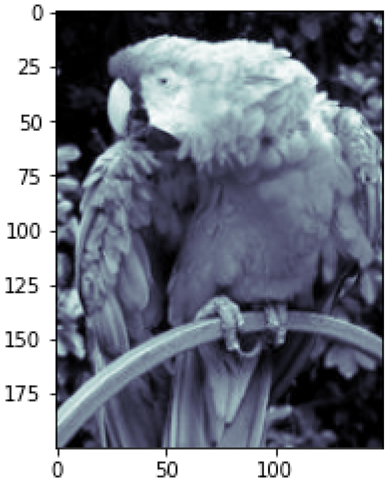
DIP LAB EXERCISE 06

In [163]:

```
import matplotlib.pyplot as plt
import numpy as np
import cv2
import math
```

In [164]:

```
img = plt.imread("img.jpg")
plt.imshow(img, cmap=plt.cm.bone)
plt.show()
img.shape
```



Out[164]:

```
(200, 150)
```

In [165]:

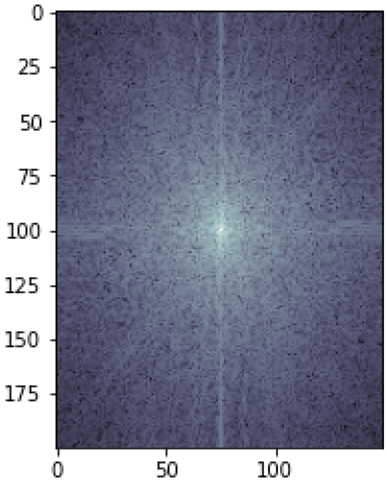
```
rows , cols = img.shape
```

In [166]:

```
dft = cv2.dft(np.float32(img),flags = cv2.DFT_COMPLEX_OUTPUT)
fotrans = np.fft.fftshift(dft)
mag = 20*np.log(cv2.magnitude(fotrans[:,:,0],fotrans[:,:,1]))
```

In [167]:

```
plt.imshow(mag, cmap=plt.cm.bone)
plt.show()
img.shape
```



Out[167]:

```
(200, 150)
```

Frequency Domain Smoothing Filters

In [168]:

```
D_0 = 20
```

In [169]:

```
def Distance(rows,cols,u,v):
    dist = math.sqrt((u-rows/2)**2 + (v-cols/2)**2)

    return dist
```

#1 Ideal Low Pass Filter

In [170]:

```
def IdealLowPass(D_0,dist):
    if dist <= D_0:
        return 1
    else:
        return 0
```

In [171]:

```
ideallpf = np.zeros((rows,cols,2))
magspec = np.zeros((rows,cols,2))
```

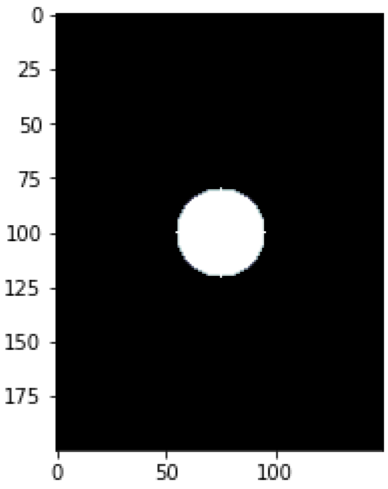
In [172]:

```
for u in range(rows):
    for v in range(cols):
        dist = Distance(rows,cols,u,v)
        H_uv = IdealLowPass(D_0,dist)

        ideallpf[u][v] = H_uv
```

In [173]:

```
magspec = cv2.magnitude(ideallpf[:,:,0],ideallpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

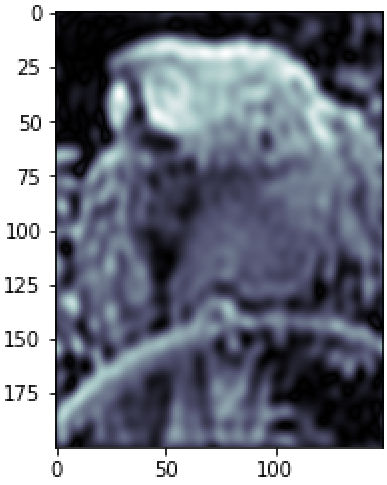


In [174]:

```
fshift = fotrans*ideallpf
f_ishift = np.fft.ifftshift(fshift)
imgideallpf = cv2.idft(f_ishift)
imgideallpf = cv2.magnitude(imgideallpf[:,:,0],imgideallpf[:,:,1])
```

In [175]:

```
plt.imshow(imgideallpf, cmap=plt.cm.bone)
plt.show()
```



#2 Butterworth Low Pass Filter

In [176]:

```
def ButterworthLowPass(D_0,dist,n):
    return (1/(1+(dist/D_0)**(2*n)))
```

In [177]:

```
butterlpf = np.zeros((rows,cols,2))
magspec = np.zeros((rows,cols,2))
```

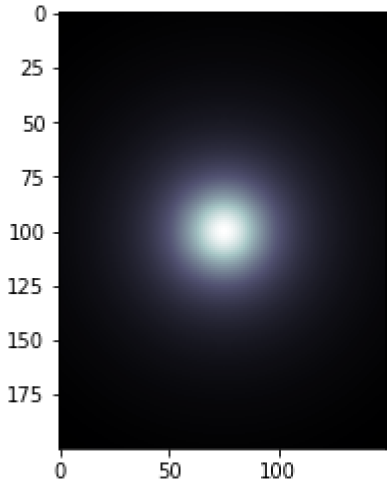
In [178]:

```
for u in range(rows):
    for v in range(cols):
        dist = Distance(rows,cols,u,v)
        H_uv = ButterworthLowPass(D_0,dist,1)

        butterlpf[u][v] = H_uv
```

In [179]:

```
magspec = cv2.magnitude(butterlpf[:,:,0],butterlpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

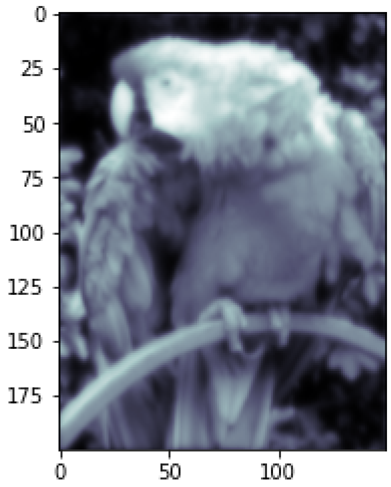


In [180]:

```
fshift = fotrans*butterlpf
f_ishift = np.fft.ifftshift(fshift)
imgbutterlpf = cv2.idft(f_ishift)
imgbutterlpf = cv2.magnitude(imgbutterlpf[:,:,0],imgbutterlpf[:,:,1])
```

In [181]:

```
plt.imshow(imgbutterlpf, cmap=plt.cm.bone)
plt.show()
```



#3 Gaussian Low Pass Filter

In [182]:

```
def GaussianLowPass(D_0,dist):
    return (math.exp(-1*((dist)**2)/(2*(D_0**2))))
```

