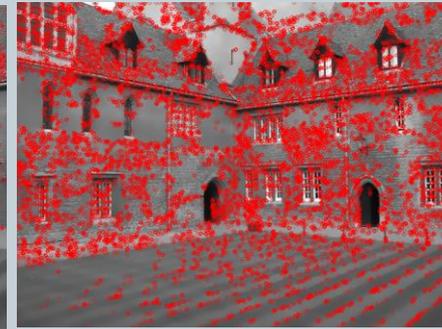
SIFT with Watershed

Matches

Evaluation: Features and Matches

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Outdoor - Static



MSER

SIFT

SFD with Watershed

Matches

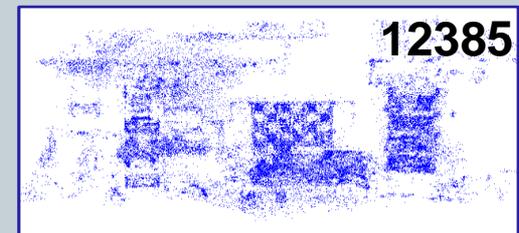
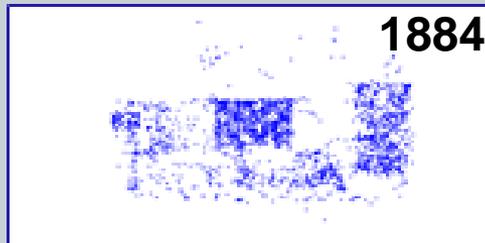
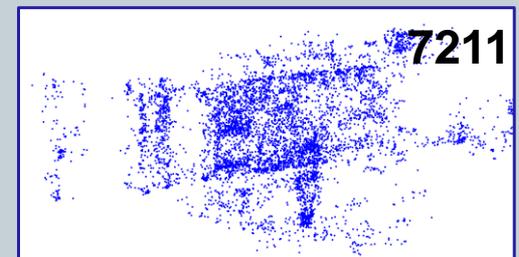
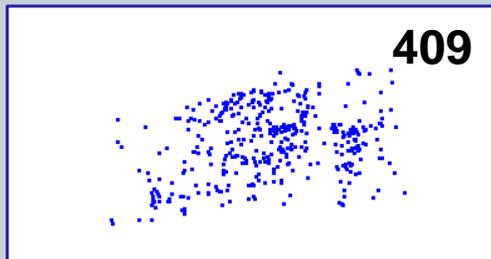
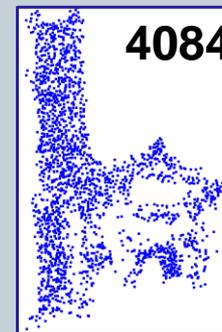
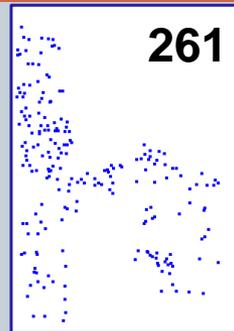
Evaluation: Sparse reconstruction

