Open in Colab

In [54]:
```
import numpy as np
import numpy.linalg as npl
import matplotlib.pyplot as plt
import PIL
from PIL import Image
```

In [52]:
```
plt.rcParams["figure.figsize"] = (10,10)
origin2D = np.array([0,0])
origin3D = np.array([0,0,0])
scale = 10
```

(행)벡터, 열벡터

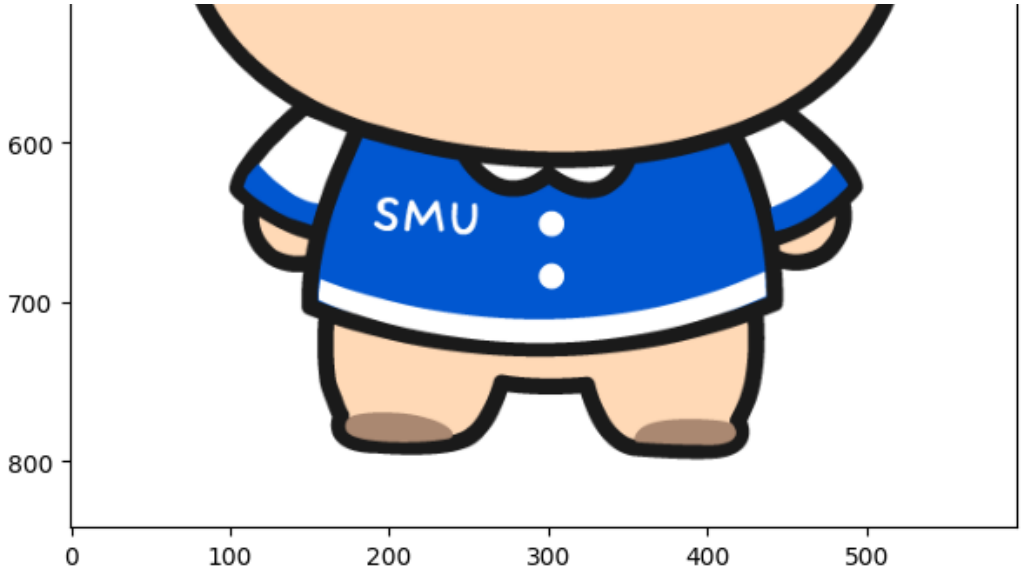
In [26]:
```
print(np.array([1,0]))
print(np.hstack([1,0]))
print(np.vstack([1,0]))
```

```
[1 0]
[1 0]
[[1]
 [0]]
```

In [45]:
```
smung = Image.open('smung.png')
print(smung)