In [183]:

```
glpf = np.zeros((rows,cols,2))
magspec = np.zeros((rows,cols,2))
```

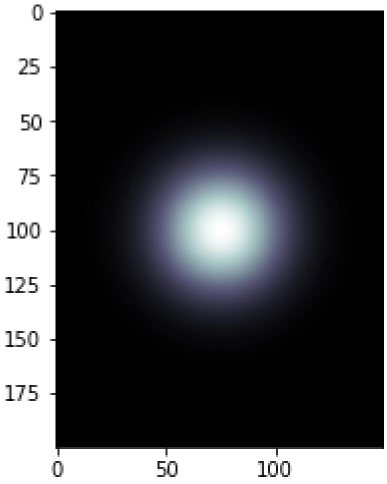
In [184]:

```
for u in range(rows):
    for v in range(cols):
        dist = Distance(rows,cols,u,v)
        H_uv = GaussianLowPass(D_0,dist)

        glpf[u][v] = H_uv
```

In [185]:

```
magspec = cv2.magnitude(glpf[:,:,0],glpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

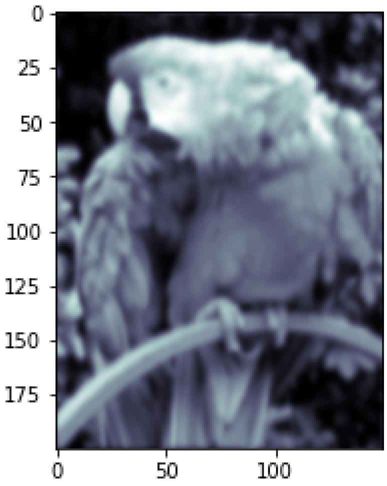


In [186]:

```
fshift = fotrans*glpf
f_ishift = np.fft.ifftshift(fshift)
imgglpf = cv2.idft(f_ishift)
imgglpf = cv2.magnitude(imgglpf[:,:,0],imgglpf[:,:,1])
```

In [187]:

```
plt.imshow(imgglpf, cmap=plt.cm.bone)
plt.show()
```



For the given cut-off frequency value D_0 = 20, We clearly see the smoothing quality:

Gaussian Low Pass Filter > Butterworth Low Pass Filter > Ideal Low Pass Filter

Ringing Effect of Ideal Low Pass Filter

In [188]:

```
D_0 = 25
```

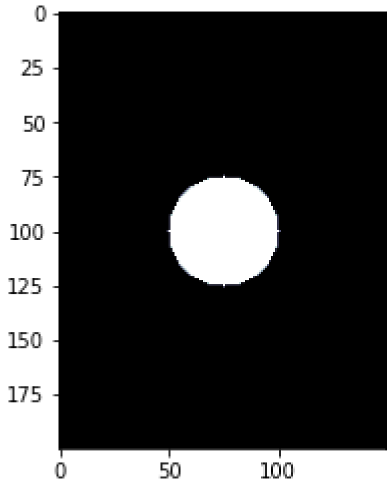
In [189]:

```
for u in range(rows):
    for v in range(cols):
        dist = Distance(rows,cols,u,v)
        H_uv = IdealLowPass(D_0,dist)

        ideallpf[u][v] = H_uv
```

In [190]:

```
magspec = cv2.magnitude(ideallpf[:,:,0],ideallpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

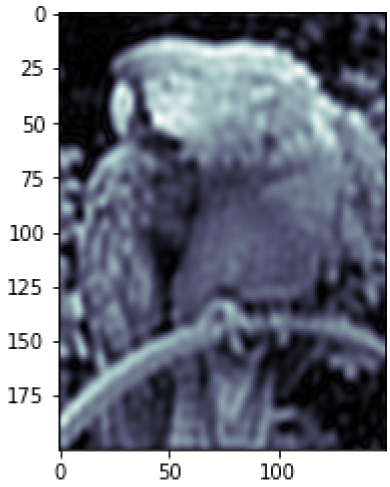


In [191]:

```
fshift = fotrans*ideallpf
f_ishift = np.fft.ifftshift(fshift)
imgideallpf = cv2.idft(f_ishift)
imgideallpf = cv2.magnitude(imgideallpf[:,:,0],imgideallpf[:,:,1])
```

In [192]:

```
plt.imshow(imgideallpf, cmap=plt.cm.bone)
plt.show()
```



The rippling artifact around the edges of the objects in the image is the 'ringing effect'.

Butterworth Low Pass Filters for different cut-off frequencies (n = 2)

In [193]:

```
n = 2
```

For D_0 = 5

In [194]:

```
D_0 = 5
```

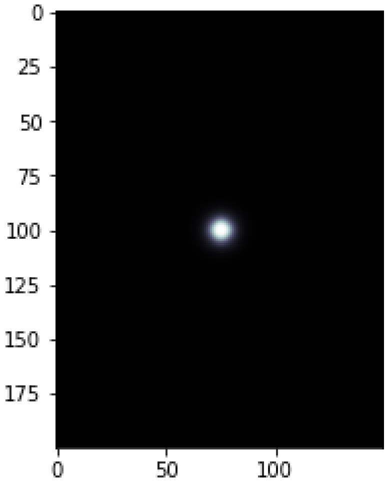
In [195]:

```
for u in range(rows):
    for v in range(cols):
        dist = Distance(rows,cols,u,v)
        H_uv = ButterworthLowPass(D_0,dist,n)

        butterlpf[u][v] = H_uv
```

In [196]:

```
magspec = cv2.magnitude(butterlpf[:,:,0],butterlpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

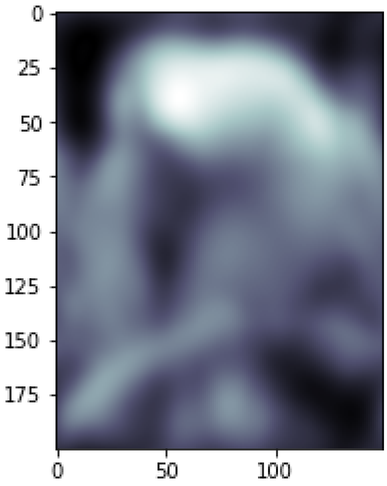


In [197]:

```
fshift = fotrans*butterlpf
f_ishift = np.fft.ifftshift(fshift)
imgbutterlpf = cv2.idft(f_ishift)
imgbutterlpf = cv2.magnitude(imgbutterlpf[:,:,0],imgbutterlpf[:,:,1])
```

In [198]:

```
plt.imshow(imgbutterlpf, cmap=plt.cm.bone)
plt.show()
```



For D_0 = 15

In [199]:

```
D_0 = 15
```

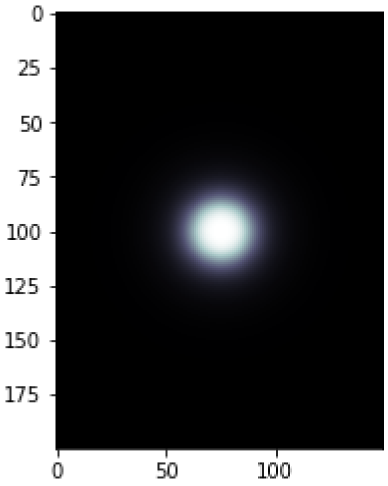
In [200]:

```
for u in range(rows):
    for v in range(cols):
        dist = Distance(rows,cols,u,v)
        H_uv = ButterworthLowPass(D_0,dist,n)

        butterlpf[u][v] = H_uv
```

In [201]:

```
magspec = cv2.magnitude(butterlpf[:,:,0],butterlpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

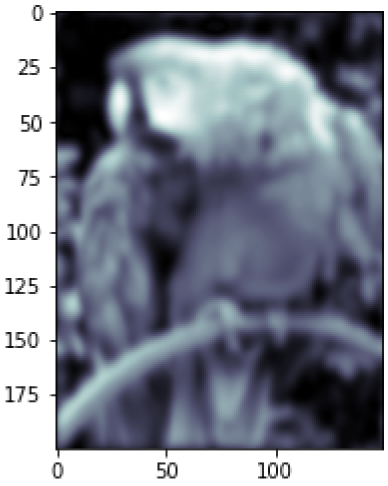


In [202]:

```
fshift = fotrans*butterlpf
f_ishift = np.fft.ifftshift(fshift)
imgbutterlpf = cv2.idft(f_ishift)
imgbutterlpf = cv2.magnitude(imgbutterlpf[:,:,0],imgbutterlpf[:,:,1])
```

In [203]:

```
plt.imshow(imgbutterlpf, cmap=plt.cm.bone)
plt.show()
```



For D_0 = 30

In [204]:

```
D_0 = 30
```

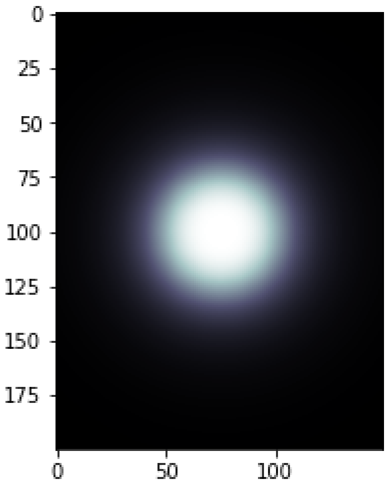
In [205]:

```
for u in range(rows):
    for v in range(cols):
        dist = Distance(rows,cols,u,v)
        H_uv = ButterworthLowPass(D_0,dist,n)

        butterlpf[u][v] = H_uv
```

In [206]:

```
magspec = cv2.magnitude(butterlpf[:,:,0],butterlpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

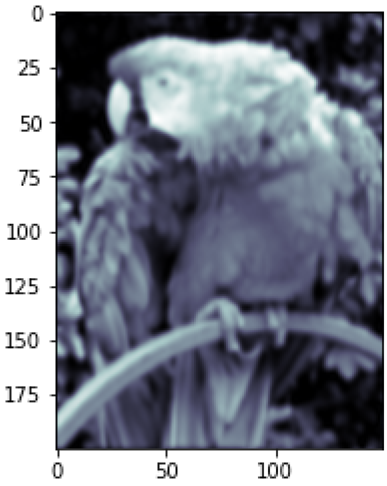


In [207]:

```
fshift = fotrans*butterlpf
f_ishift = np.fft.ifftshift(fshift)
imgbutterlpf = cv2.idft(f_ishift)
imgbutterlpf = cv2.magnitude(imgbutterlpf[:,:,0],imgbutterlpf[:,:,1])
```

In [208]:

```
plt.imshow(imgbutterlpf, cmap=plt.cm.bone)
plt.show()
```



For D_0 = 90

In [209]:

```
D_0 = 90
```

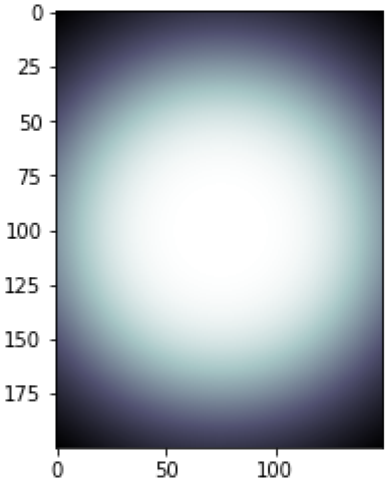
In [210]:

```
for u in range(rows):
    for v in range(cols):
        dist = Distance(rows,cols,u,v)
        H_uv = ButterworthLowPass(D_0,dist,n)

        butterlpf[u][v] = H_uv
```

In [211]:

```
magspec = cv2.magnitude(butterlpf[:,:,0],butterlpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

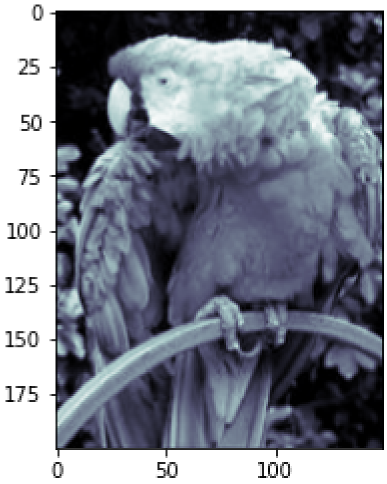


In [212]:

```
fshift = fotrans*butterlpf
f_ishift = np.fft.ifftshift(fshift)
imgbutterlpf = cv2.idft(f_ishift)
imgbutterlpf = cv2.magnitude(imgbutterlpf[:,:,0],imgbutterlpf[:,:,1])
```

In [213]:

```
plt.imshow(imgbutterlpf, cmap=plt.cm.bone)
plt.show()
```



For D_0 = 120

In [214]:

```
D_0 = 120
```

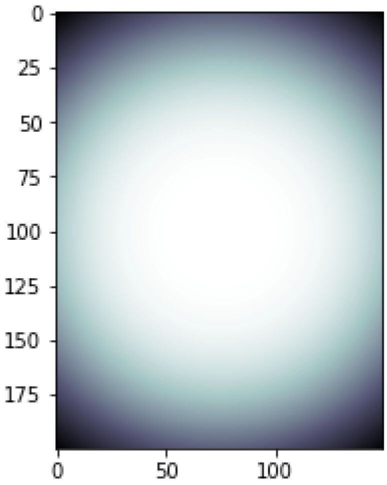
In [215]:

```
for u in range(rows):
    for v in range(cols):
        dist = Distance(rows,cols,u,v)
        H_uv = ButterworthLowPass(D_0,dist,n)

        butterlpf[u][v] = H_uv
```

