ejemplo

November 12, 2024

[1]:

```
import numpy as np
import matplotlib.pyplot as plt
from skimage.transform import radon, iradon
from skimage.draw import ellipse
```

[2]:

```
def plot_phantom(phantom: np.ndarray) -> plt.Figure:
    fig = plt.Figure()
    axes = fig.gca()
    ax = axes.imshow(phantom, cmap=plt.get_cmap("hot"), vmax=1, vmin=0)
    plt.colorbar(ax)
    return fig
```

[3]:

```
def plot_radon_transform(radon_transform: np.ndarray, theta: np.ndarray) -> plt.
 ↪Figure:
    fig = plt.Figure()
    axes = fig.gca()
    ax = axes.imshow(
        radon_transform,
        cmap=plt.cm.get_cmap("hot"),
        aspect='auto',
        extent=[theta[0], theta[-1], 125, -125]
    )
    plt.colorbar(ax)
    return fig
```

[4]:

```
def plot_single_degree_radon_transform(radon_transform: np.ndarray, degree:␣
 ↪int, theta: np.ndarray) -> plt.Figure:
    if degree not in theta:
        return None
    idx = np.where(theta == degree)
    fig = plt.Figure()
    axes = fig.gca()
    axes.plot(radon_transform[:, idx[0]])
    return fig
```

[5]:

```
def plot_inverse_radon(iphantom: np.ndarray) -> plt.Figure:
    fig = plt.Figure()
    axes = fig.gca()
    ax = axes.imshow(
        iphantom,
        cmap=plt.cm.get_cmap("hot"),
        aspect='auto',
        vmin=0,
        vmax=1
    )
    plt.colorbar(ax)
    return fig
```

[6]:

```
# Intensidad. I   [-1; 1]
I = 1

# Inclinación
A = 0

# Semi-eje X. X   (0; 1]
X = 0

# Semi-eje Y. Y   (0; 1]
Y = 0

# Centro X. CX   [-1; 1]
CX = 0

# Centro Y. CY   [-1; 1]
CY = 0
```

[7]:

```
def new_phantom() -> np.ndarray:
   phantom = np.zeros((250, 250))
   return phantom
```

[8]:

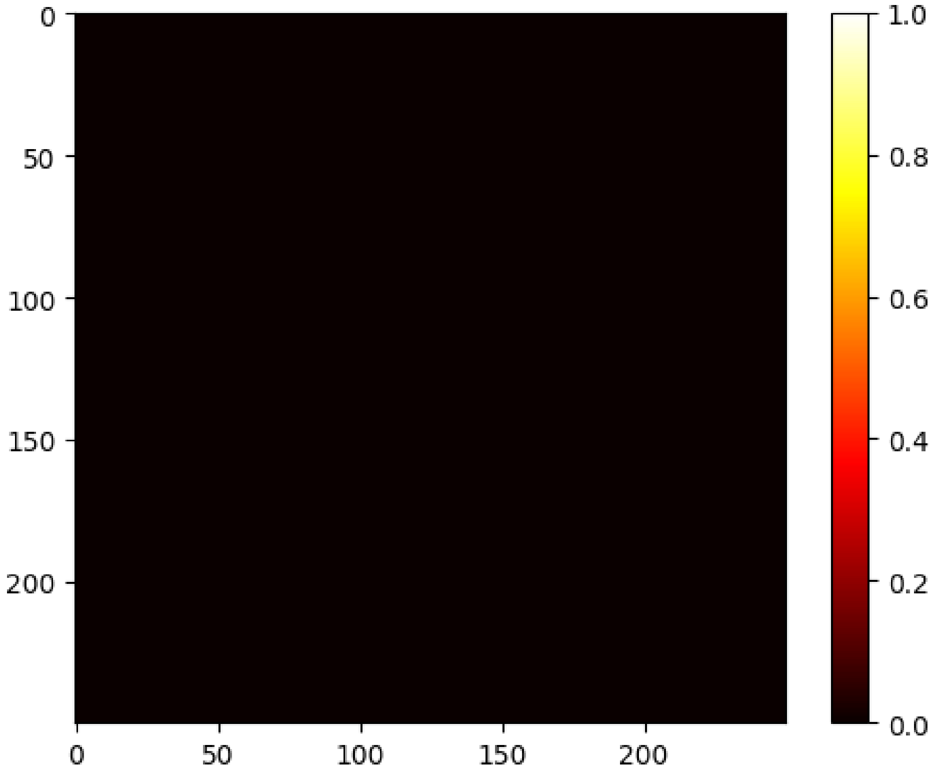
```
def new_ellipse(
    phantom: np.ndarray,
    I: int,
    A: int,
    X: int,
    Y: int,
    CX: int,
    CY: int
) -> tuple[np.ndarray, np.ndarray, int]:

    rad_A = A*np.pi/180

    scaled_X = (X * phantom.shape[1])/2
    scaled_Y = (Y * phantom.shape[0])/2
    scaled_CX = (CX * phantom.shape[1]/2) + phantom.shape[1]/2
    scaled_CY = phantom.shape[0] - ((CY * phantom.shape[0]/2) + phantom.
 ↪shape[0]/2)

    rr, cc = ellipse(r=scaled_CY, c=scaled_CX, r_radius=scaled_Y,␣
 ↪c_radius=scaled_X, rotation=rad_A, shape=phantom.shape)

    return rr, cc, I
```

