Mathematical Morphology

Math/CS/Phys 445
Spring 2009
Image Processing: Reality

Restoration

Segmentation

Classification

KIWI!
NOTE:

Image \quad \text{Filter} \quad \text{Image}
NOTE:

Image → Filter → Image

Image → Classify → Category
Mathematical Morphology, Defined

*Morphological image processing* is a tool for extracting or modifying information on the shape and structure of objects within an image.
Mathematical Morphology, Defined

Morphological image processing is a tool for extracting or modifying information on the shape and structure of objects within an image (binary or gray-scale).
Mathematical Morphology, Categories (binary)

*Morphological image processing* is a tool for **extracting** or **modifying** information on the **shape and structure of objects** within an image.

- **Dilation**
- **Erosion**
- **Opening**
- **Closing**
- **Hit or Miss**
- **Thinning**
- **Thickening**
- **Skeletonization**
Mathematical Morphology, Categories (binary)

*Morphological image processing* is a tool for *extracting* or *modifying* information on the *shape and structure of objects* within an image.

Dilation

Erosion
Dilation

1. Choose size and direction of dilation to create a *structuring element*.

```
1 1 1
1 1 1
1 1 1
1 1 1
```

Dilates in all directions.
1. Choose size and direction of dilation to create a *structuring element*.

- **Dilates in all directions.**
- **Dilates horizontally and vertically.**
Dilation

1. Choose size and direction of dilation to create a *structuring element*.

2. Place structuring element on image.
Dilation

1. Choose size and direction of dilation to create a *structuring element*.
2. Place structuring element on image.
3. **If at least one** picture in the structuring element matches **at least one** image region pixel, replace center pixel with 1.
Dilation

1. Choose size and direction of dilation to create a *structuring element*.
2. Place structuring element on image.
3. If at least one pixel in structuring element matches with at least one pixel in the image region, replace center pixel with 1.

4. **Repeat across image.**
Dilation

1. Choose size and direction of dilation to create a *structuring element*.
2. Place structuring element on image.
3. If at least one pixel in structuring element matches with at least one pixel in the image region, replace center pixel with 1.
4. Repeat across image.

**You try!**

- Create structuring element:
  - by hand, creating a matrix B representing the desired structure
  - `se = strel('..',)`: see help for `strel` for options
- Convert (efficiency): `decomp = getsequence(se);`
- Apply to image A:
  - `imdilate(A,B);`
  - `imdilate(A, decomp);`
Dilation: One Use (there are many)

1. Dilate once (all directions).
2. Subtract original from dilated.
3. Get boundary!
Erosion = Dual of dilation

1. Choose size and direction of dilation to create a **structuring element**.
2. Place structuring element on image.
3. If **every** pixel in structuring element matches **every** pixel in image region, place a 1 in center pixel.
Erosion

1. Choose size and direction of dilation to create a *structuring element*.
2. Place structuring element on image.
3. If *every* pixel in structuring element matches *every* pixel in image region, place a 1 in center pixel.
4. Repeat across image.
Dilation -vs- Erosion
Erosion

1. Choose size and direction of dilation to create a structuring element.
2. Place structuring element on image.
3. If every pixel in structuring element matches every pixel in image region, place a 1 in center pixel.
4. Repeat across image.

You try!

- Create structuring element:
  - by hand, creating a matrix B representing the desired structure
  - \( se = \text{strel}(...); \) see help for \text{strel} for options
- Convert (efficiency): \( \text{decomp} = \text{getsequence}(\text{se}); \)
- Apply to image A:
  - \( \text{imerode}(A,B); \)
  - \( \text{imerode}(A, \text{decomp}); \)
Acknowledgement

Very useful website! (From which I took many of the dilation/erosion images.)