In [216]:

```
magspec = cv2.magnitude(butterlpf[:,:,0],butterlpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

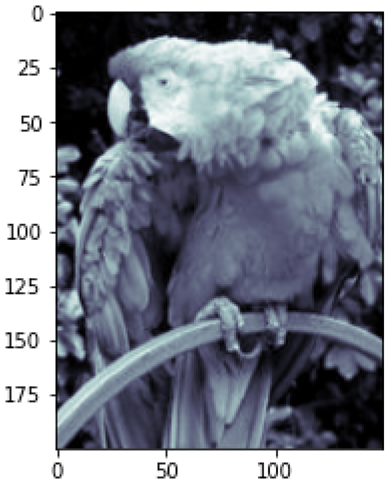


In [217]:

```
fshift = fotrans*butterlpf
f_ishift = np.fft.ifftshift(fshift)
imgbutterlpf = cv2.idft(f_ishift)
imgbutterlpf = cv2.magnitude(imgbutterlpf[:,:,0],imgbutterlpf[:,:,1])
```

In [218]:

```
plt.imshow(imgbutterlpf, cmap=plt.cm.bone)
plt.show()
```



Gaussian Low Pass Filters for different cut-off frequencies

For D_0 = 5

In [219]:

```
D_0 = 5
```

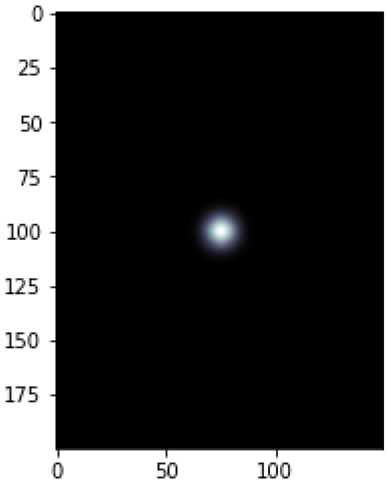
In [220]:

```
for u in range(rows):
    for v in range(cols):
        dist = Distance(rows,cols,u,v)
        H_uv = GaussianLowPass(D_0,dist)

        glpf[u][v] = H_uv
```

In [221]:

```
magspec = cv2.magnitude(glpf[:,:,0],glpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

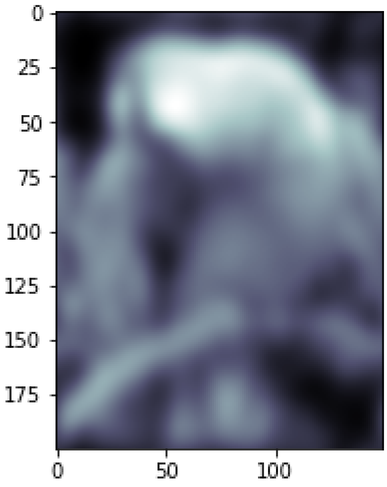


In [222]:

```
fshift = fotrans*glpf
f_ishift = np.fft.ifftshift(fshift)
imgglpf = cv2.idft(f_ishift)
imgglpf = cv2.magnitude(imgglpf[:,:,0],imgglpf[:,:,1])
```

In [223]:

```
plt.imshow(imgglpf, cmap=plt.cm.bone)
plt.show()
```



D_0 = 15

In [224]:

```
D_0 = 15
```

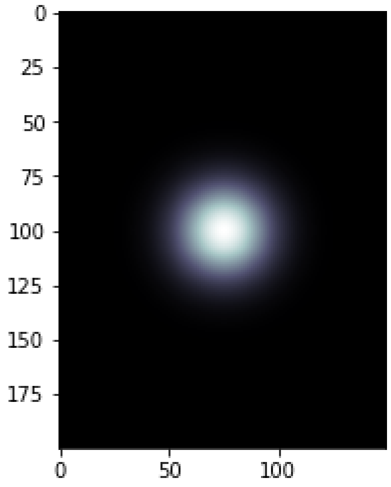
In [225]:

```
for u in range(rows):
    for v in range(cols):
        dist = Distance(rows,cols,u,v)
        H_uv = GaussianLowPass(D_0,dist)

        glpf[u][v] = H_uv
```

In [226]:

```
magspec = cv2.magnitude(glpf[:,:,0],glpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

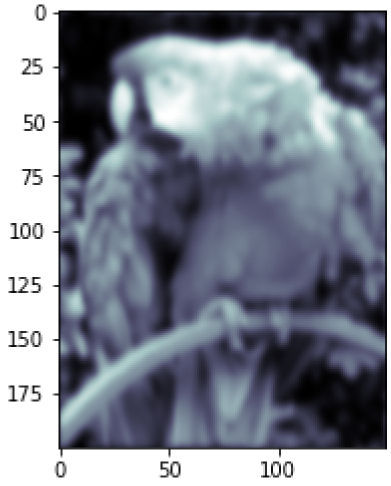


In [227]:

```
fshift = fotrans*glpf
f_ishift = np.fft.ifftshift(fshift)
imgglpf = cv2.idft(f_ishift)
imgglpf = cv2.magnitude(imgglpf[:,:,0],imgglpf[:,:,1])
```

In [228]:

```
plt.imshow(imgglpf, cmap=plt.cm.bone)
plt.show()
```



For D_0 = 30

In [229]:

```
D_0 = 30
```

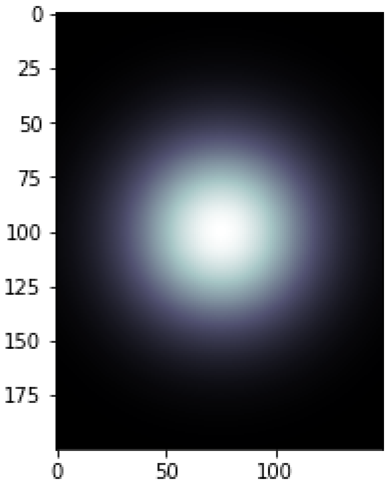
In [230]:

```
for u in range(rows):
    for v in range(cols):
        dist = Distance(rows,cols,u,v)
        H_uv = GaussianLowPass(D_0,dist)

        glpf[u][v] = H_uv
```

In [231]:

```
magspec = cv2.magnitude(glpf[:,:,0],glpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

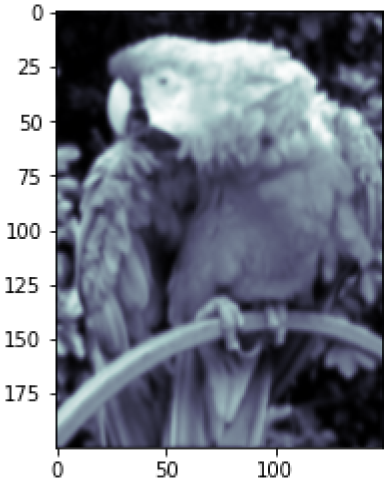


In [232]:

```
fshift = fotrans*glpf
f_ishift = np.fft.ifftshift(fshift)
imgglpf = cv2.idft(f_ishift)
imgglpf = cv2.magnitude(imgglpf[:,:,0],imgglpf[:,:,1])
```

