

Morphological Operators

Dr Frazer Noble

Introduction

In this presentation, I will describe:

- How to use OpenCV to apply morphological operators to an image.

Requirements

To follow along with this tutorial, you will need the following tools:

- [Python 3.8.6](#).
- [Visual Studio Code 1.53.1](#).

You will also need to install the following Python packages:

- [OpenCV](#).
- [NumPy](#).

It is assumed that you are using Windows; however, these instructions should be easily adapted to Linux.

Getting Started

Open Visual Studio Code. To open the app: Open the Start menu, type `Visual Studio Code`, and then select the app.

Open the Explorer tab. To display the tab: Left click `View > Explorer` or press `Ctrl + Shift + E`. This will display the Explorer tab.

Left click on the `Open Folder` button. This will display the Open Folder prompt. Browse to the following directory:

```
C:/Users/%USER%/Documents
```

Note: Replace `%USER%` with your own username. My username is `fknoBLE`; hence, the path is `C:/Users/fknoBLE/Documents`.

In `C:/Users/%USER%/Documents` create a new folder named `opencv_04` . To create a new folder: Right click in the Explorer tab, left click `New Folder` , and rename it.

In `C:/Users/%USER%/Documents/opencv_04` create a new folder named `data` . Download `apples.PNG` from [here](#); save it in `C:/Users/%USER%/Documents/opencv_04/data` .

In `C:/Users/%USER%/Documents/opencv_04` create new files named `erode.py` and `dilate.py` . To create a new file: Right click on `/opencv_04` in the Explorer tab, left click `New File` , and rename it. The file will open automatically.

`/opencv_04` should contain the following files and folders:

```
/opencv_04
  /data
    apple.PNG
  erode.py
  dilate.py
```

erode.py

Type the following code into `erode.py` :

```
import cv2 as cv
import numpy as np
```

OpenCV's Python module `cv2` is imported as `cv` and NumPy's Python module `numpy` is imported as `np` .

Type the following code into `erode.py` :

```
def main():  
  
    rows, cols = 480, 640  
    img = np.zeros((rows, cols), dtype=np.uint8)  
  
    cv.circle(img, (320, 240), 150, (255), 40)  
    cv.circle(img, (320, 240), 100, (255), 40)
```

This begins `main()` 's definition. `zeros()` creates a 480 x 640 x 1 array of 0's and assigns it to array `img` . Two circles are drawn on `img` .

Type the following code into `erode.py` :

```
coordinates = [(int(random.random() * cols),
                int(random.random() * rows)) for _ in range(100)]

for c in coordinates:

    cv.circle(img, c, 2, (255), -1)

cv.imshow("img", img)
cv.waitKey(1)
cv.imwrite("data/morph_img.PNG", img)
```

An array of 100, random (x, y) coordinates is assigned to array `coordinates` . For each coordinate, a filled circle is drawn on `img` at that location. `img` is then displayed in the `img` window and saved as `morph_img.PNG` in `/data` .