print(smung.format)
print(smung.size)
print(smung.mode)

plt.imshow(smung)
plt.show()
```

```
<PIL.PngImagePlugin.PngImageFile image mode=RGBA size=595x842 at 0x7F936B626AD0>
PNG
(595, 842)
RGBA
```



In [46]:
```
imMatrix = np.array(smung.convert("L"))/255.0
print( imMatrix.shape )
print( imMatrix )
```

```
(842, 595)
[[0. 0. 0. ... 0. 0. 0.]
 [0. 0. 0. ... 0. 0. 0.]
 [0. 0. 0. ... 0. 0. 0.]
 ...
 [0. 0. 0. ... 0. 0. 0.]
 [0. 0. 0. ... 0. 0. 0.]
 [0. 0. 0. ... 0. 0. 0.]]
```

In [101…
```
scalar = 1/2
shape = np.shape(imMatrix)
U, S, V = npl.svd(imMatrix)
if (imMatrix.shape[0] > imMatrix.shape[1]):
  Sd = np.vstack([np.eye(shape[1])*S.copy(),np.zeros((shape[0]-shape[1],shape[1]))])
  print(np. shape(U), np.shape(Sd), np.shape(V))
else:
  Sd = np.vstack([np.eye(shape[0])*S.copy(),np.zeros((shape[0],shape[1]-shape[0]))])
  print(np. shape(U), np.shape(Sd), np.shape(V))
```

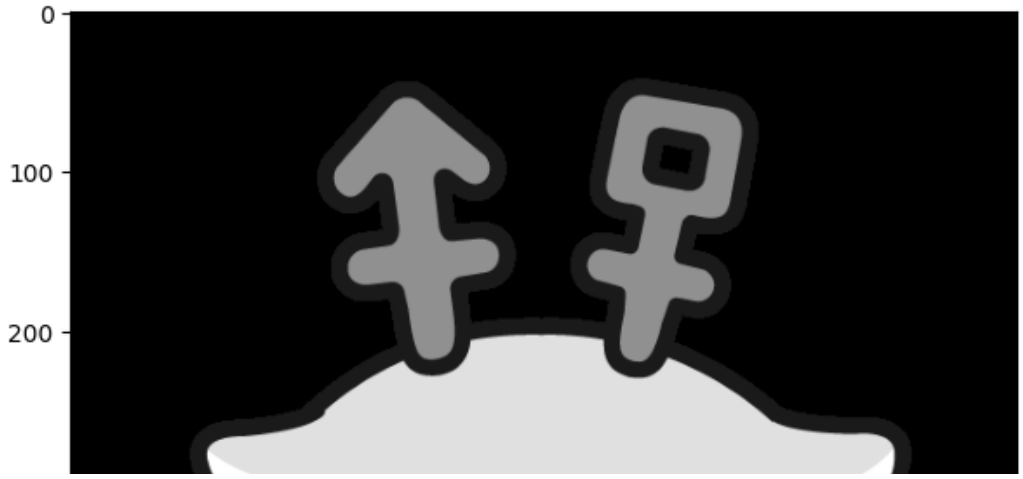
```
(842, 842) (842, 595) (595, 595)
```

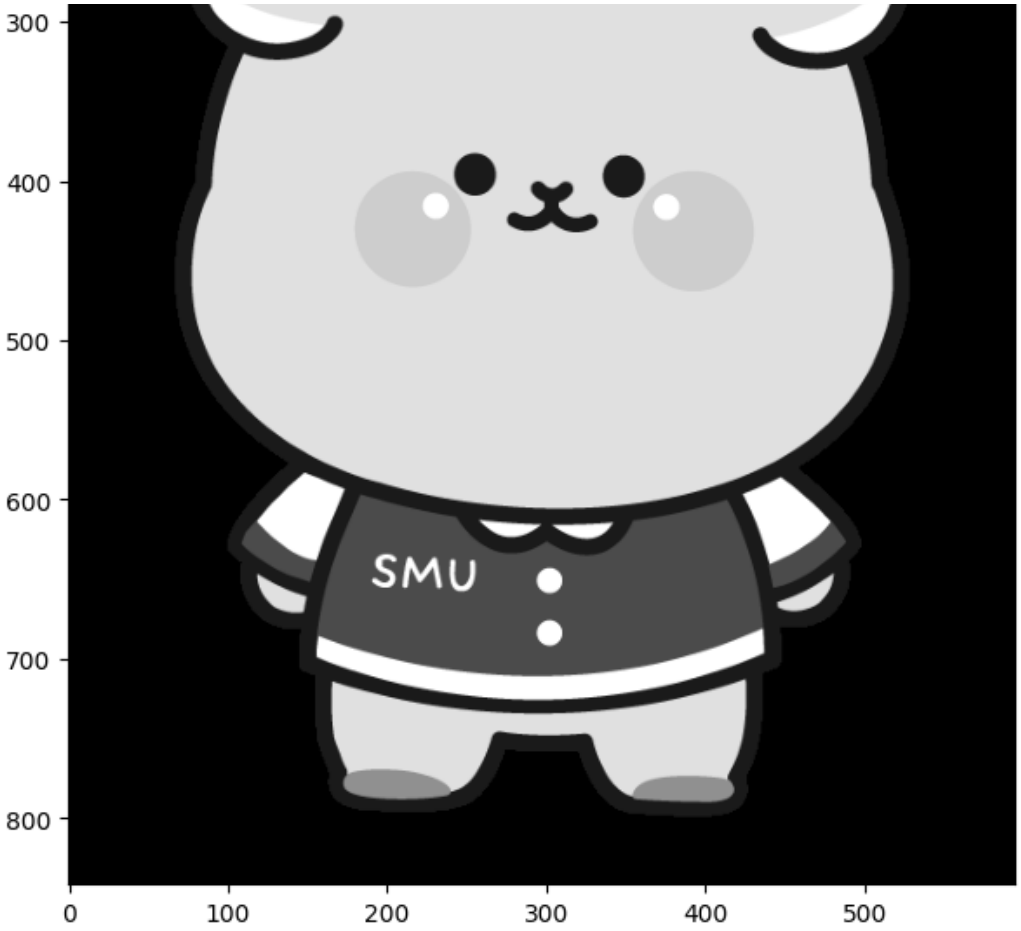