In [233]:

```
plt.imshow(imgglpf, cmap=plt.cm.bone)
plt.show()
```



For D_0 = 90

In [234]:

```
D_0 = 90
```

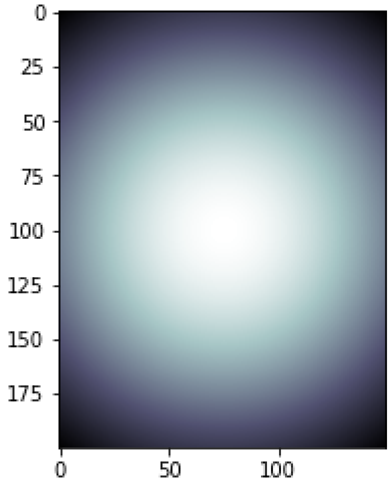
In [235]:

```
for u in range(rows):
    for v in range(cols):
        dist = Distance(rows,cols,u,v)
        H_uv = GaussianLowPass(D_0,dist)

        glpf[u][v] = H_uv
```

In [236]:

```
magspec = cv2.magnitude(glpf[:,:,0],glpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

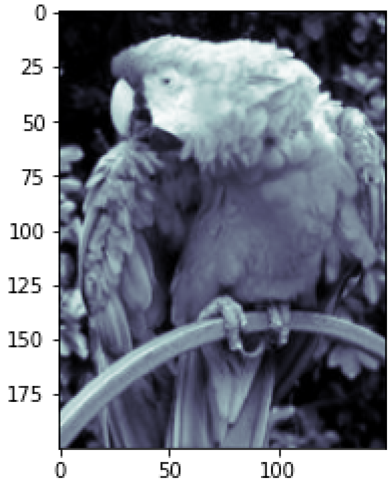


In [237]:

```
fshift = fotrans*glpf
f_ishift = np.fft.ifftshift(fshift)
imgglpf = cv2.idft(f_ishift)
imgglpf = cv2.magnitude(imgglpf[:,:,0],imgglpf[:,:,1])
```

In [238]:

```
plt.imshow(imgglpf, cmap=plt.cm.bone)
plt.show()
```



For D_0 = 120

In [239]:

```
D_0 = 120
```

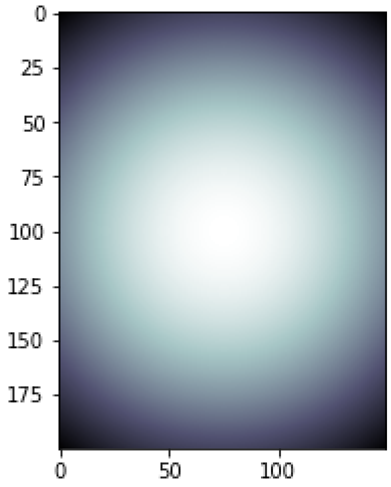
In [240]:

```
for u in range(rows):
    for v in range(cols):
        dist = Distance(rows,cols,u,v)
        H_uv = GaussianLowPass(D_0,dist)

        glpf[u][v] = H_uv
```

In [241]:

```
magspec = cv2.magnitude(glpf[:,:,0],glpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

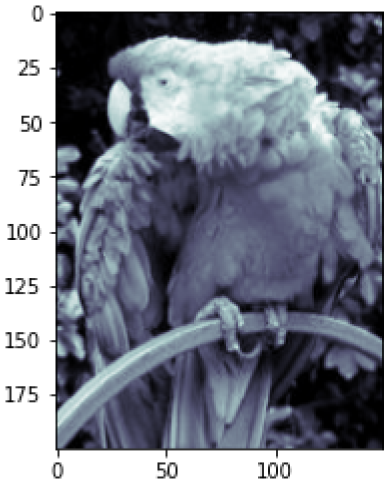


In [242]:

```
fshift = fotrans*glpf
f_ishift = np.fft.ifftshift(fshift)
imgglpf = cv2.idft(f_ishift)
imgglpf = cv2.magnitude(imgglpf[:,:,0],imgglpf[:,:,1])
```

In [243]:

```
plt.imshow(imgglpf, cmap=plt.cm.bone)
plt.show()
```



Frequency Domain Sharpening Filters

In [244]:

```
D_0 = 20
```

#1 Ideal High Pass Filter

In [245]:

```
def IHPFTransFunc(D_0,dist):
    if dist <= D_0:
        return 0
    else:
        return 1
```

In [246]:

```
ihpf = np.zeros((rows,cols,2))
magspec = np.zeros((rows,cols,2))
```

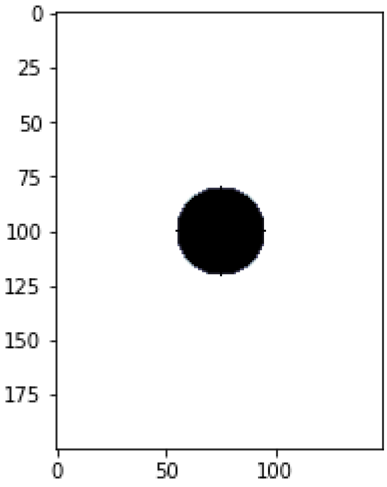
In [247]:

```
for u in range(rows):
    for v in range(cols):
        dist = Distance(rows,cols,u,v)
        H_uv = IHPFTransFunc(D_0,dist)

        ihpf[u][v] = H_uv
```

In [248]:

```
magspec = cv2.magnitude(ihpf[:,:,0],ihpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

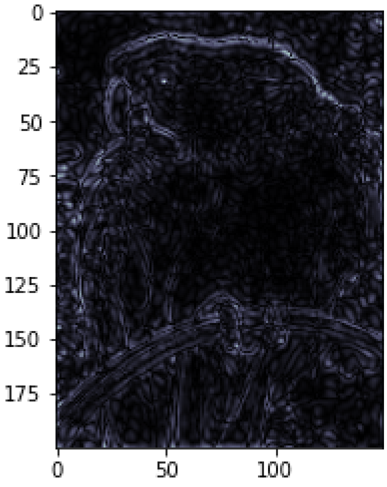


In [249]:

```
fshift = fotrans*ihpf
f_ishift = np.fft.ifftshift(fshift)
imgihpf = cv2.idft(f_ishift)
imgihpf = cv2.magnitude(imgihpf[:,:,0],imgihpf[:,:,1])
```

In [250]:

```
plt.imshow(imgihpf, cmap=plt.cm.bone)
plt.show()
```



#2 Butterworth High Pass Filter

In [251]:

```
def BHPFTransFunc(D_0,dist,n):
    return (1/(1+(D_0/dist)**(2*n)))
```

In [252]:

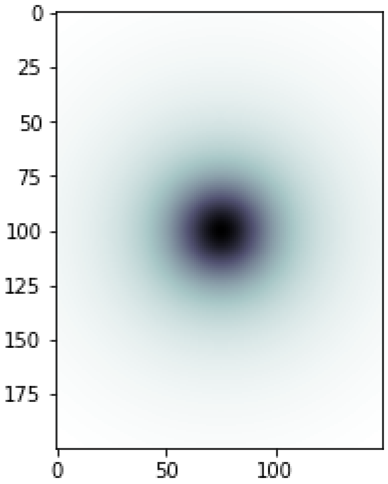
```
bhpf = np.zeros((rows,cols,2))
magspec = np.zeros((rows,cols,2))
```

In [253]:

```
for u in range(rows):
    for v in range(cols):
        if (u == rows/2 and v == cols/2):
            bhpf[u][v] = 0
        else:
            dist = Distance(rows,cols,u,v)
            H_uv = BHPFTransFunc(D_0,dist,1)
            bhpf[u][v] = H_uv
```

In [254]:

```
magspec = cv2.magnitude(bhpf[:,:,0],bhpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

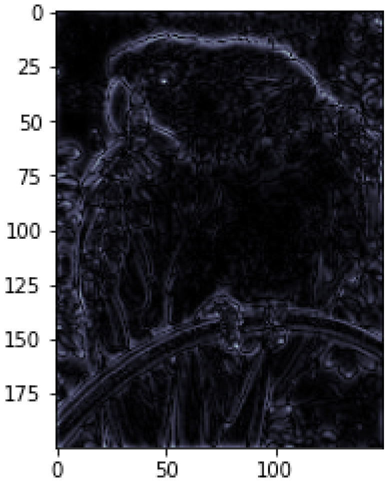


In [255]:

```
fshift = fotrans*bhpf
f_ishift = np.fft.ifftshift(fshift)
imgbhpf = cv2.idft(f_ishift)
imgbhpf = cv2.magnitude(imgbhpf[:,:,0],imgbhpf[:,:,1])
```

In [256]:

```
plt.imshow(imgbhpf, cmap=plt.cm.bone)
plt.show()
```



#3 Gaussian High Pass Filter

In [257]:

```
def GHPFTransFunc(D_0,dist):
    return (1 - math.exp(-1*((dist)**2)/(2*(D_0**2))))
```

In [258]:

```
ghpf = np.zeros((rows,cols,2))
magspec = np.zeros((rows,cols,2))
```

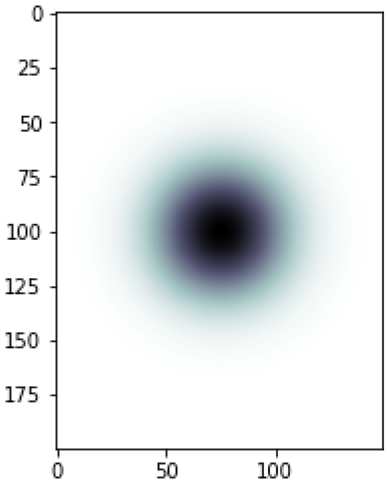
In [259]:

```
for u in range(rows):
    for v in range(cols):
        dist = Distance(rows,cols,u,v)
        H_uv = GHPFTransFunc(D_0,dist)

        ghpf[u][v] = H_uv
```

In [260]:

```
magspec = cv2.magnitude(ghpf[:,:,0],ghpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

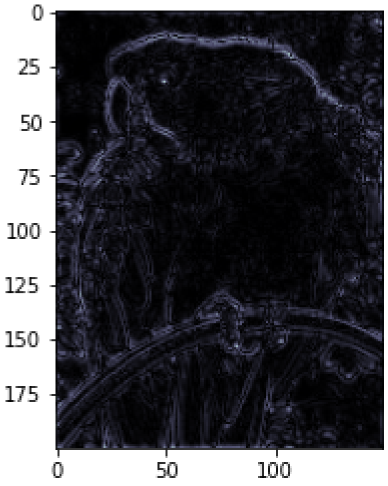


In [261]:

```
fshift = fotrans*ghpf
f_ishift = np.fft.ifftshift(fshift)
imgghpf = cv2.idft(f_ishift)
imgghpf = cv2.magnitude(imgghpf[:,:,0],imgghpf[:,:,1])
```

In [262]:

```
plt.imshow(imgghpf, cmap=plt.cm.bone)
plt.show()
```



For the given cut-off frequency value D_0 = 20, We clearly see the sharpening quality:

Ringing Effect of Ideal High Pass Filter

In [263]:

```
D_0 = 25
```

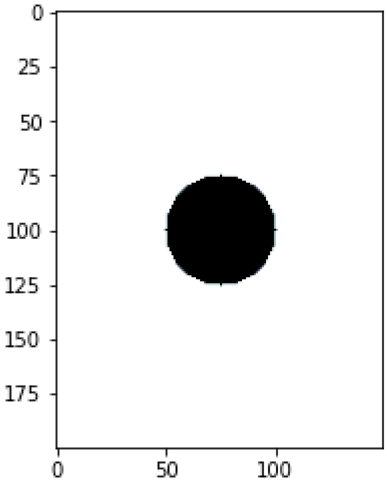
In [264]:

```
for u in range(rows):
    for v in range(cols):
        dist = Distance(rows,cols,u,v)
        H_uv = IHPFTransFunc(D_0,dist)

        ihpf[u][v] = H_uv
```

In [265]:

```
magspec = cv2.magnitude(ihpf[:,:,0],ihpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

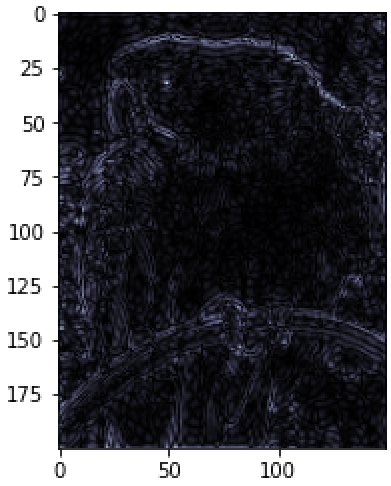


In [266]:

```
fshift = fotrans*ihpf
f_ishift = np.fft.ifftshift(fshift)
imgihpf = cv2.idft(f_ishift)
imgihpf = cv2.magnitude(imgihpf[:,:,0],imgihpf[:,:,1])
```

In [267]:

```
plt.imshow(imgihpf, cmap=plt.cm.bone)
plt.show()
```



The rippling artifact around the edges of the objects in the image is the 'ringing effect'.

