# Outline

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Introduction

- **Segmentation** simplifies the representation into a structure that should be more meaningful and easier to analyze.

- **Segments** are regions where the image is roughly homogeneous (like superpixels). They may correspond to image structures like sky, sheep, person, a human face.

- As mid-level computer vision, segmentation may be performed without object-specific knowledge.
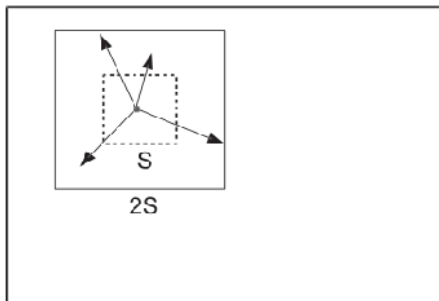
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SLIC superpixels (R. Achanta et al., PAMI 2012)

- K-means clusters on the 5-dimensional [*labxy*] space.
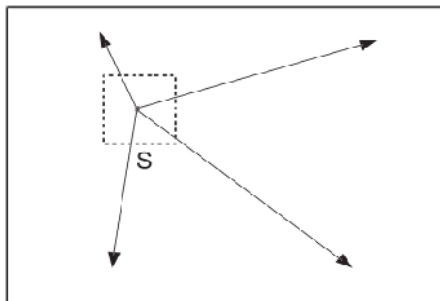
(a) standard k-means searches the entire image

(b) SLIC searches a limited region

Instead of using just an Euclidean distance in the 5D space, a new distance measure D_s is defined in order to control how important is the spatial position x, y with respect to l, a, b.

$$d_{lab} = \sqrt{(l_k - l_i)^2 + (a_k - a_i)^2 + (b_k - b_i)^2} \qquad (1)$$

$$d_{xy} = \sqrt{(x_k - x_i)^2 + (y_k - y_i)^2} \qquad (2)$$

$$D_s = d_{lab} + \frac{m}{S} d_{xy} \qquad (3)$$

The greater the value of m, the more spatial proximity is emphasized and the more compact the cluster.

SLIC

Algorithm

- ▶ Initialize K clusters in grid positions
- ▶ Move K clusters to lowest gradient positions (3 pixels vicinity)
  $G(x, y) = ||\mathbf{I}(x + 1, y) - \mathbf{I}(x - 1, y)||^2 + ||\mathbf{I}(x, y + 1) - \mathbf{I}(x, y - 1)||^2$
- ▶ Assign each pixel to a cluster center (limited to a 2S vicinity).
- ▶ Recalculate the centers as the average *labxy* vector of all the pixels belonging to each cluster
- ▶ Iterate until convergence
- ▶ Fix disconnected segments

Produces an oversegmentation of the image, good starting point for grouping segments.
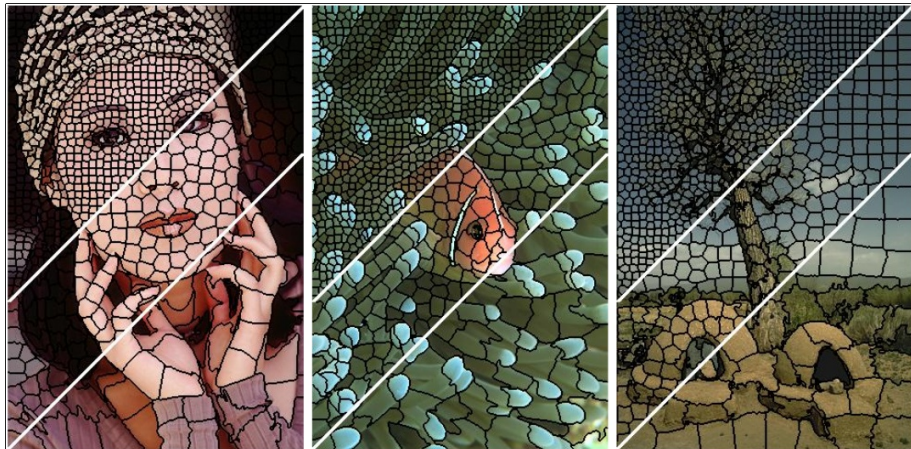
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SLIC

Image segmented into SLIC superpixels of (approximate) size 64, 256, and 1024 pixels. (R. Achanta et al., PAMI 2012)