In [96]:
```
usv = U @ Sd @ V

print( np.allclose(imMatrix, usv))

plt.imshow(usv, cmap='gray')
plt.show()
```

```
True
```





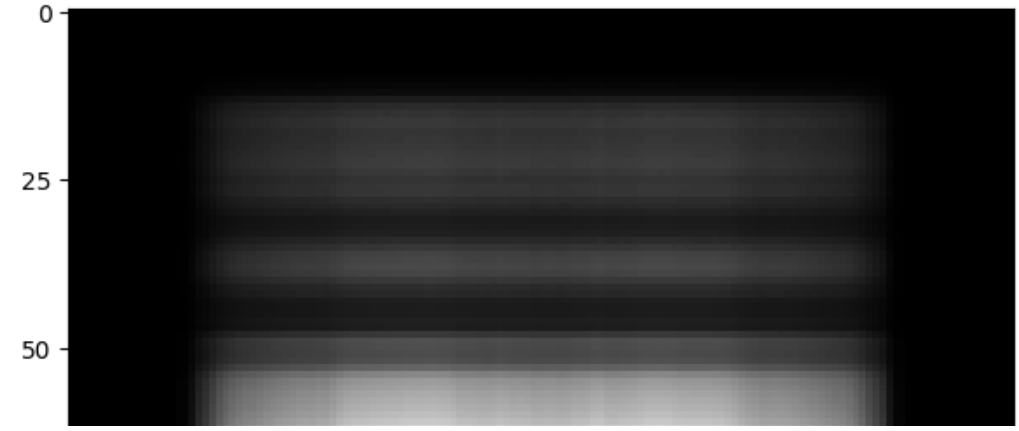
In [97]:

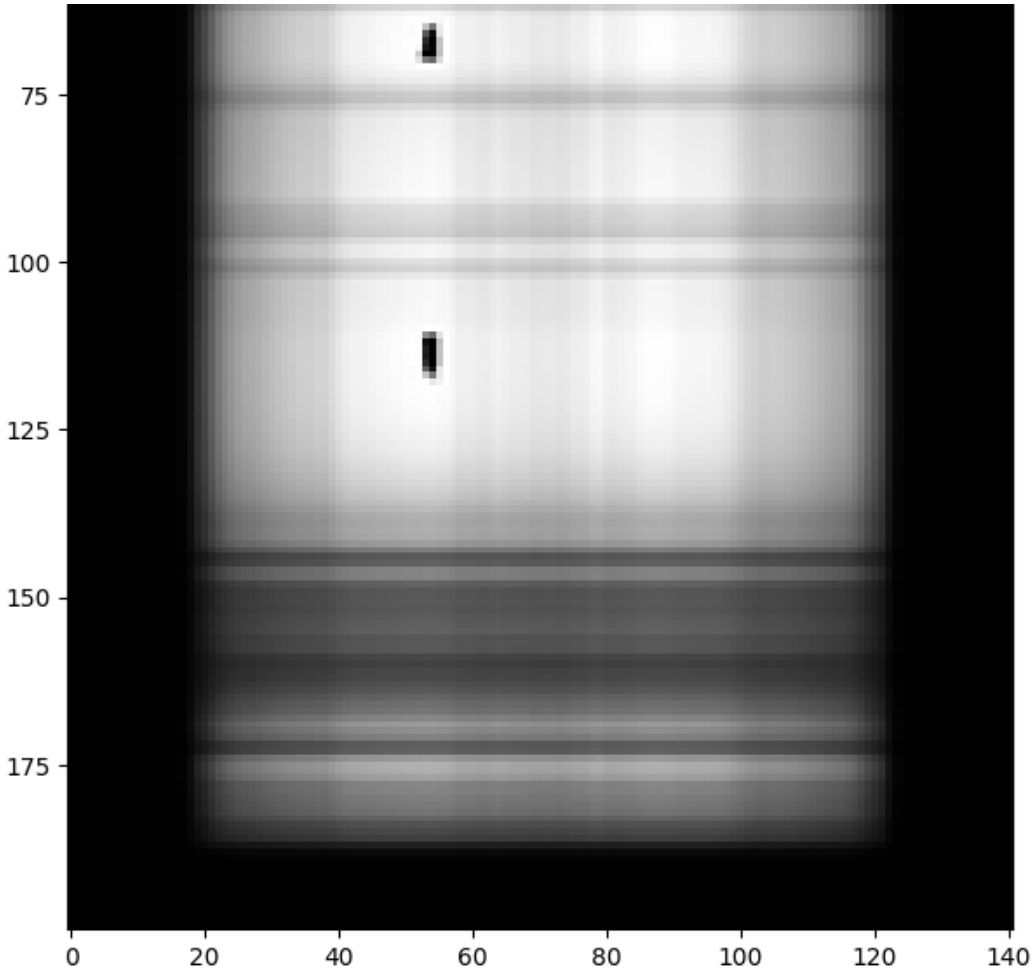
```
k = 1
print(np. shape(U[:,:k]))
print(np. shape(np.diag(S[:k])))
print(np. shape(V.T[:,:k].T))

m,n = np.shape(imMatrix)
partial, total = k*(m+n)+k, m*n
print(np.ndim(imMatrix),[np.shape(i) for i in [imMatrix,U,Sd,V]])
print(partial,total,partial/total)

size = (200,200)