[9]:
```
def add_ellipse(phantom: np.ndarray, ellipse: tuple[np.ndarray, np.ndarray,␣
 ↪int]) -> np.ndarray:
    rr, cc, I = ellipse
    phantom[rr, cc] = I
    return phantom
```

[10]:
```
phantom = new_phantom()
plot_phantom(phantom)
```

```
/tmp/ipykernel_7999/4255785446.py:5: UserWarning: Adding colorbar to a different
Figure <Figure size 640x480 with 2 Axes> than <Figure size 640x480 with 0 Axes>
which fig.colorbar is called on.
  plt.colorbar(ax)
```

[10]:

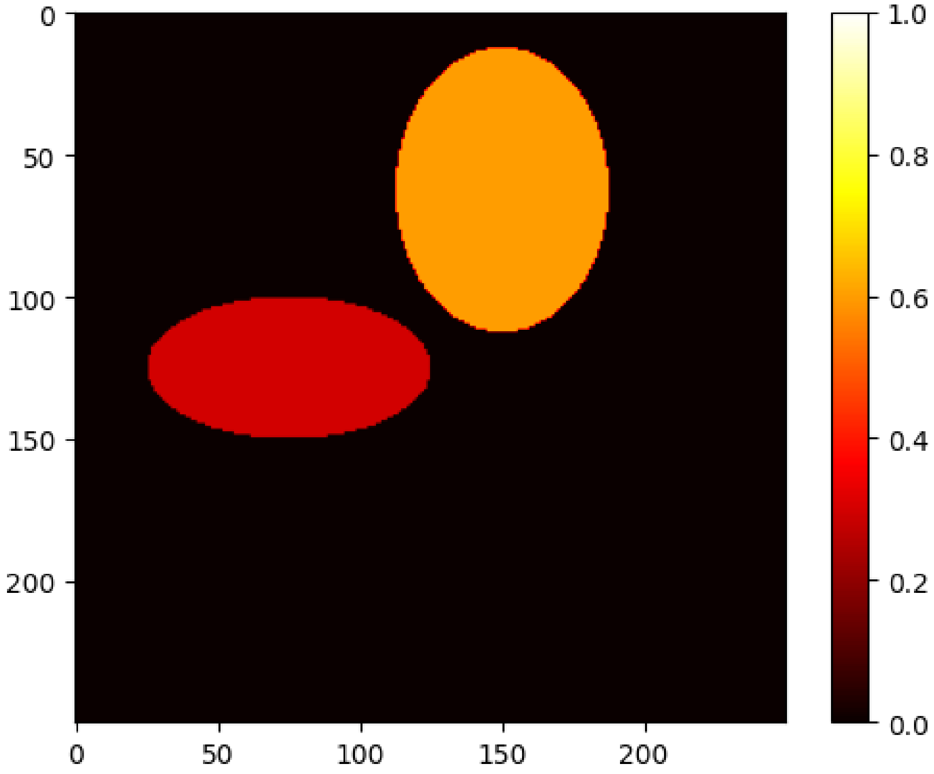


```
<Figure size 640x480 with 0 Axes>
```