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SIFT

Original

SFD



Some more results

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

Paper ID: 4

Evaluation: Over-segmentation

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Original Image



Watershed



Mean shift

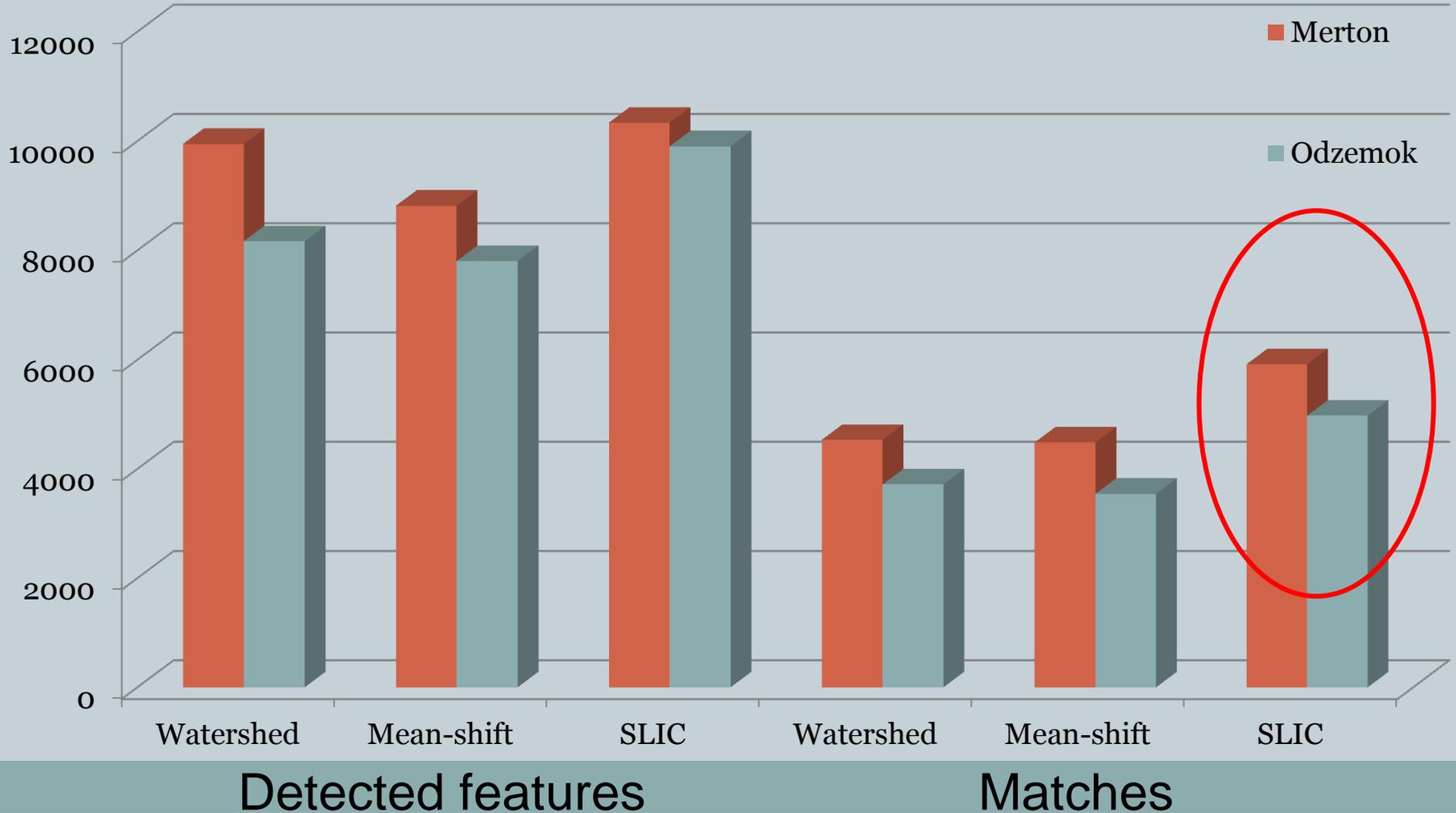


SLIC

SFD: Independent of segmentation technique

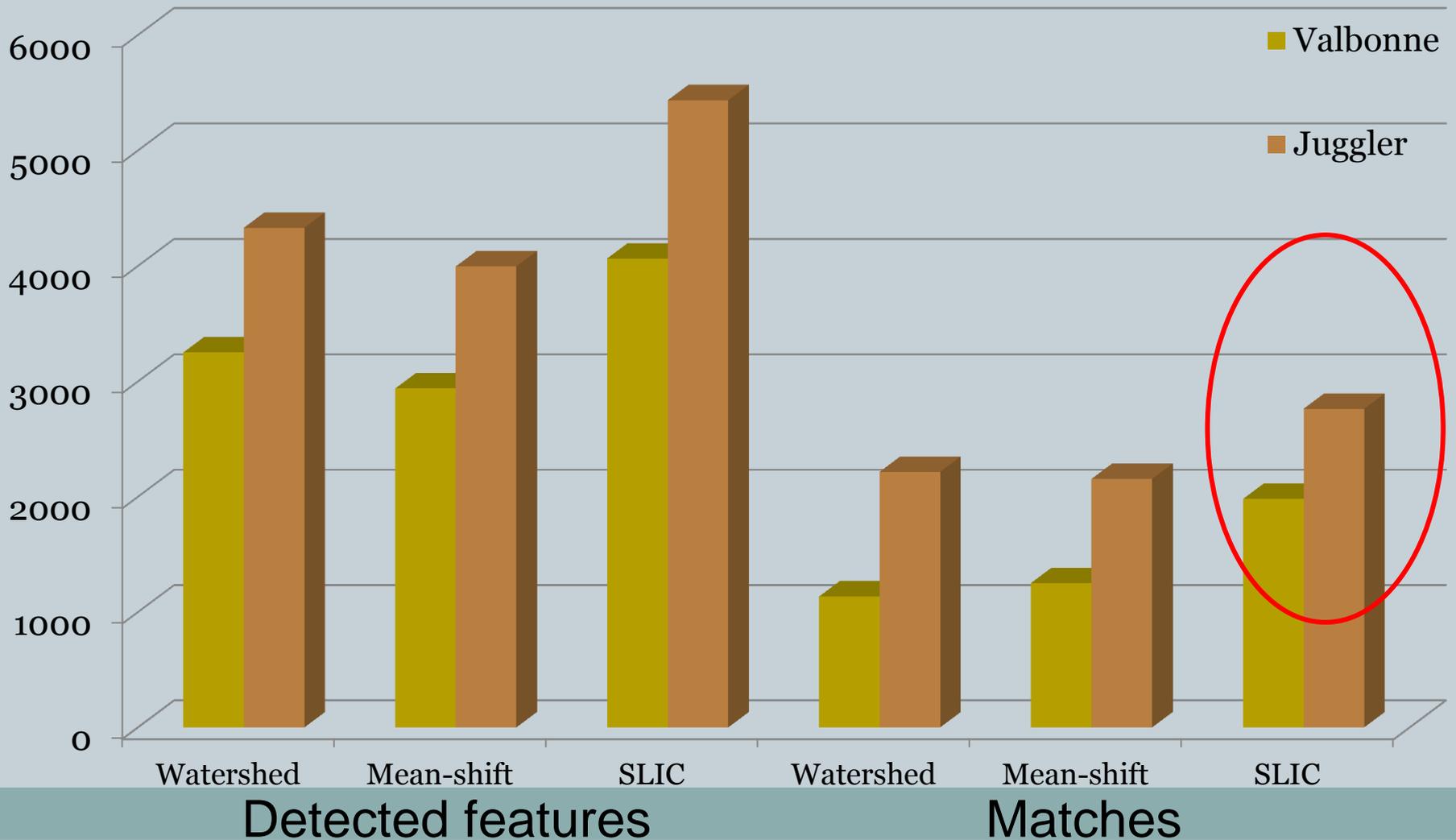
Evaluation: Over-segmentation

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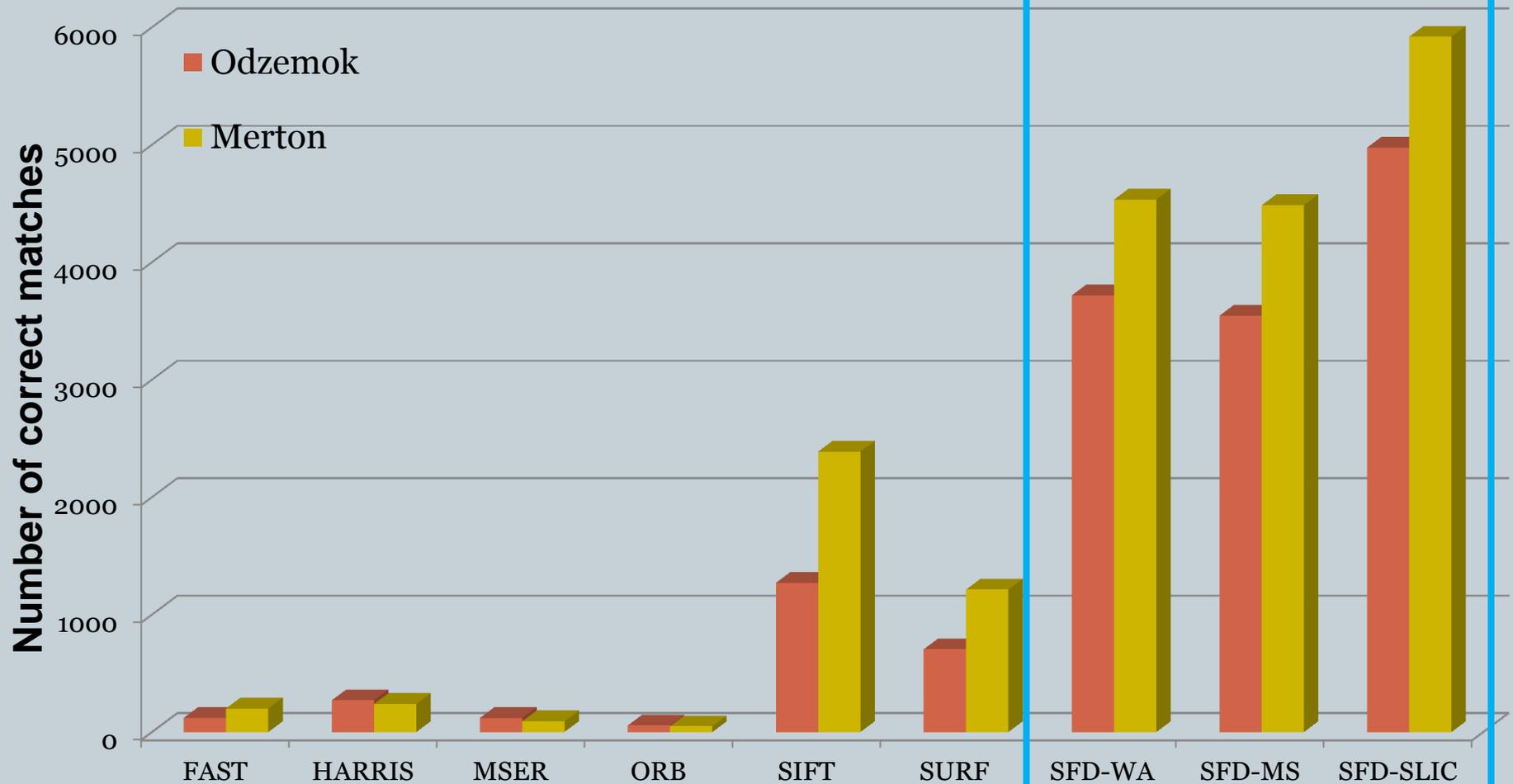
Evaluation: Over-segmentation

