

Medical Image Processing for Interventional Applications

Introduction to Feature Matching

Online Course – Unit 9

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Pattern Recognition Lab (CS 5)

Topics

Feature Matching

Introduction

Requirements

Pipeline

Summary

Take Home Messages

Further Readings

Introduction: Stereo Vision in Image-guided Radiation Therapy



Figure 1: AlignRT system – overview of the workflow in image-guided radiation therapy (images courtesy of [VisionRT](#))

Introduction: Stereo Vision in Image-guided Radiation Therapy

1. Identify pairs of corresponding points
2. Reconstruct depth by triangulation



Figure 2: VisionRT stereo imaging device (image courtesy of [VisionRT](#))

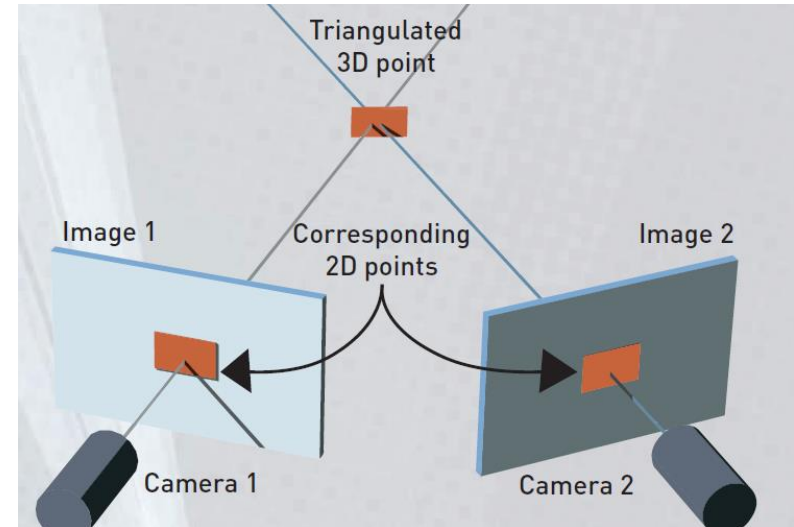


Figure 3: Epipolar geometry (image courtesy of [VisionRT](#))

Introduction: Importance of features

**Many computer vision applications
are based on local features**

Requirements and Invariances

What makes a feature suitable for matching?

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- Locality

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- Locality
- Invariance to transformations

Requirements and Invariances

What makes a feature suitable for matching?

- Locality
- Invariance to transformations
- Repeatability, quantity

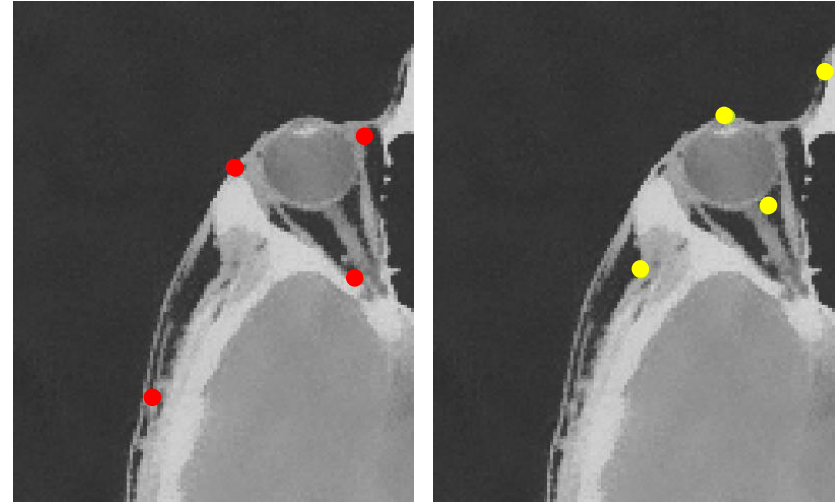


Figure 4: Local feature points

Requirements and Invariances

What makes a feature suitable for matching?

