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Lab 7 Object Detection
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Let's Find STARBUCKS!

PREPROCESSING : Convert RGB input images to grayscale images. `I = rgb2gray(im_rgb);`

STEP 1: Feature Detection

Each image is searched for locations that are likely to match well in other images.

MATLAB functions	Description
`points = detectHarrisFeatures(I)`	Harris-Stephens algorithm to find corner points.
`points = detectSURFFeatures(I)`	Speeded-Up Robust Features (SURF) algorithm to find blob features.
`points = detectMSERFeatures(I)`	Maximally Stable Extremal Regions (MSER) algorithm to find regions.

A reference image:
(reference_sm.jpg)

An input image:

STEP 2: Feature Description

Each region around detected keypoint locations is converted into a more compact and stable (invariant) descriptor that can be matched against other descriptors.

MATLAB functions	Description
`[features, validPoints] = extractFeatures(I,points)`	Extracted feature vectors (aka. descriptors), and their corresponding locations, from a binary or intensity image.

STEP 3: Feature Matching

Find candidate matches between features

3.1 Find matching features using two matching methods: Nearest Neighbor Ratio method (default) and Threshold method.

MATLAB functions	Input Arguments	Input Argument Value
`indexPairs = matchFeatures(features_ref,features,Name,Value)`	`'Method'`	**Matching method:** NearestNeighborRatio (default)| Threshold
	`'MatchThreshold'`	Percent value in the range (0, 100), increase this value to return more matches.

Example

```
indexPairs = matchFeatures(feature_ref,features,'Method','Threshold','MatchThreshold',20.0);
indexPairs = matchFeatures(feature_ref,features,'Method','NearestNeighborRatio',...
                           'MatchThreshold', 4, 'MaxRatio', 0.6);
```

Find matched points

```
matchedPoints1 = validPoints_ref (indexPairs(:, 1));
matchedPoints2 = validPoints (indexPairs(:, 2));
```

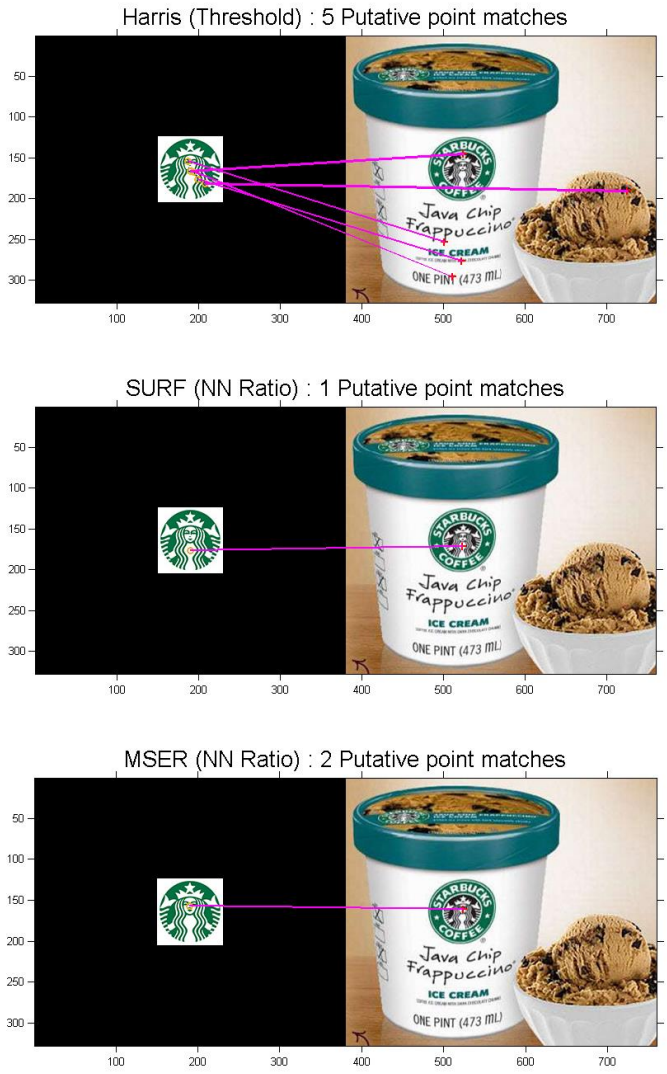
3.2 Display corresponding feature points

MATLAB functions	Input Arguments	Input Argument Value
showMatchedFeatures(I_ref,I,matchedPoints1,matchedPoints2,method)	'method'	Display methods: falsecolor (default) | blend | montage

Example

```
showMatchedFeatures(I_ref,I, matchedPoints1, matchedPoints2,'montage');
```

Example Results:



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Reference

[1] Harris, C., and M. Stephens, "A Combined Corner and Edge Detector," Proceedings of the 4th Alvey Vision Conference, August 1988, pp. 147-151.

[2] Herbert, B., A. Ess, T. Tuytelaars, and L. Van Gool, SURF: "Speeded Up Robust Features", Computer Vision and Image Understanding (CVIU), Vol. 110, No. 3, pp. 346--359, 2008.

[3] Matas, J., O. Chum, M. Urba, and T. Pajdla. "Robust wide baseline stereo from maximally stable extremal regions." Proceedings of British Machine Vision Conference, pages 384-396, 2002.