imtemp = lambda k: (np.vstack(U[:,k-1])@np.vstack([S[k-1]])@np.vstack(V[k-1]).T)*255
for i in list(range(1,6)):
  im = Image.fromarray(imtemp(i).astype('uint8'))
  im.thumbnail(size, Image.ANTIALIAS)
  plt.imshow(im, cmap='gray')
  plt.show()
```

```
(842, 1)
(1, 1)
(1, 595)
2 [(842, 595), (842, 842), (842, 595), (595, 595)]
1438 500990 0.002870316772789876
```

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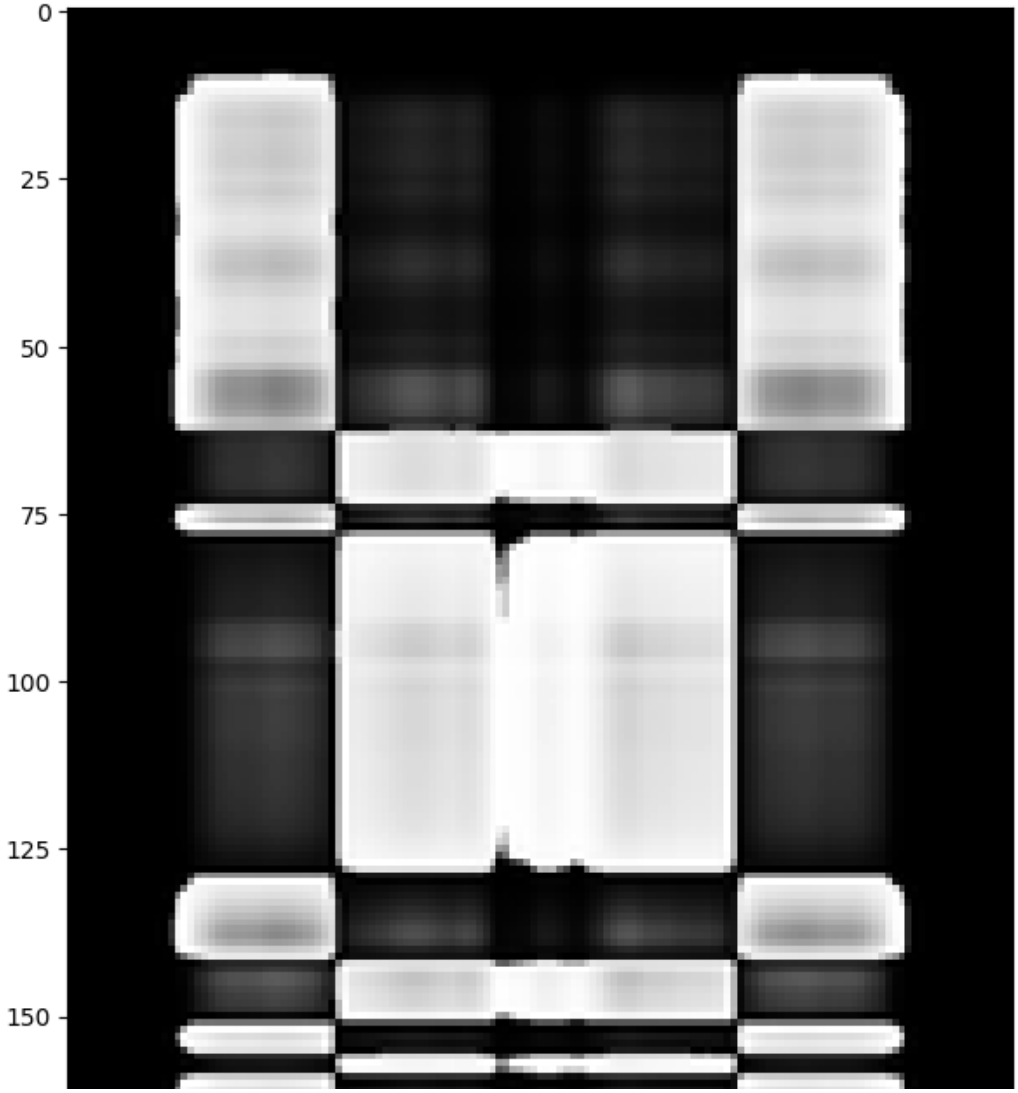
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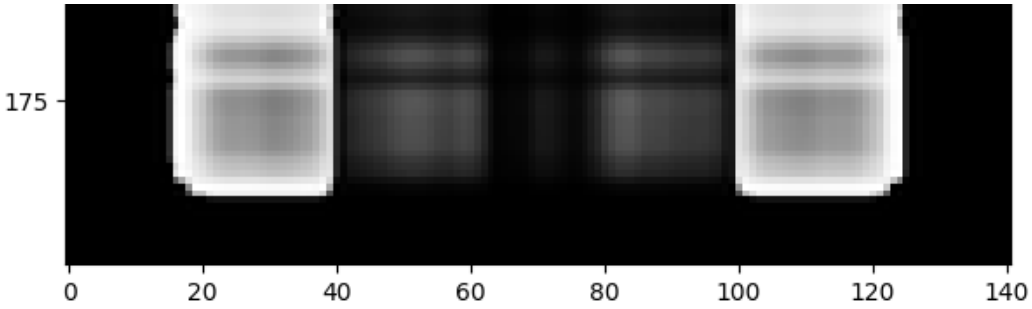