- Locality
- Invariance to transformations
- Repeatability, quantity
- Distinctiveness

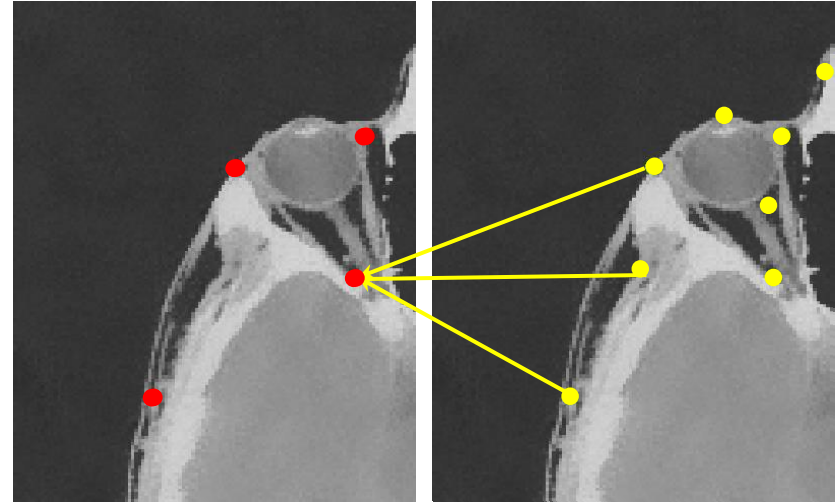


Figure 5: Matching trial

Requirements and Invariances

What makes a feature suitable for matching?

- Locality
- Invariance to transformations
- Repeatability, quantity
- Distinctiveness
- Robustness (illumination, viewpoint, noise, ...)

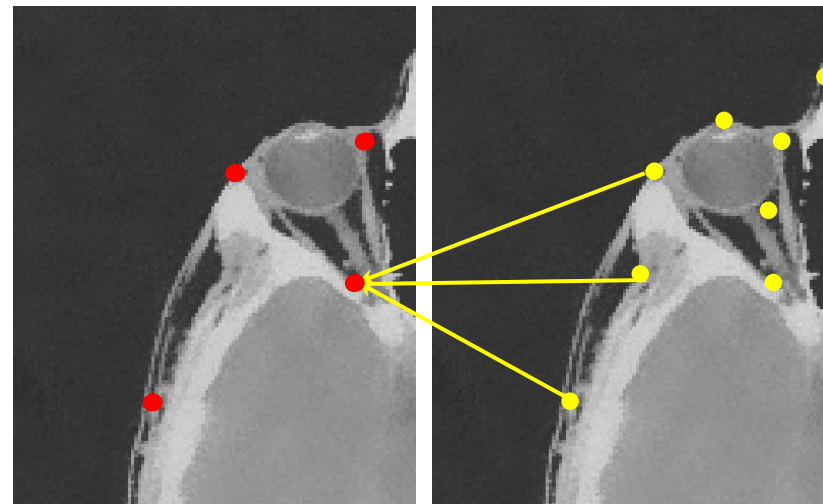


Figure 5: Matching trial

Feature Matching Pipeline

Matching cascade:




Image 1


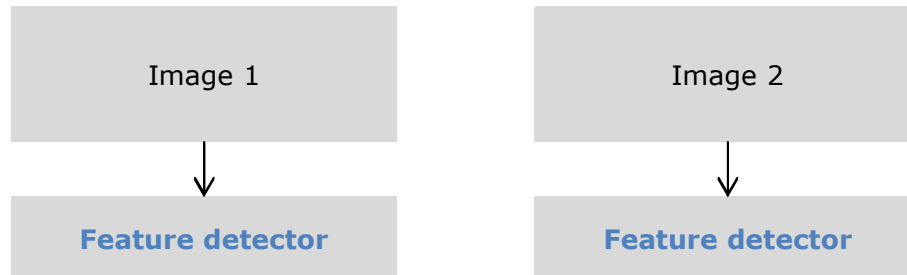


Image 2

Feature Matching Pipeline

Matching cascade:

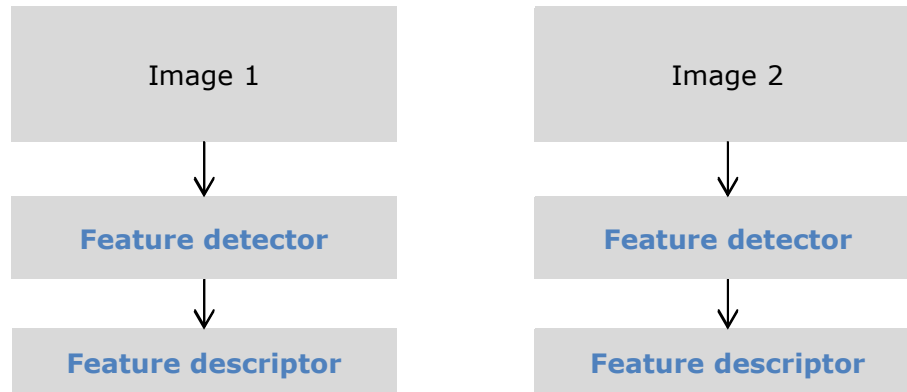
1. Identify potential interest points with low-level algorithms