[11]:
```
ellipse1 = new_ellipse(phantom, .3, 90, X=0.2, Y=0.4, CX=-0.4, CY=0)
ellipse2 = new_ellipse(phantom, .6, 0, X=0.3, Y=0.4, CX=0.2, CY=0.5)
phantom = add_ellipse(phantom, ellipse1)
phantom = add_ellipse(phantom, ellipse2)
plot_phantom(phantom)
```

```
/tmp/ipykernel_7999/4255785446.py:5: UserWarning: Adding colorbar to a different
Figure <Figure size 640x480 with 2 Axes> than <Figure size 640x480 with 0 Axes>
which fig.colorbar is called on.
  plt.colorbar(ax)
```

[11]:



```
<Figure size 640x480 with 0 Axes>
```

[12]:
```
def calculate_radon_transform(phantom: np.ndarray, start: int, step: int, end:␣
 ↪int) -> tuple[np.ndarray, np.ndarray]:
    theta = np.array(list(range(start, end, step)))
    radon_transform = radon(phantom, theta)
    return radon_transform, theta
```

[13]:

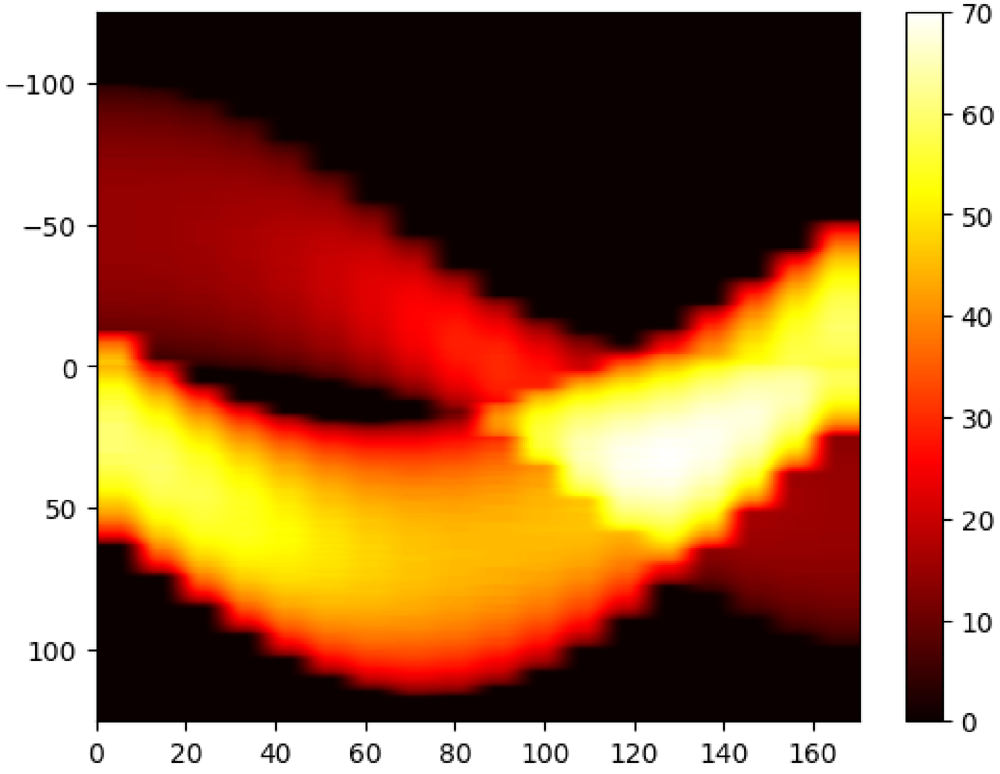
```
radon_transform, theta = calculate_radon_transform(phantom, start=0, step=10,␣
  ↪end=180)
```