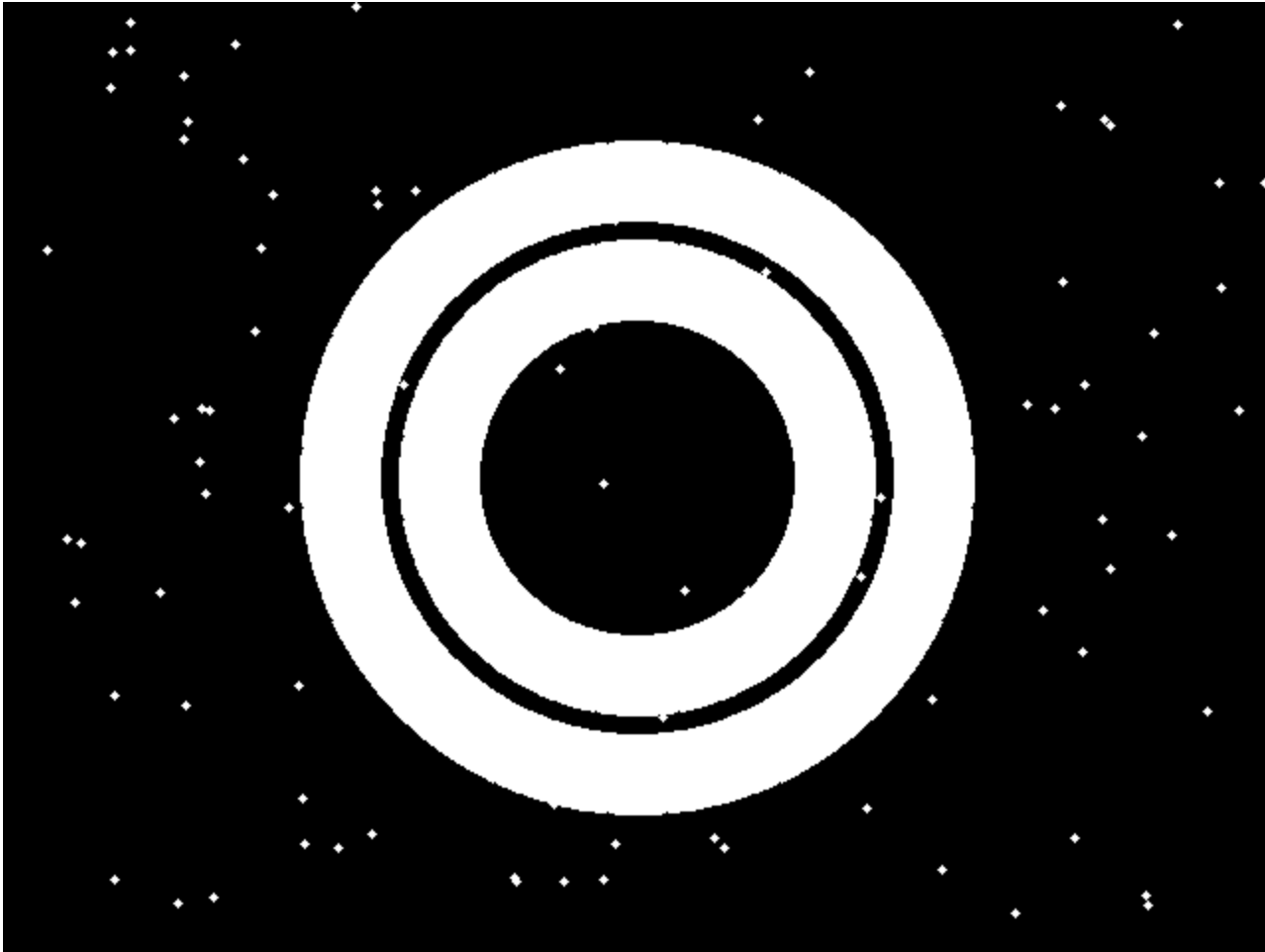


Figure: The `img` array.

Type the following code into `erode.py` :

```
shapes = [cv.MORPH_RECT, cv.MORPH_CROSS, cv.MORPH_ELLIPSE]
shapes_label = ["MORPH_RECT", "MORPH_CROSS", "MORPH_ELLIPSE"]

for i, s in enumerate(shapes):

    kernel = cv.getStructuringElement(s, (20, 20))
    print("{}: \n{}\n".format(shapes_label[i], kernel))

    eroded = cv.erode(img, kernel)
```

```
    cv.imshow("Eroded + {}".format(shapes_label[i]), eroded)
    cv.waitKey(0)
    cv.imwrite("data/eroded_{}.png".format(shapes_label[i]), eroded)

cv.destroyAllWindows()

return 0
```

A list of common OpenCV kernel shapes is assigned to list `shapes`. Labels for the kernel shapes are assigned to `shapes_label`. For each kernel shape, `getStructuringElement()` creates a kernel and assigns it to array `kernel`. `erode()` uses the kernel to erode `img` and then assigns the results to array `eroded`. The array is then displayed in its own window and saved in `/data`.