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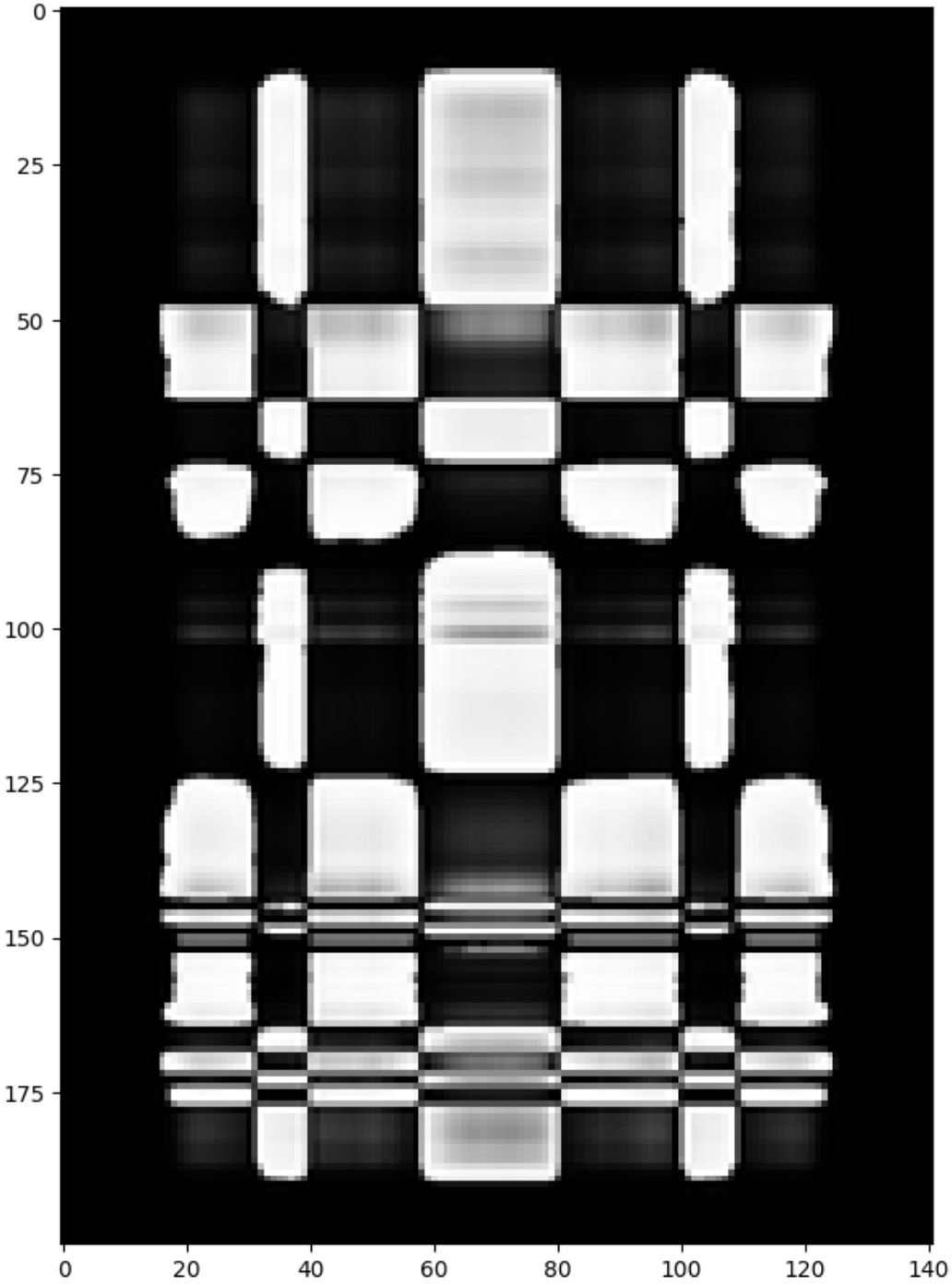
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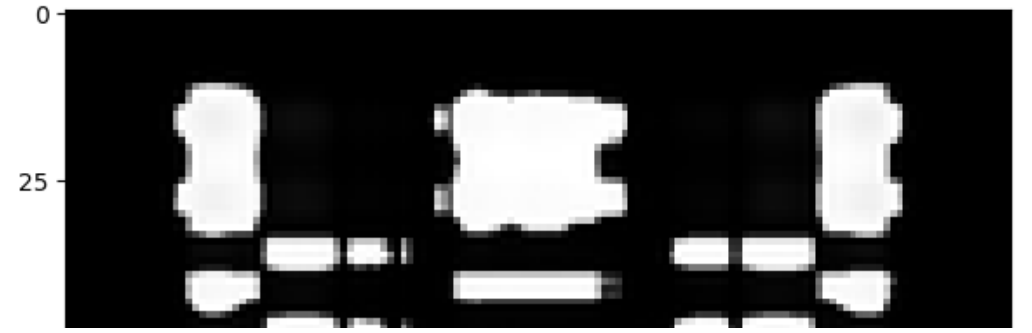
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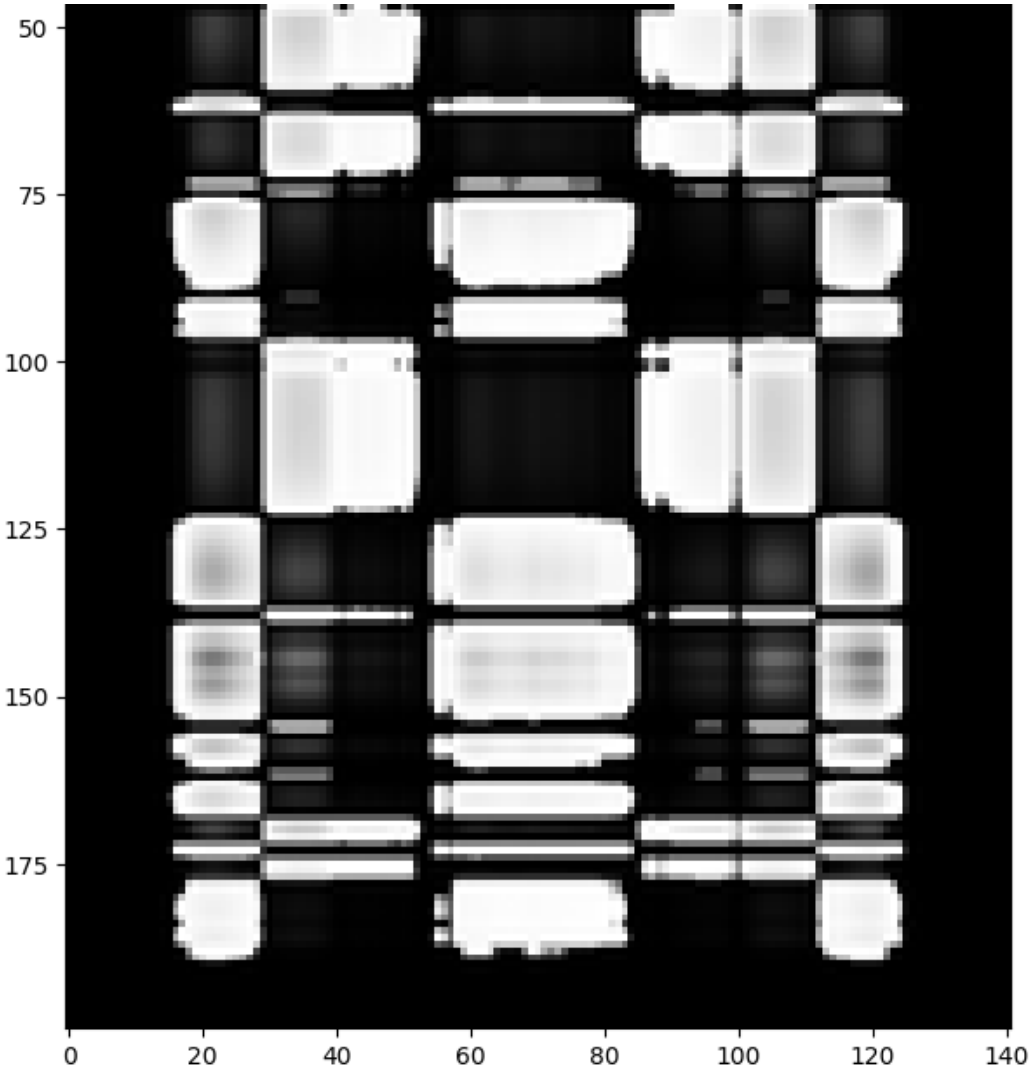
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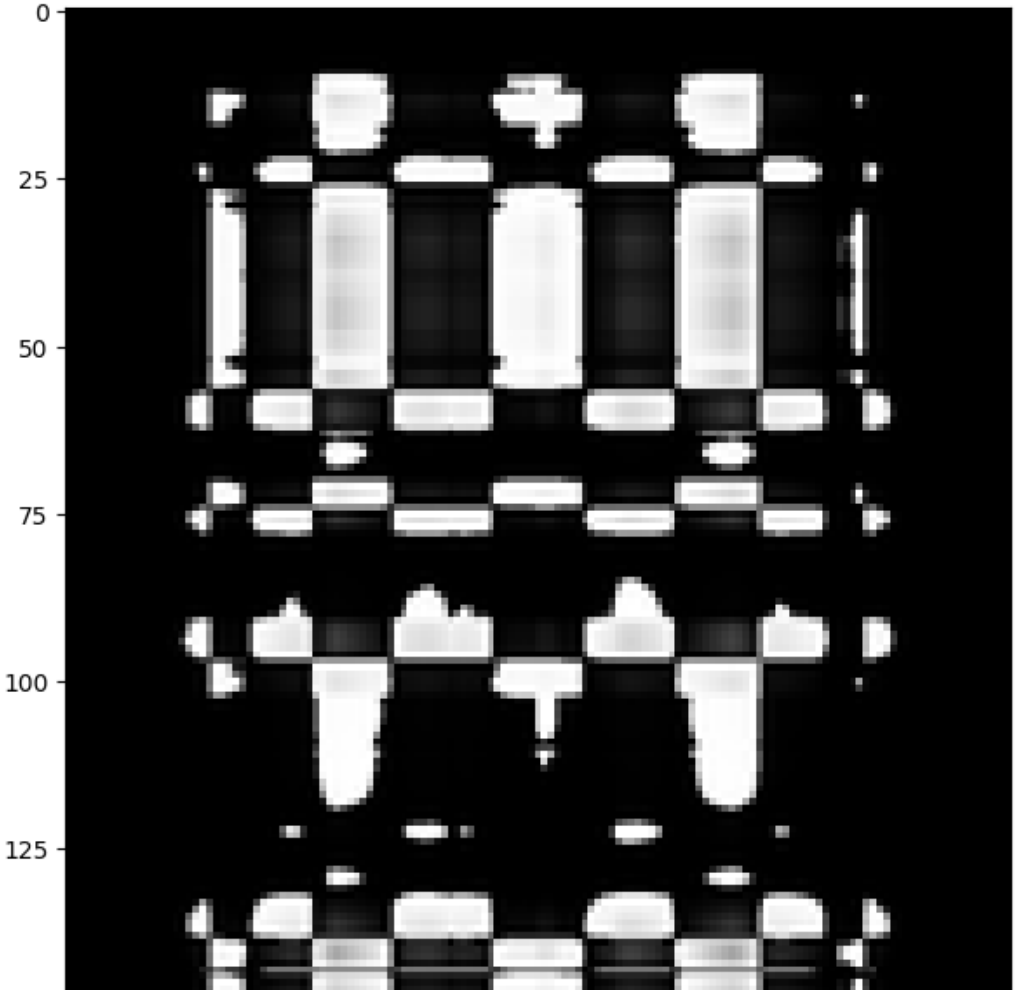
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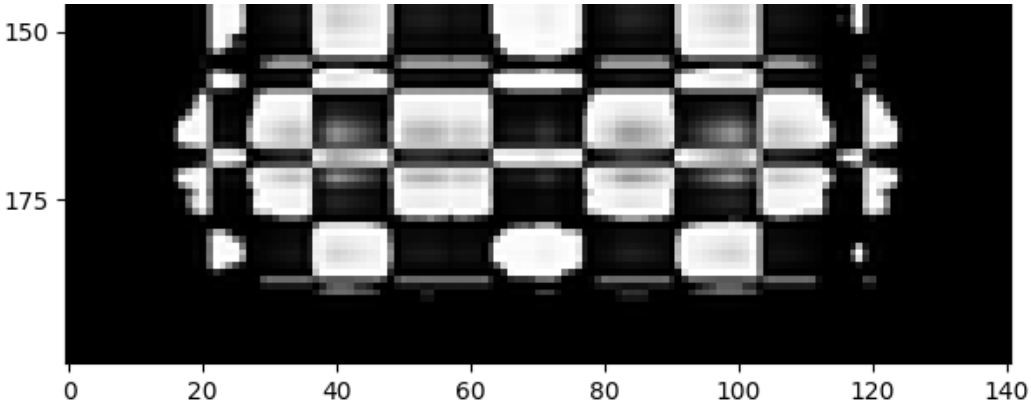