Butterworth High Pass Filters for different cut-off frequencies (n = 2)

In [268]:

```
n = 2
```

For D_0 = 5

In [269]:

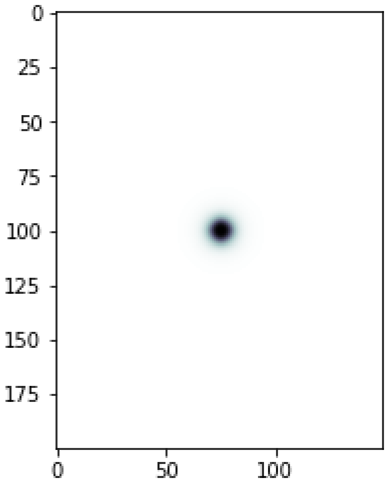
```
D_0 = 5
```

In [270]:

```
for u in range(rows):
    for v in range(cols):
        if (u == rows/2 and v == cols/2):
            bhpf[u][v] = 0
        else:
            dist = Distance(rows,cols,u,v)
            H_uv = BHPFTransFunc(D_0,dist,n)
            bhpf[u][v] = H_uv
```

In [271]:

```
magspec = cv2.magnitude(bhpf[:,:,0],bhpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

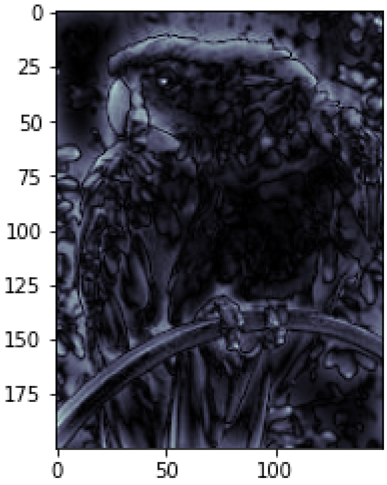


In [272]:

```
fshift = fotrans*bhpf
f_ishift = np.fft.ifftshift(fshift)
imgbhpf = cv2.idft(f_ishift)
imgbhpf = cv2.magnitude(imgbhpf[:,:,0],imgbhpf[:,:,1])
```

In [273]:

```
plt.imshow(imgbhpf, cmap=plt.cm.bone)
plt.show()
```



For D_0 = 15

In [274]:

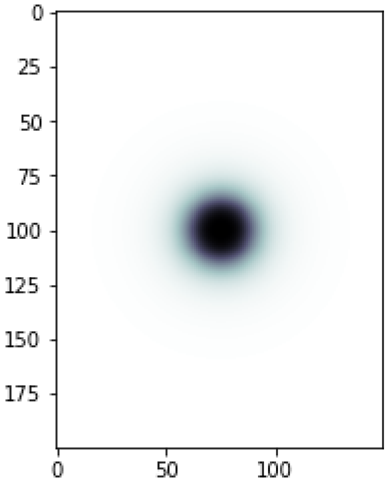
```
D_0 = 15
```

In [275]:

```
for u in range(rows):
    for v in range(cols):
        if (u == rows/2 and v == cols/2):
            bhpf[u][v] = 0
        else:
            dist = Distance(rows,cols,u,v)
            H_uv = BHPFTransFunc(D_0,dist,n)
            bhpf[u][v] = H_uv
```

In [276]:

```
magspec = cv2.magnitude(bhpf[:,:,0],bhpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

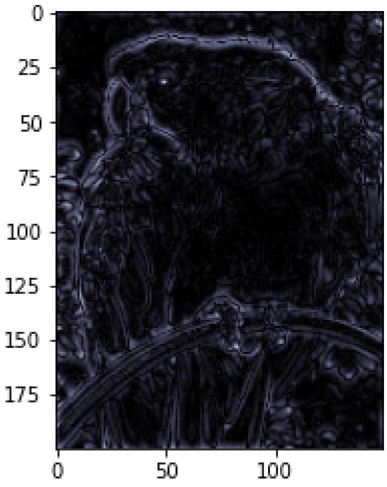


In [277]:

```
fshift = fotrans*bhpf
f_ishift = np.fft.ifftshift(fshift)
imgbhpf = cv2.idft(f_ishift)
imgbhpf = cv2.magnitude(imgbhpf[:,:,0],imgbhpf[:,:,1])
```

In [278]:

```
plt.imshow(imgbhpf, cmap=plt.cm.bone)
plt.show()
```



For D_0 = 30

In [279]:

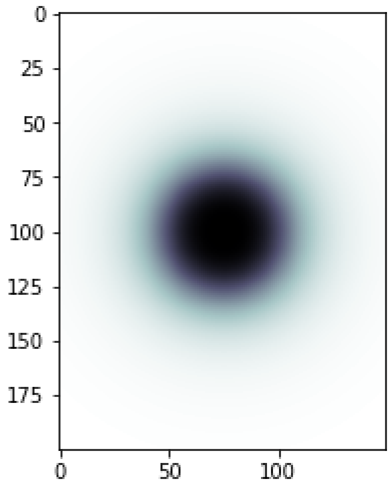
```
D_0 = 30
```

In [280]:

```
for u in range(rows):
    for v in range(cols):
        if (u == rows/2 and v == cols/2):
            bhpf[u][v] = 0
        else:
            dist = Distance(rows,cols,u,v)
            H_uv = BHPFTransFunc(D_0,dist,n)
            bhpf[u][v] = H_uv
```

In [281]:

```
magspec = cv2.magnitude(bhpf[:,:,0],bhpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

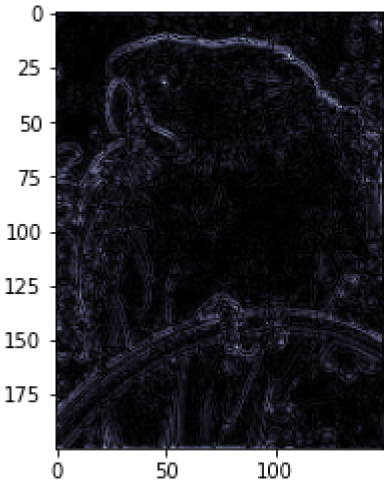


In [282]:

```
fshift = fotrans*bhpf
f_ishift = np.fft.ifftshift(fshift)
imgbhpf = cv2.idft(f_ishift)
imgbhpf = cv2.magnitude(imgbhpf[:,:,0],imgbhpf[:,:,1])
```

In [283]:

```
plt.imshow(imgbhpf, cmap=plt.cm.bone)
plt.show()
```



For D_0 = 90

In [284]:

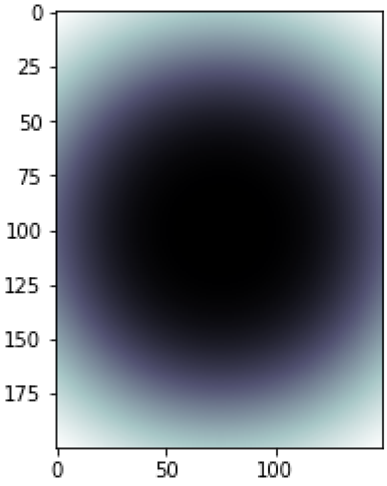
```
D_0 = 90
```

In [285]:

```
for u in range(rows):
    for v in range(cols):
        if (u == rows/2 and v == cols/2):
            bhpf[u][v] = 0
        else:
            dist = Distance(rows,cols,u,v)
            H_uv = BHPFTransFunc(D_0,dist,n)
            bhpf[u][v] = H_uv
```

In [286]:

```
magspec = cv2.magnitude(bhpf[:,:,0],bhpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