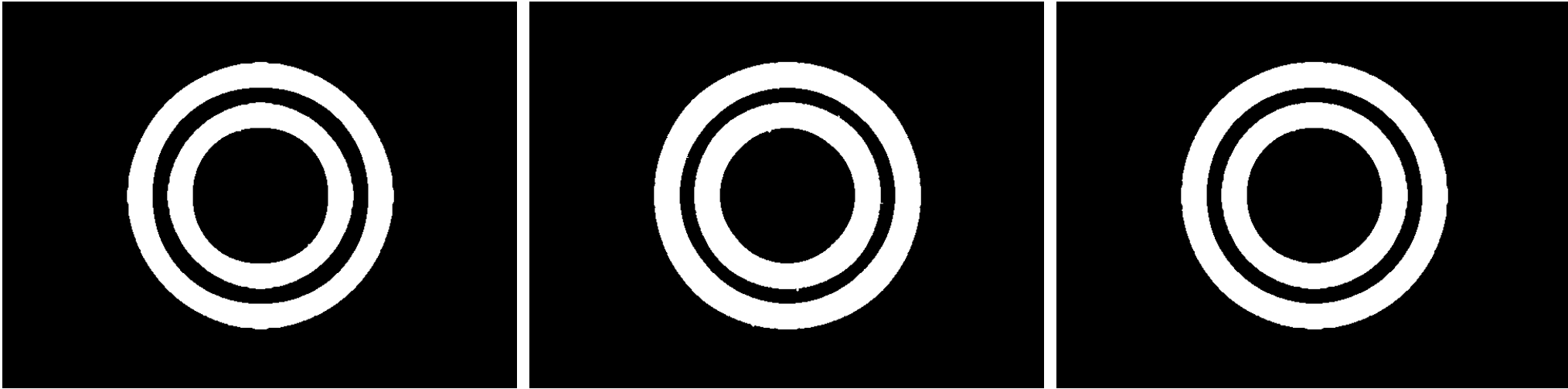


Figure: (Left) `img` array with a `MORPH_RECT` shaped kernel applied; (Middle) `img` array with a `MORPH_CROSS` shaped kernel applied; and (Right) `img` array with a `MORPH_ELLIPSE` shaped kernel applied.

Type the following code into `erode.py` :

```
if __name__ == '__main__':  
    main()
```

`main()` will be called when the `erode.py` is run.

Run `erode.py`

Open a new terminal in Visual Studio Code. To open a new terminal: Left click `View > Terminal` or press `Ctrl + ``.

Type the following commands into the terminal and then press `Enter` after each one:

```
cd ./opencv_04  
python erode.py
```

This will change the current directory to the `/opencv_04` sub-directory and then run `erode.py`.

Press any key to close the windows and stop `erode.py`.

dilate.py

Type the following code into `dilate.py` :

```
import cv2 as cv
import numpy as np
```

OpenCV's Python module `cv2` is imported as `cv` and NumPy's Python module `numpy` is imported as `np` .

Type the following code into `dilate.py` :

```
def main():  
  
    rows, cols = 480, 640  
    img = np.zeros((rows, cols), dtype=np.uint8)  
  
    cv.circle(img, (320, 240), 150, (255), 40)  
    cv.circle(img, (320, 240), 100, (255), 40)
```

This begins `main()` 's definition. `zeros()` creates a 480 x 640 x 1 array of 0's and assigns it to array `img` . Two circles are drawn on `img` .

Type the following code into `dilate.py` :

```
coordinates = [(int(random.random() * cols),
                 int(random.random() * rows)) for _ in range(100)]

for c in coordinates:

    cv.circle(img, c, 2, (255), -1)

cv.imshow("img", img)
cv.waitKey(1)
cv.imwrite("data/morph_img.PNG", img)
```

An array of 100, random (x, y) coordinates is assigned to array `coordinates` . For each coordinate, a filled circle is drawn on `img` at that location. `img` is then displayed in the `img` window and saved as `morph_img.PNG` in `/data` .