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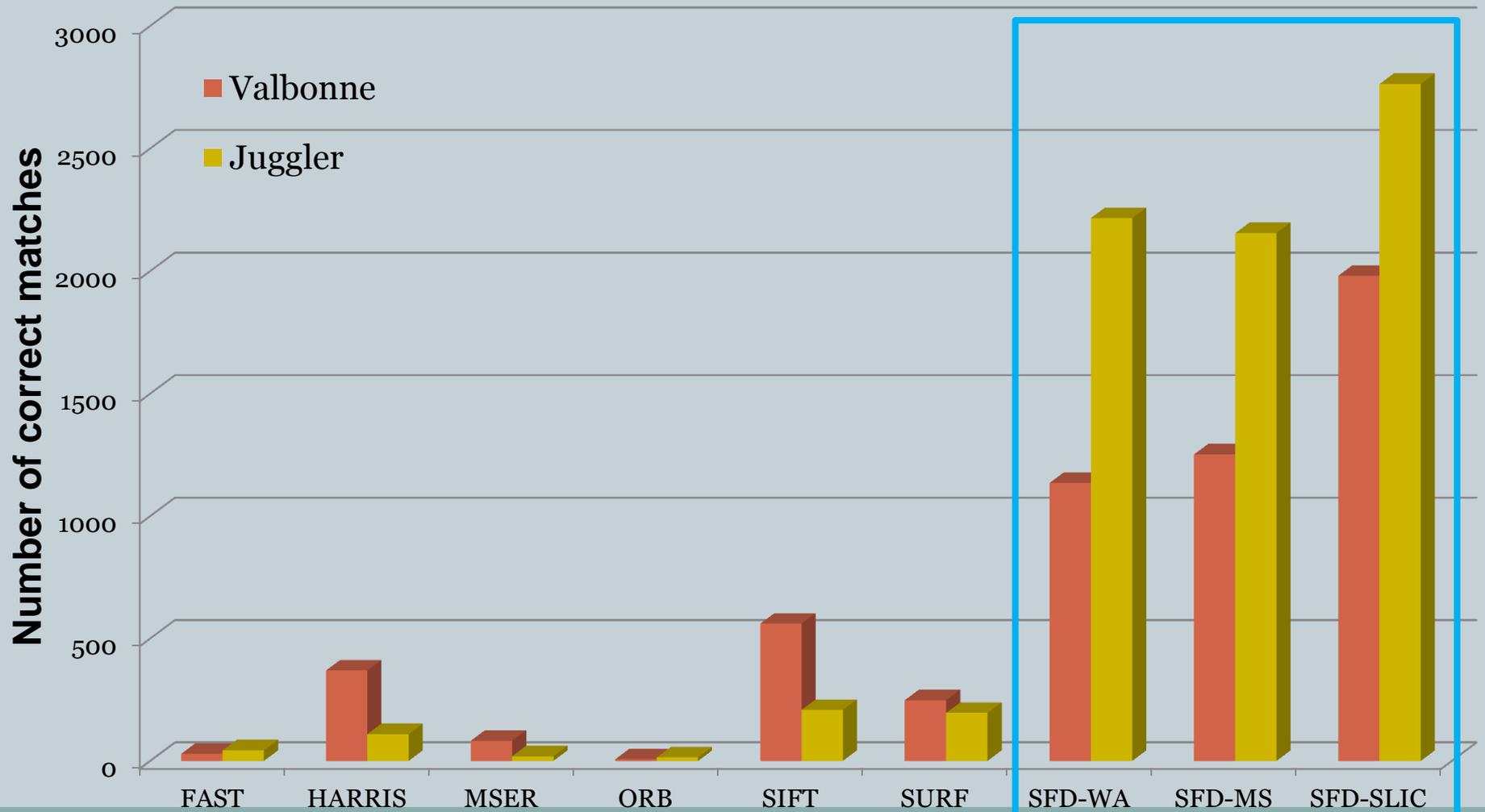
Evaluation: Matches