Feature Matching Pipeline

Matching cascade:

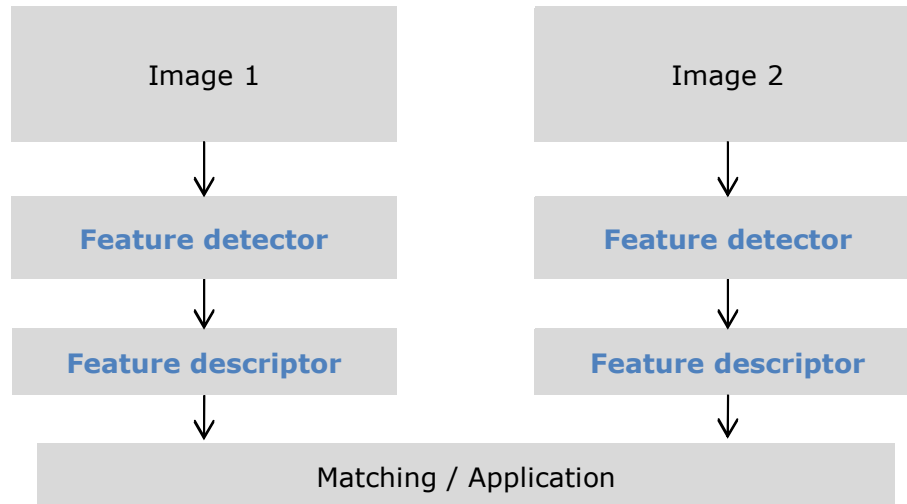
1. Identify potential interest points with low-level algorithms
2. Compute high-level descriptor only at these locations



Feature Matching Pipeline

Matching cascade:

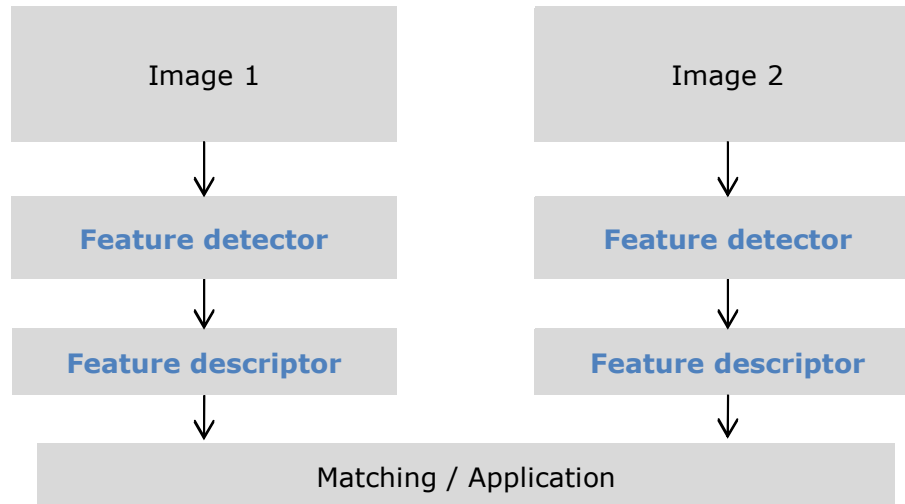
1. Identify potential interest points with low-level algorithms
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Feature Matching Pipeline

Matching cascade:

1. Identify potential interest points with low-level algorithms
2. Compute high-level descriptor only at these locations



- Minimizing the cost of feature extraction
- Reducing the correspondence search space

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- Imaging for interventional imaging involves tasks similar to computer vision tasks.
- Often two different images have to be matched, so distinct interest points have to be detected.
- Invariances of features w.r.t. locality and certain transformations is desired and most often necessary.

Credits:

We acknowledge the contributions of F.F. Li, E. Angelopoulou, D. Lowe, and A. Berg for their material in units 9-14 (on feature detectors/descriptors).

Further Readings

- David G. Lowe. “Distinctive Image Features from Scale-Invariant Keypoints”. In: *International Journal of Computer Vision* 60.2 (Nov. 2004), pp. 91–110. DOI: 10.1023/B:VISI.0000029664.99615.94
- Cordelia Schmid, Roger Mohr, and Christian Bauckhage. “Evaluation of Interest Point Detectors”. In: *International Journal of Computer Vision* 37.2 (June 2000), pp. 151–172. DOI: 10.1023/A:1008199403446
- D. Marr and E. Hildreth. “Theory of Edge Detection”. In: *Proceedings of the Royal Society of London B: Biological Sciences* 207.1167 (Feb. 1980), pp. 187–217. DOI: 10.1098/rspb.1980.0020