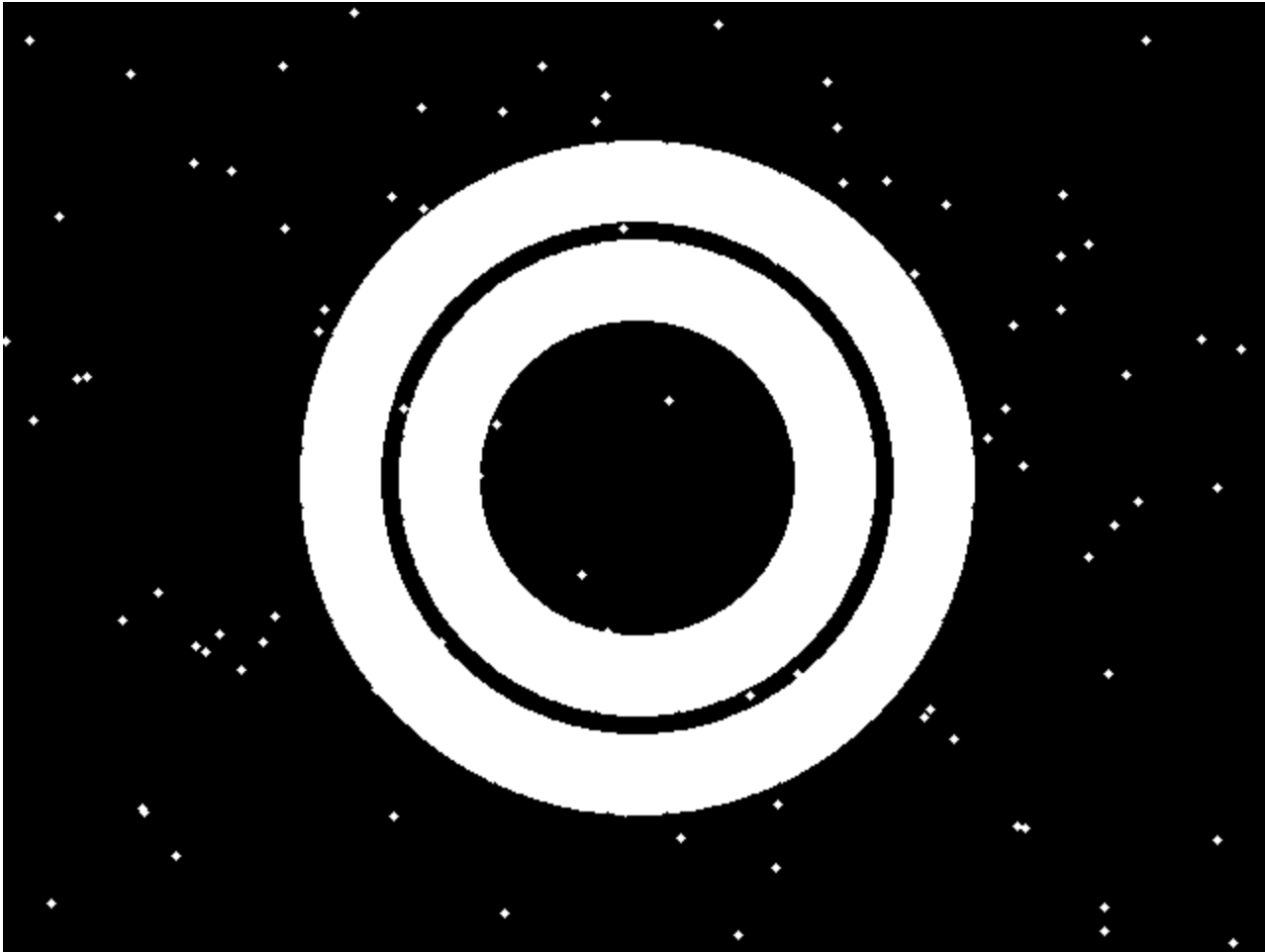


Figure: The `img` array.