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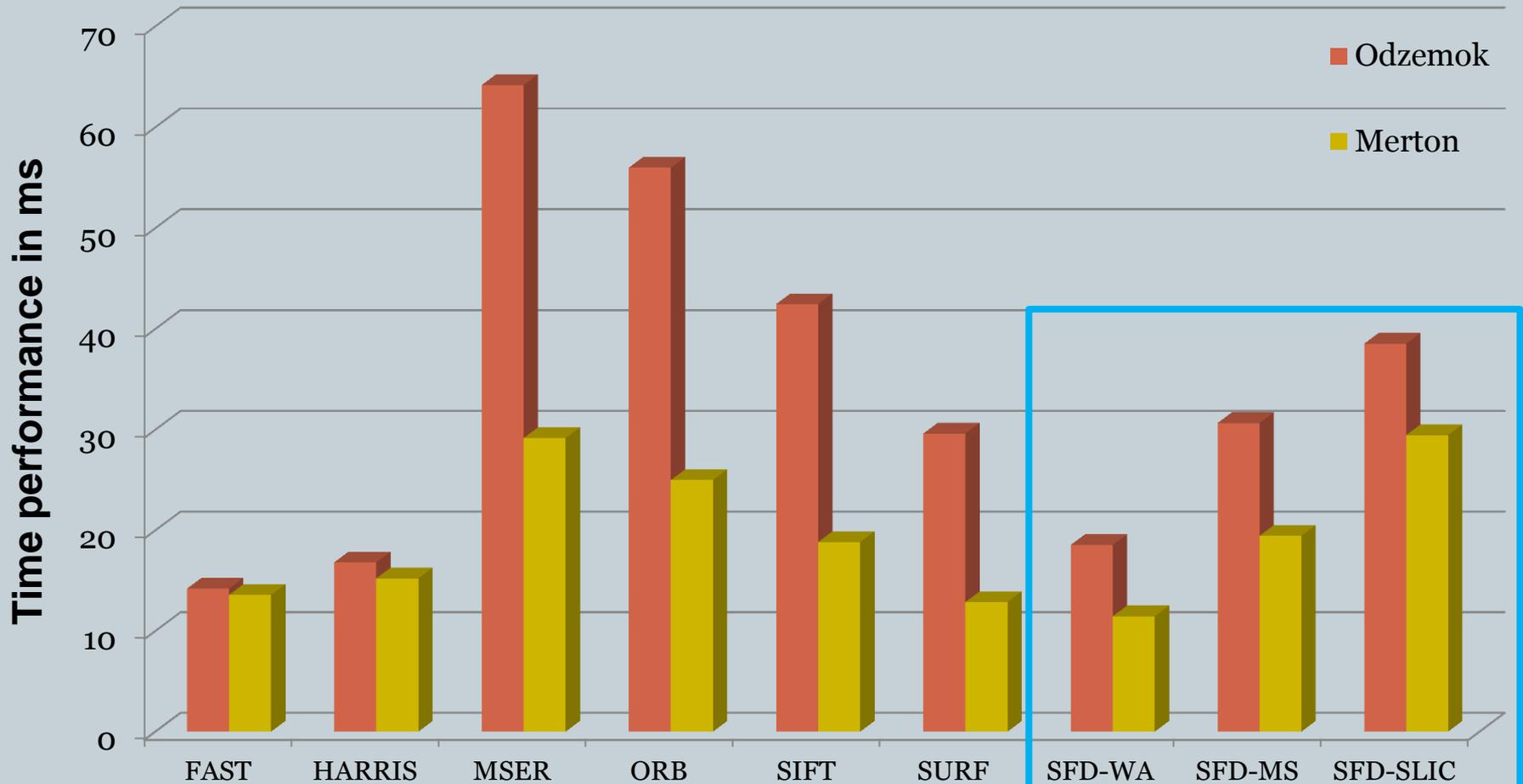
Evaluation: Matches

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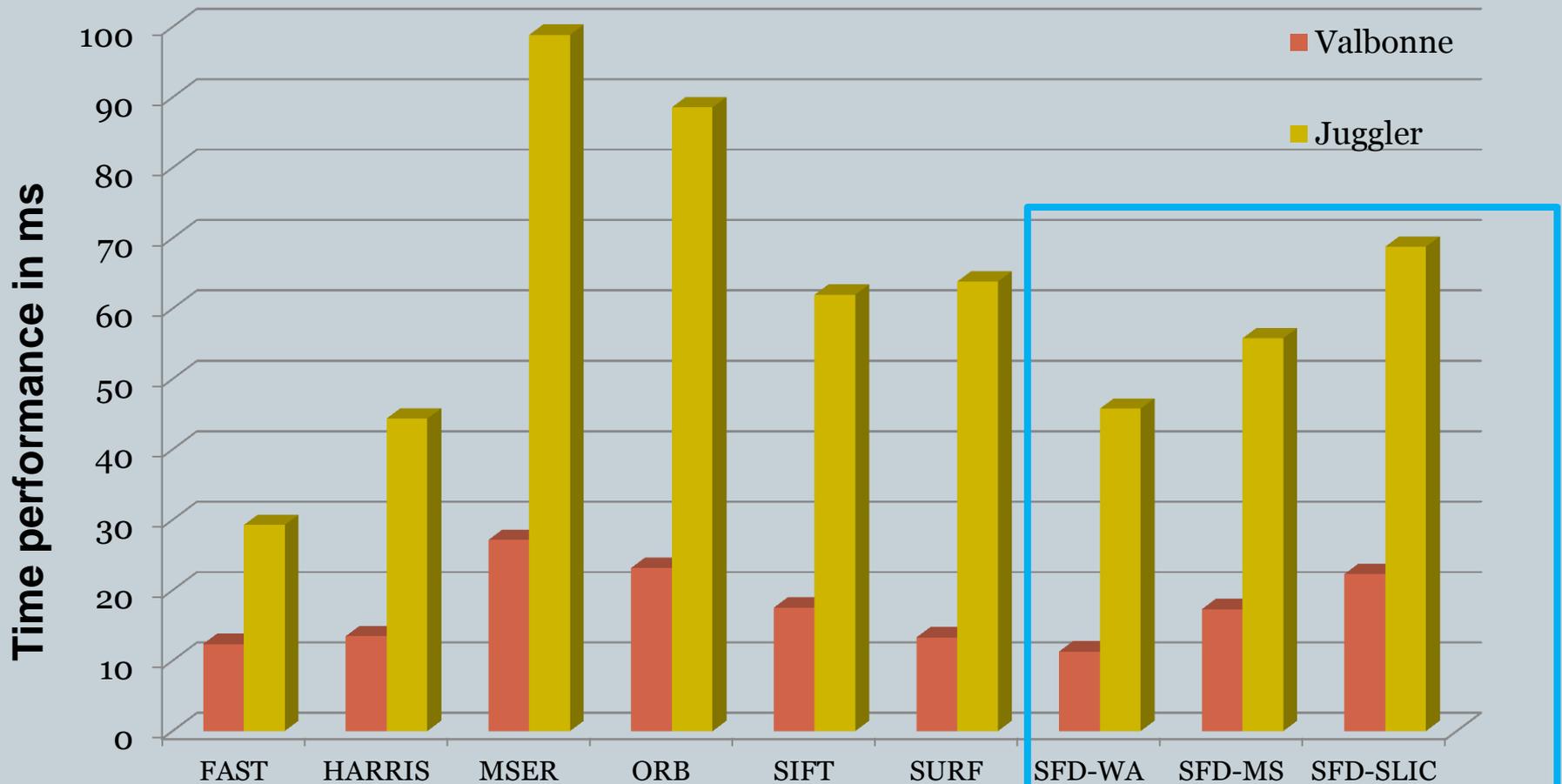
Evaluation: Time performance