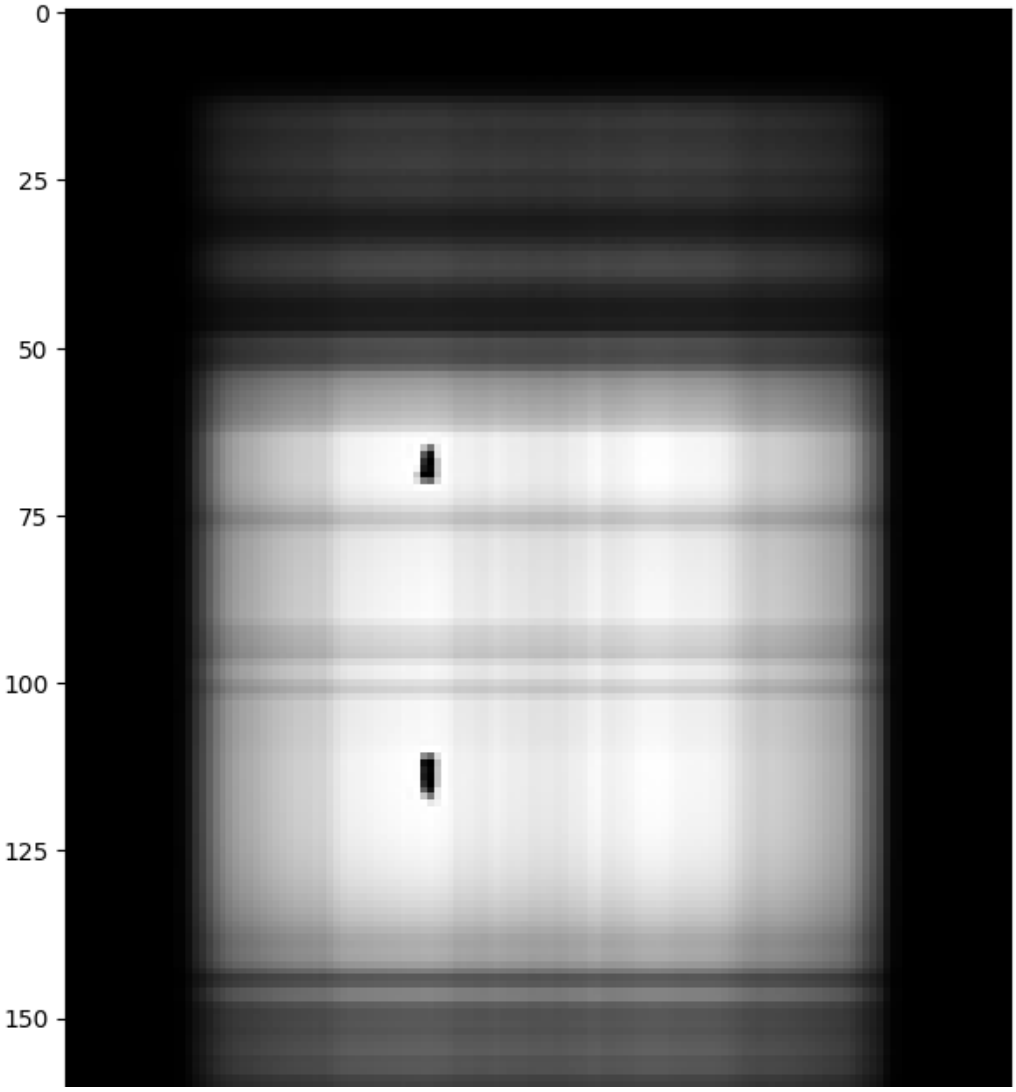


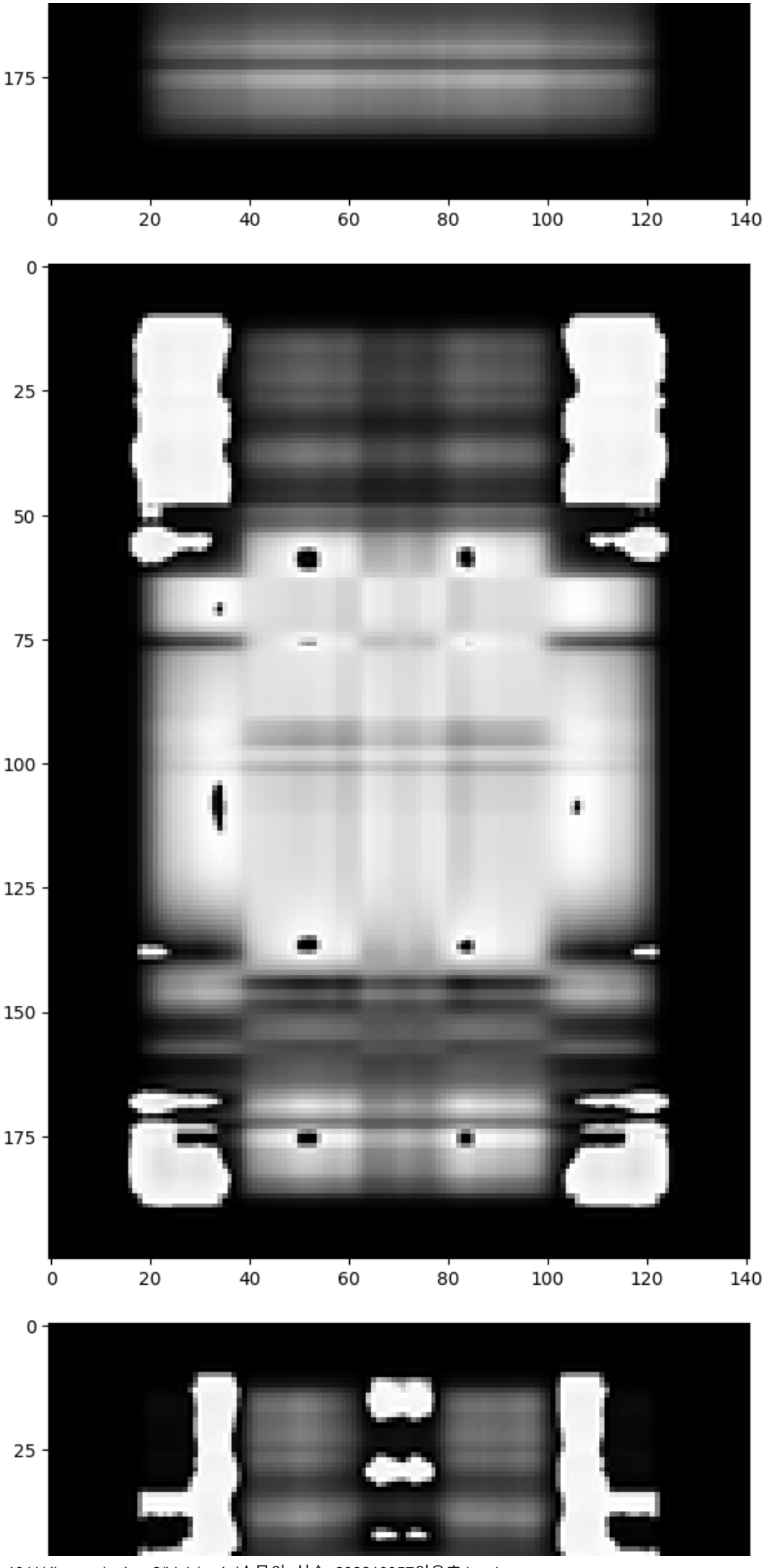
In [98]:

```
quality = 5
np. shape(U[:,:quality])
np. shape(np.diag(S[:quality]))
np. shape(V[:quality,:])
k = quality

m,n = np.shape(imMatrix)
partial, total = k*(m+n)+k, m*n
np.ndim(imMatrix),[np.shape(i) for i in [imMatrix,U,Sd,V]]
partial,total,partial/total

imtemp = lambda k: (U[:,:k]@np.diag(S[:k])@V.T[:,:k].T)*255
for i in list(range(1,6)):
  im = Image.fromarray(imtemp(i).astype('uint8'))