[14]:

```
plot_radon_transform(radon_transform, theta)
```

```
/tmp/ipykernel_7999/3703279406.py:6: MatplotlibDeprecationWarning: The get_cmap
function was deprecated in Matplotlib 3.7 and will be removed in 3.11. Use
``matplotlib.colormaps[name]`` or ``matplotlib.colormaps.get_cmap()`` or
``pyplot.get_cmap()`` instead.
  cmap=plt.cm.get_cmap("hot"),
/tmp/ipykernel_7999/3703279406.py:10: UserWarning: Adding colorbar to a
different Figure <Figure size 640x480 with 2 Axes> than <Figure size 640x480
with 0 Axes> which fig.colorbar is called on.
  plt.colorbar(ax)
```

[14]:

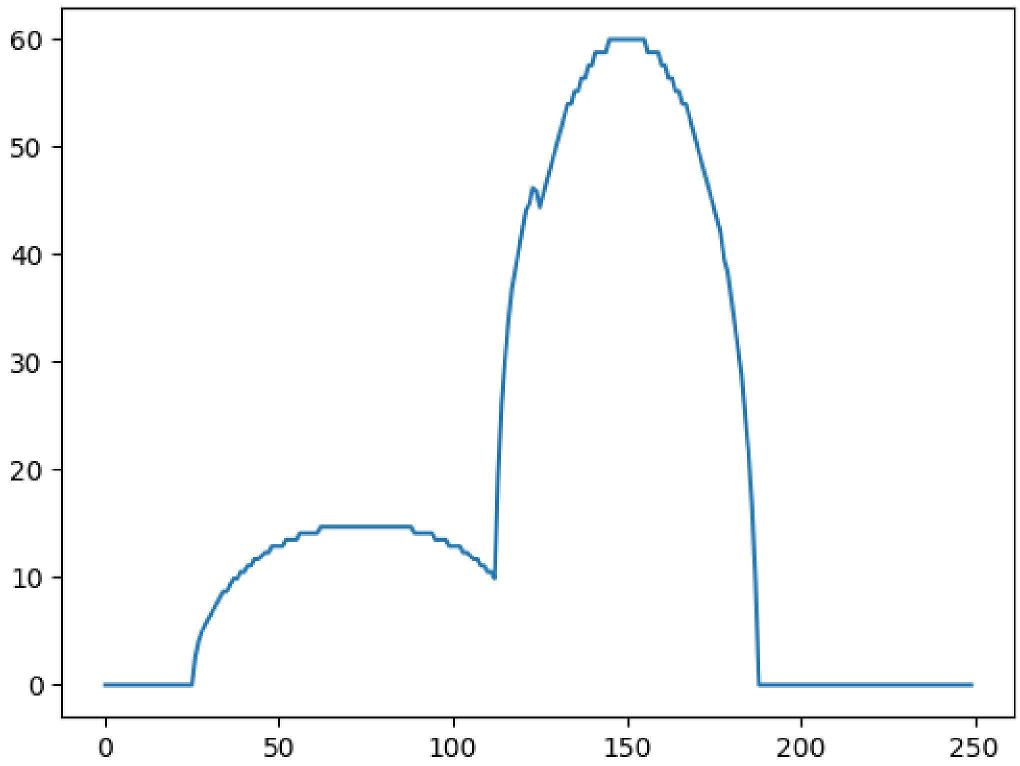


```
<Figure size 640x480 with 0 Axes>
```

[15]:

```
plot_single_degree_radon_transform(radon_transform, 0, theta)
```

[15]:



[16]:
```
def calculate_inverse_radon_transform(radon_transform: np.ndarray, theta: np.
 ↪ndarray, interpolation_name: str, filter_name: str) -> np.ndarray:
    side = radon_transform.shape[0]
    iphantom = iradon(radon_transform,
                      theta,
                      side,
                      interpolation=interpolation_name,
                      filter_name=filter_name)
    return iphantom
```

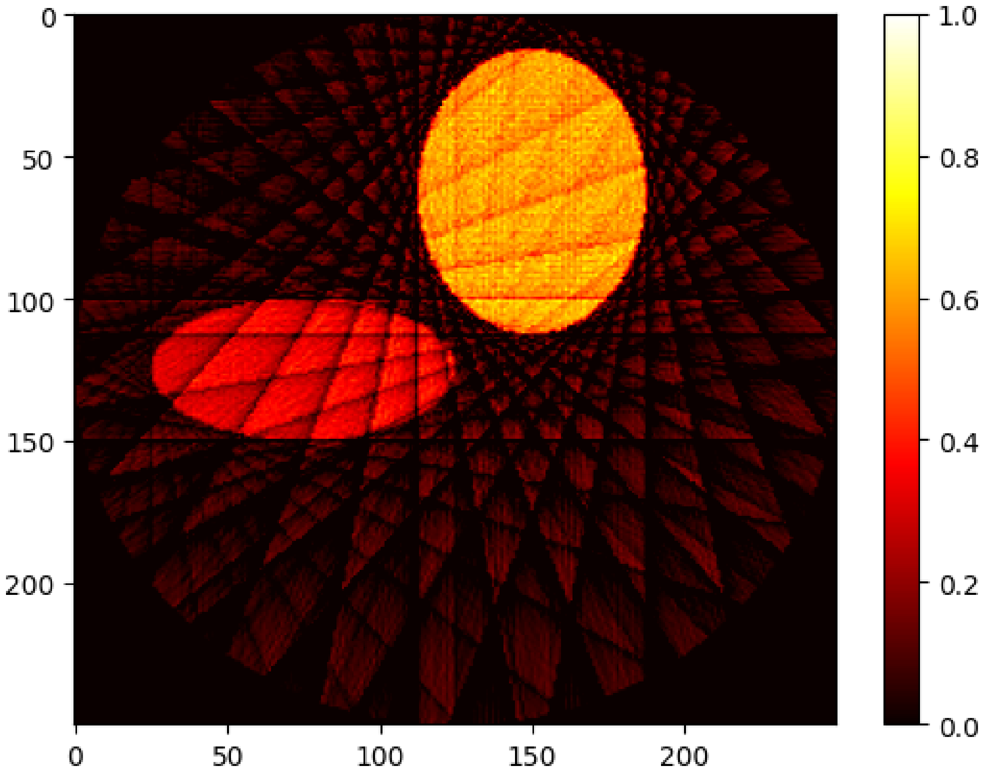
[17]:
```
iphantom = calculate_inverse_radon_transform(radon_transform, theta, "nearest",␣
 ↪"ramp")
```

[18]:
```
plot_inverse_radon(iphantom)
```

```
/tmp/ipykernel_7999/2424215151.py:6: MatplotlibDeprecationWarning: The get_cmap
function was deprecated in Matplotlib 3.7 and will be removed in 3.11. Use
``matplotlib.colormaps[name]`` or ``matplotlib.colormaps.get_cmap()`` or
``pyplot.get_cmap()`` instead.
  cmap=plt.cm.get_cmap("hot"),
/tmp/ipykernel_7999/2424215151.py:11: UserWarning: Adding colorbar to a
different Figure <Figure size 640x480 with 2 Axes> than <Figure size 640x480
```

```
with 0 Axes> which fig.colorbar is called on.
  plt.colorbar(ax)
```

[18]:



```
<Figure size 640x480 with 0 Axes>
```