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Evaluation: Time performance

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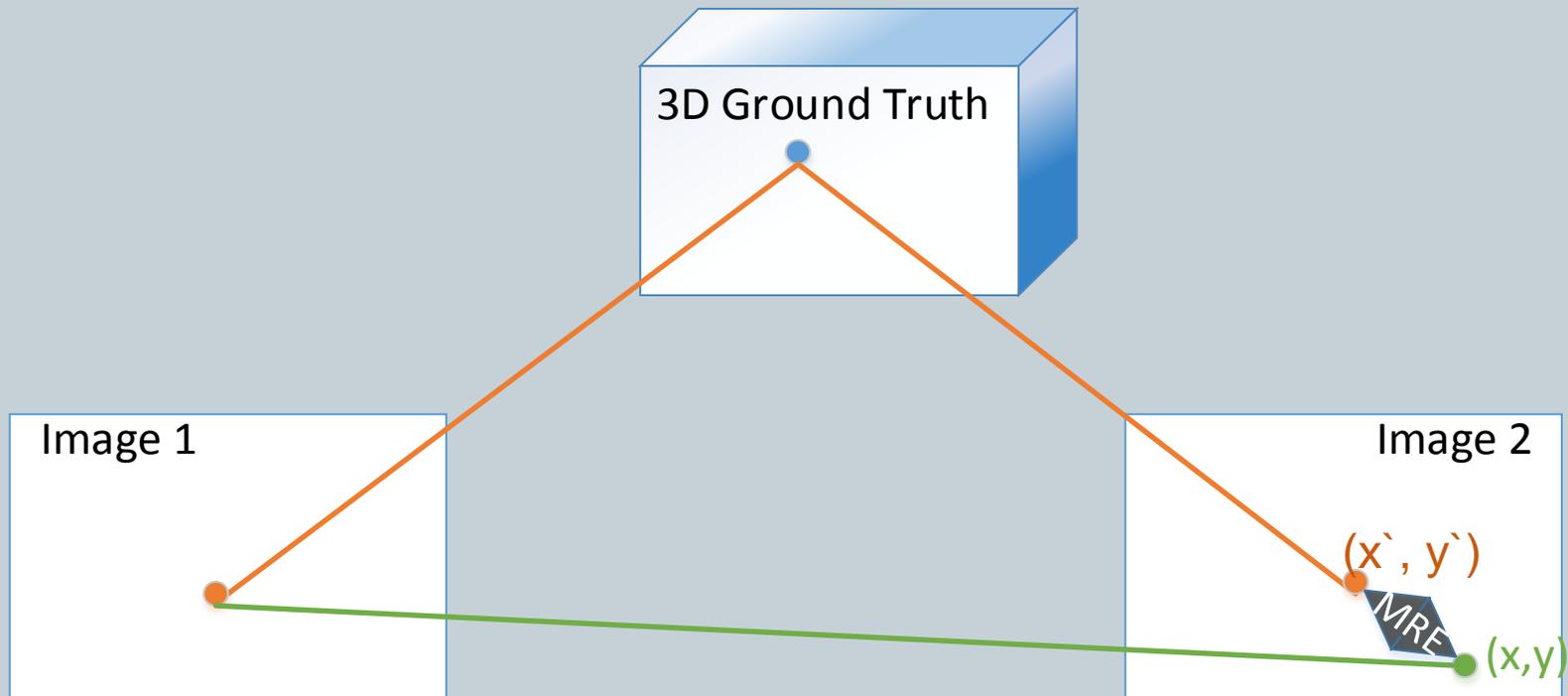
Mean re-projection error (MRE)