  im.thumbnail(size, Image.ANTIALIAS)
  plt.imshow(im, cmap='gray')
  plt.show()
```

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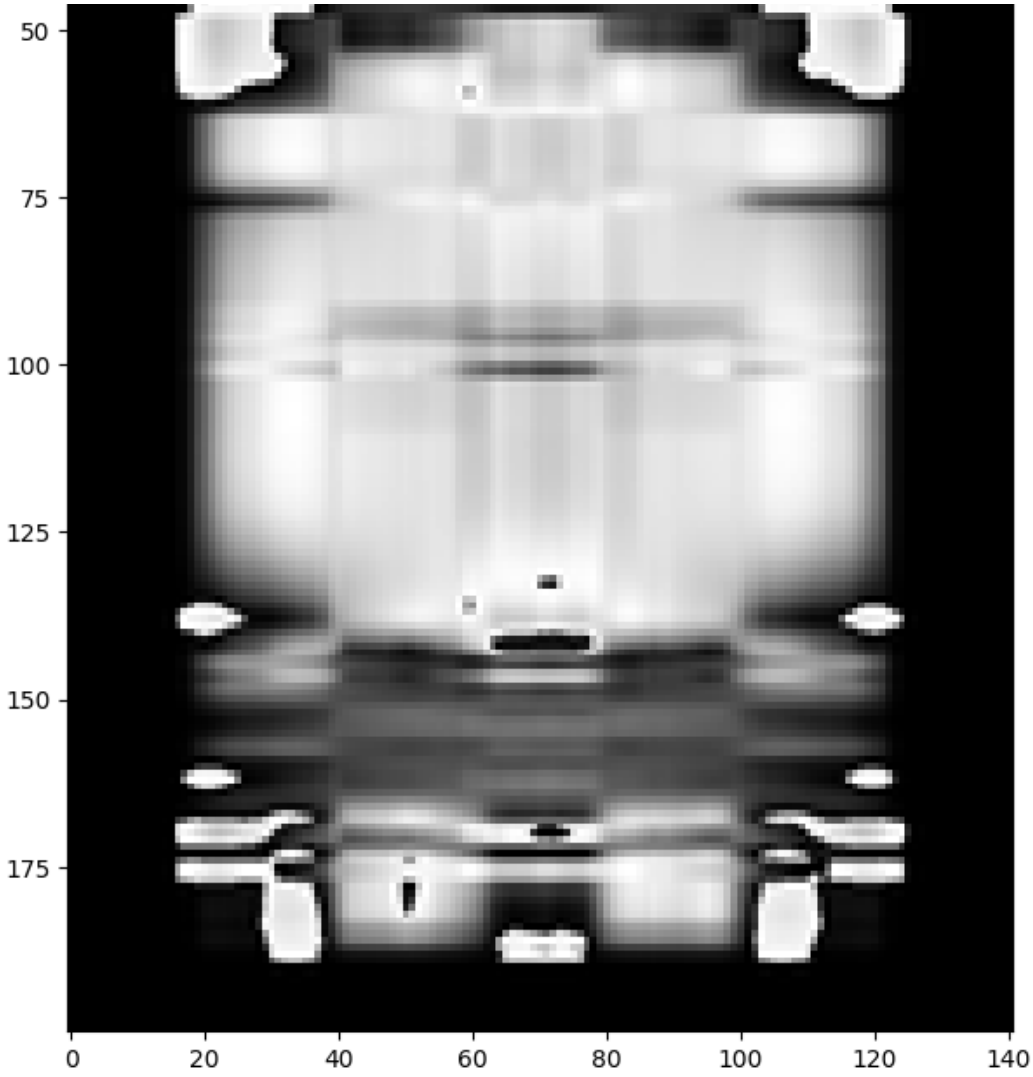
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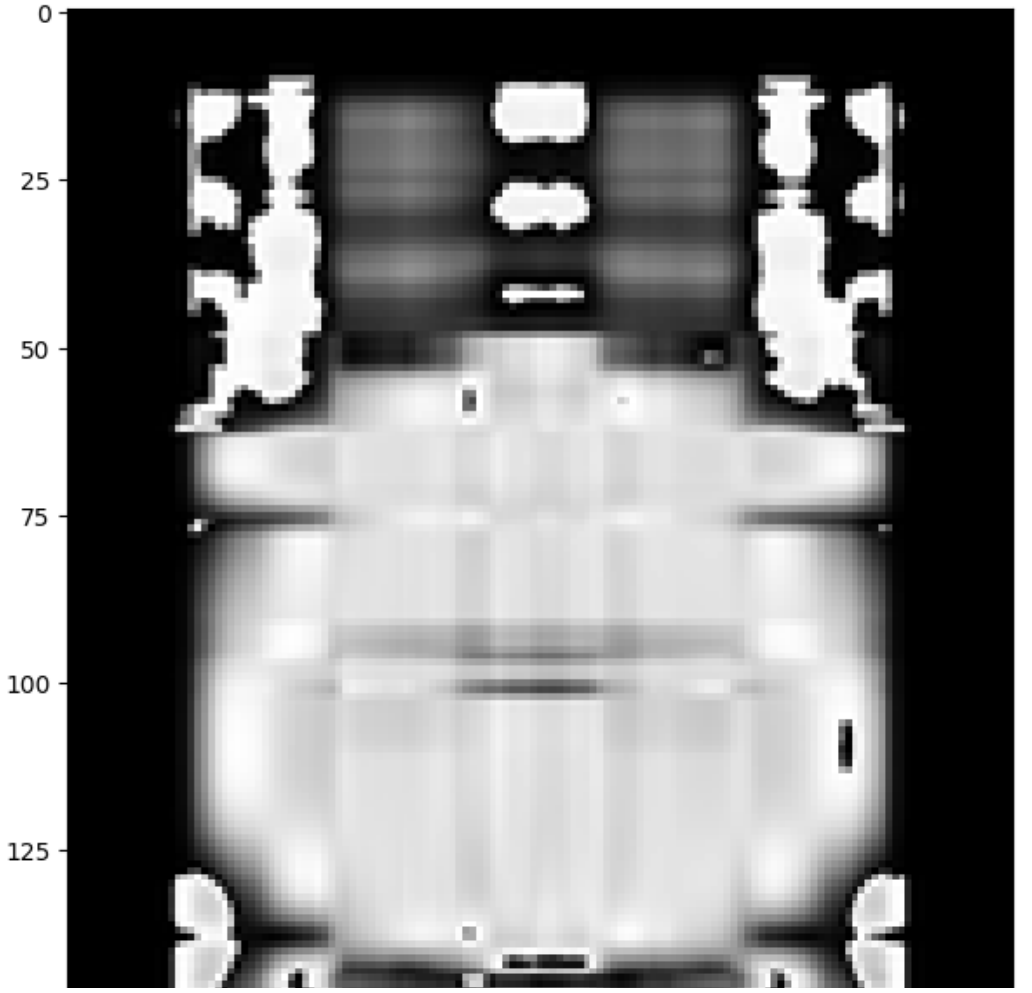
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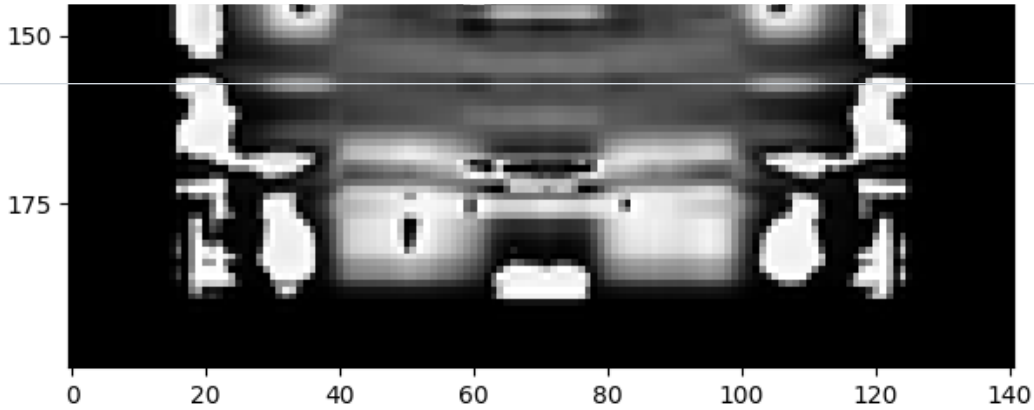
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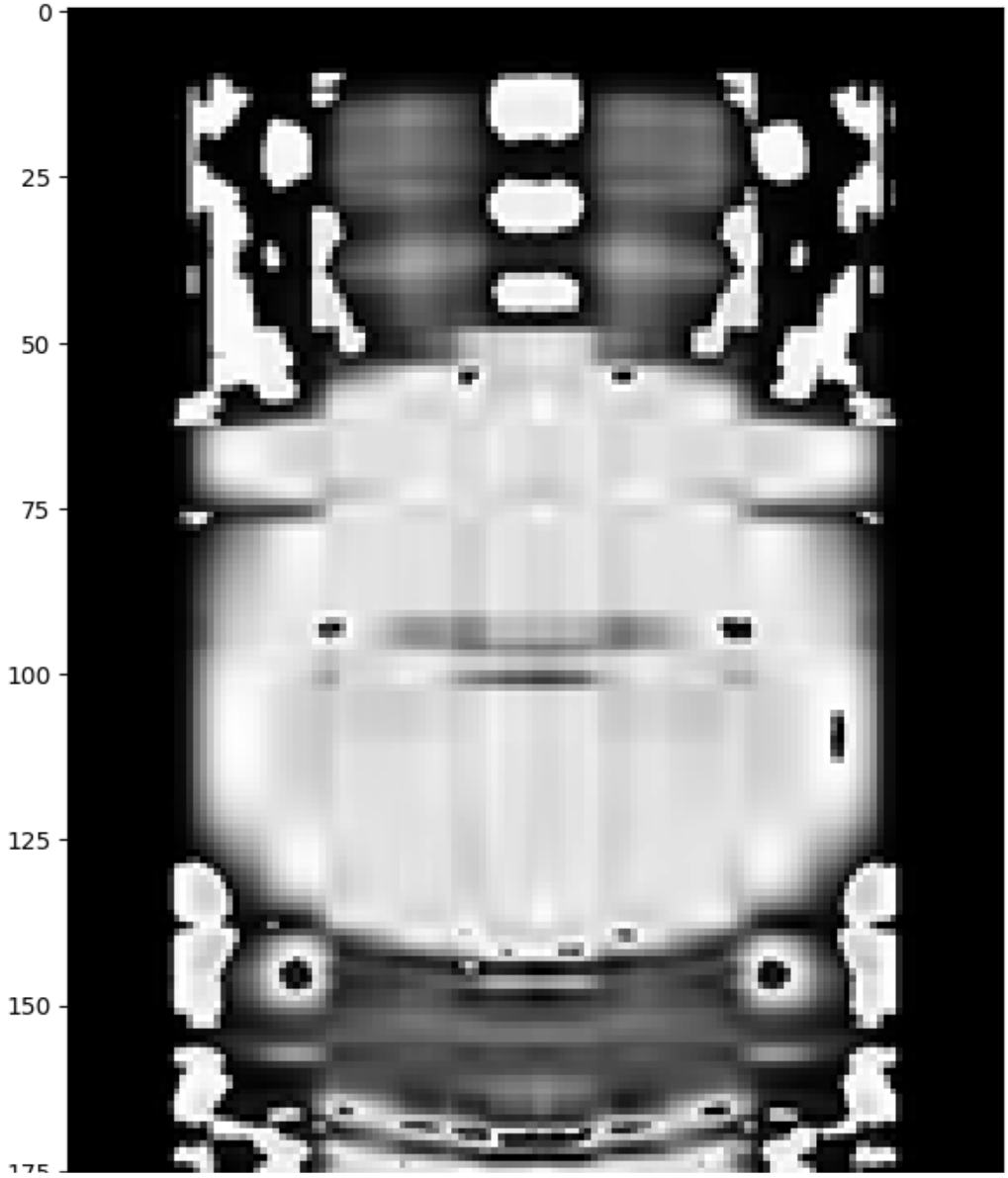
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