Type the following code into `dilate.py`:

```
shapes = [cv.MORPH_RECT, cv.MORPH_CROSS, cv.MORPH_ELLIPSE]
shapes_label = ["MORPH_RECT", "MORPH_CROSS", "MORPH_ELLIPSE"]

for i, s in enumerate(shapes):

    kernel = cv.getStructuringElement(s, (20, 20))
    print("{}: \n{}\n".format(shapes_label[i], kernel))

    dilated = cv.dilate(img, kernel)
```

```
    cv.imshow("Dilated + {}".format(shapes_label[i]), dilated)
    cv.waitKey(0)
    cv.imwrite("data/dilated_{}.png".format(shapes_label[i]), dilated)

cv.destroyAllWindows()

return 0
```

A list of common OpenCV kernel shapes is assigned to list `shapes`. Labels for the kernel shapes are assigned to `shapes_label`. For each kernel shape, `getStructuringElement()` creates a kernel and assigns it to array `kernel`. `dilate()` uses the kernel to dilate `img` and then assigns the results to array `dilated`. The array is then displayed in its own window and saved in `/data`.

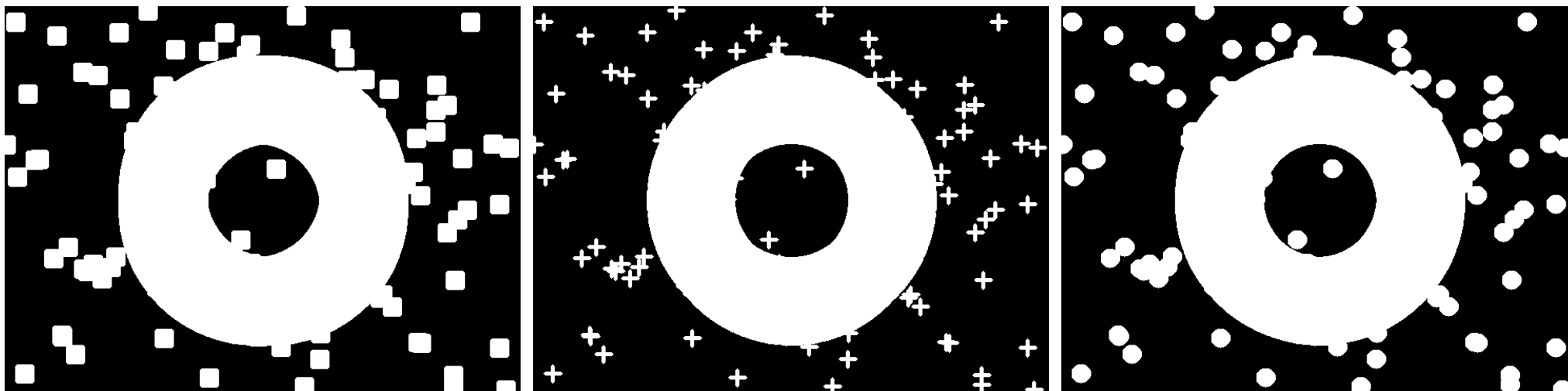


Figure: (Left) `img` array with a `MORPH_RECT` shaped kernel applied; (Middle) `img` array with a `MORPH_CROSS` shaped kernel applied; and (Right) `img` array with a `MORPH_ELLIPSE` shaped kernel applied.

Type the following code into `dilate.py`:

```
if __name__ == '__main__':  
    main()
```

`main()` will be called when the `dilate.py` is run.

Run `dilate.py`

Open a new terminal in Visual Studio Code. To open a new terminal: Left click `View > Terminal` or press `Ctrl + ``.

Type the following commands into the terminal and then press `Enter` after each one:

```
cd ./opencv_04  
python dilate.py
```

This will change the current directory to the `/opencv_04` sub-directory and then run `dilate.py`.

Press any key to close the windows and stop `dilate.py`.

Conclusion

In this presentation, I have described:

- How to use OpenCV to apply morphological operators to an image.

References

1. <https://docs.opencv.org/>.