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

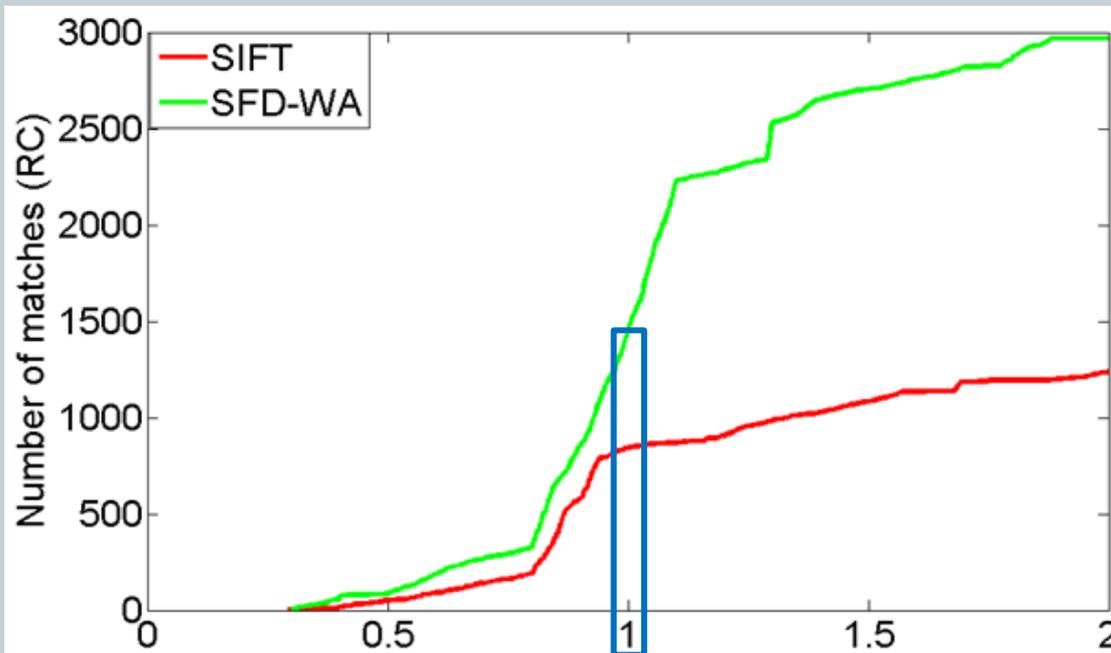
$$MRE = \frac{\sum_0^N \sqrt{(x - x')^2 + (y - y')^2}}{N}$$

N is the number of feature matches



Accuracy (MRE) Evaluation of SFD

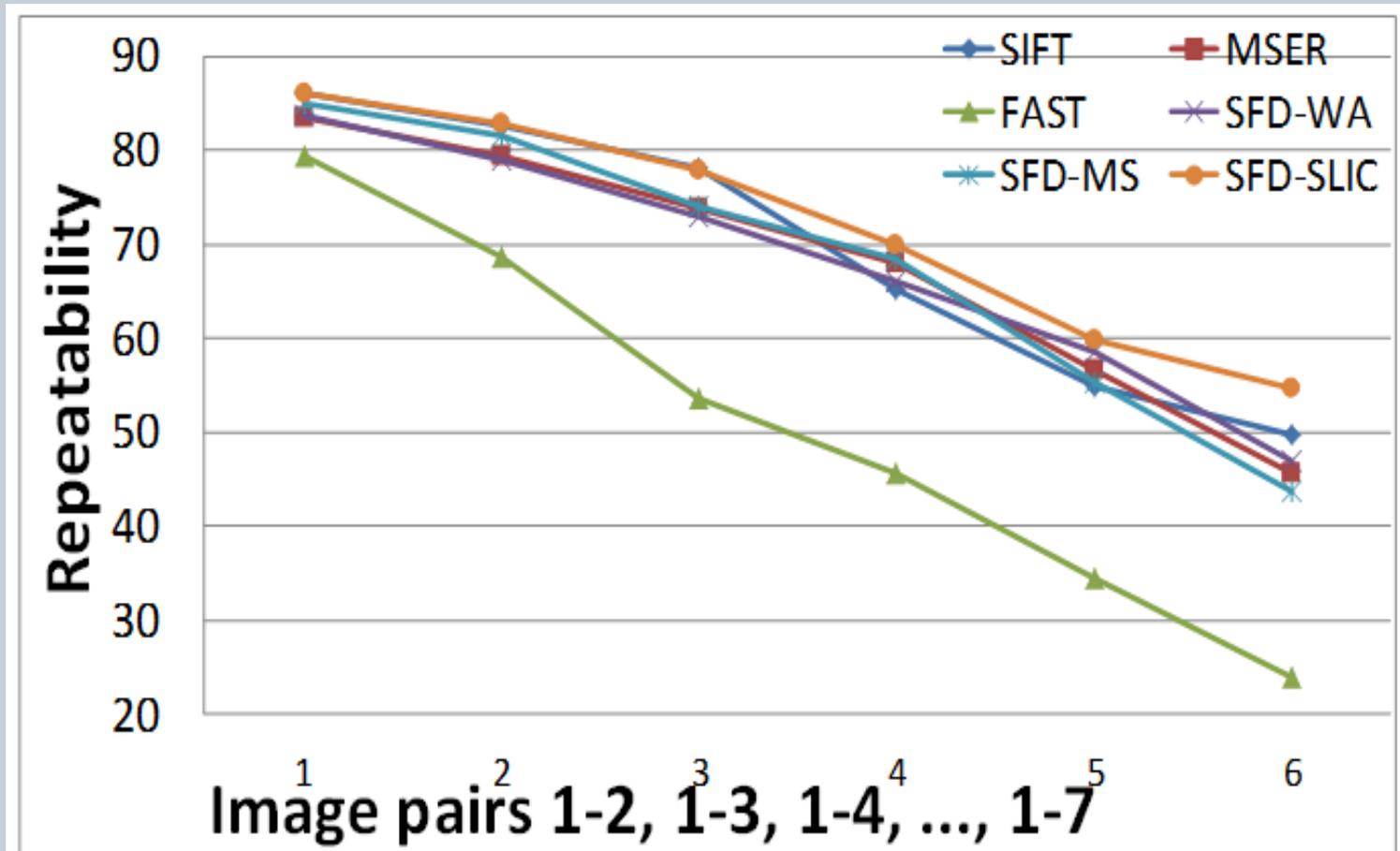
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Feature Detector	Descriptor	RC	MRE
SFD	SIFT	3717	1.351
SIFT	SIFT	1269	1.175
MSER	SIFT	119	1.390
FAST	BRIEF	121	1.483

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

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- 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!

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

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Evren Imre and Adrian Hilton

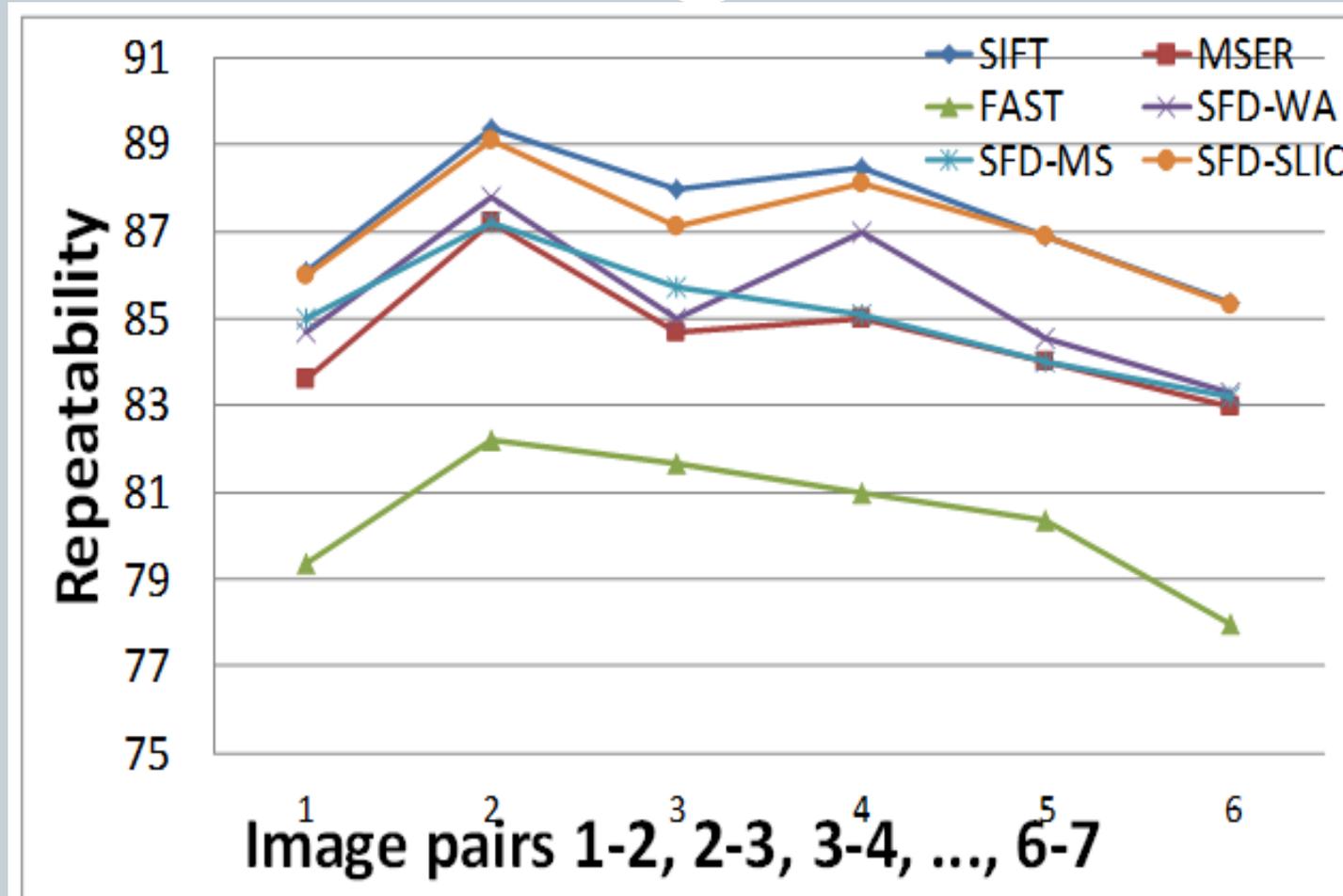
Questions??

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)