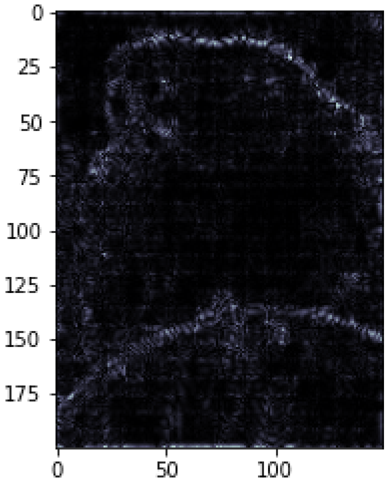


In [287]:

```
fshift = fotrans*bhpf
f_ishift = np.fft.ifftshift(fshift)
imgbhpf = cv2.idft(f_ishift)
imgbhpf = cv2.magnitude(imgbhpf[:,:,0],imgbhpf[:,:,1])
```

In [288]:

```
plt.imshow(imgbhpf, cmap=plt.cm.bone)
plt.show()
```



For D_0 = 120

In [289]:

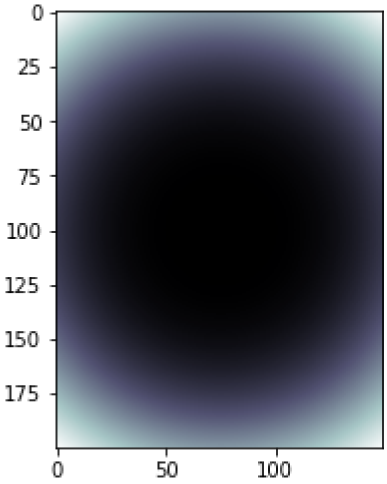
```
D_0 = 120
```

In [290]:

```
for u in range(rows):
    for v in range(cols):
        if (u == rows/2 and v == cols/2):
            bhpf[u][v] = 0
        else:
            dist = Distance(rows,cols,u,v)
            H_uv = BHPFTransFunc(D_0,dist,n)
            bhpf[u][v] = H_uv
```

In [291]:

```
magspec = cv2.magnitude(bhpf[:,:,0],bhpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

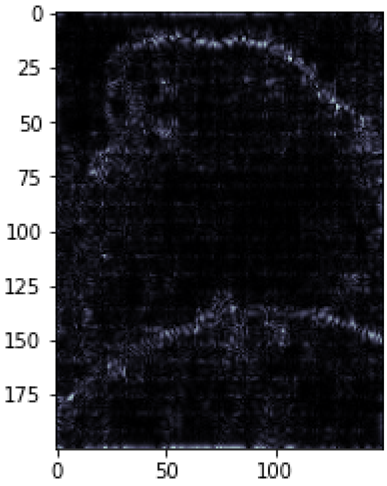


In [292]:

```
fshift = fotrans*bhpf
f_ishift = np.fft.ifftshift(fshift)
imgbhpf = cv2.idft(f_ishift)
imgbhpf = cv2.magnitude(imgbhpf[:,:,0],imgbhpf[:,:,1])
```

In [293]:

```
plt.imshow(imgbhpf, cmap=plt.cm.bone)
plt.show()
```



Gaussian High Pass Filters for different cut-off frequencies

For D_0 = 5

In [294]:

```
D_0 = 5
```

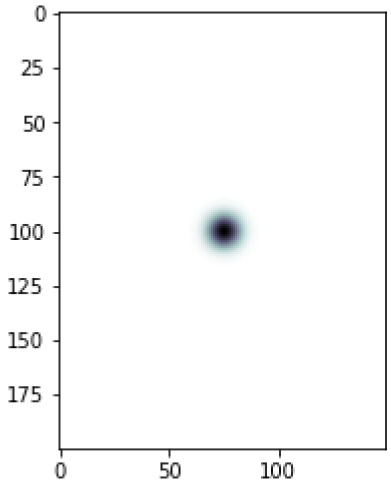
In [295]:

```
for u in range(rows):
    for v in range(cols):
        dist = Distance(rows,cols,u,v)
        H_uv = GHPFTransFunc(D_0,dist)

        ghpf[u][v] = H_uv
```

In [296]:

```
magspec = cv2.magnitude(ghpf[:,:,0],ghpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

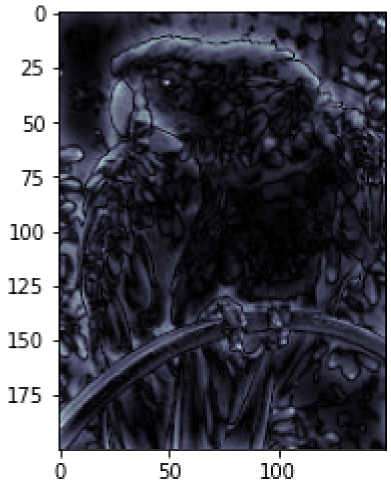


In [297]:

```
fshift = fotrans*ghpf
f_ishift = np.fft.ifftshift(fshift)
imgghpf = cv2.idft(f_ishift)
imgghpf = cv2.magnitude(imgghpf[:,:,0],imgghpf[:,:,1])
```

In [298]:

```
plt.imshow(imgghpf, cmap=plt.cm.bone)
plt.show()
```



For D_0 = 15

In [299]:

```
D_0 = 15
```

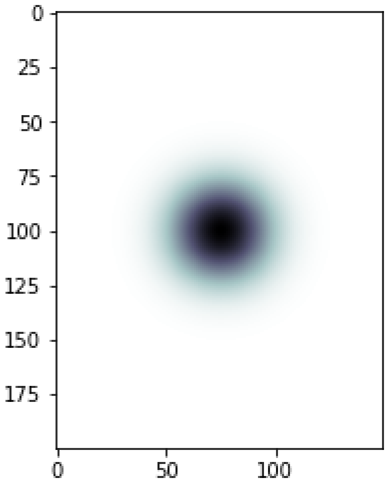
In [300]:

```
for u in range(rows):
    for v in range(cols):
        dist = Distance(rows,cols,u,v)
        H_uv = GHPFTransFunc(D_0,dist)

        ghpf[u][v] = H_uv
```

In [301]:

```
magspec = cv2.magnitude(ghpf[:,:,0],ghpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

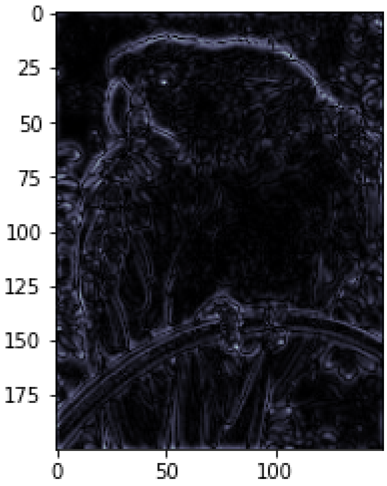


In [302]:

```
fshift = fotrans*ghpf
f_ishift = np.fft.ifftshift(fshift)
imgghpf = cv2.idft(f_ishift)
imgghpf = cv2.magnitude(imgghpf[:,:,0],imgghpf[:,:,1])
```

In [303]:

```
plt.imshow(imgghpf, cmap=plt.cm.bone)
plt.show()
```



For D_0 = 30

In [304]:

```
D_0 = 30
```

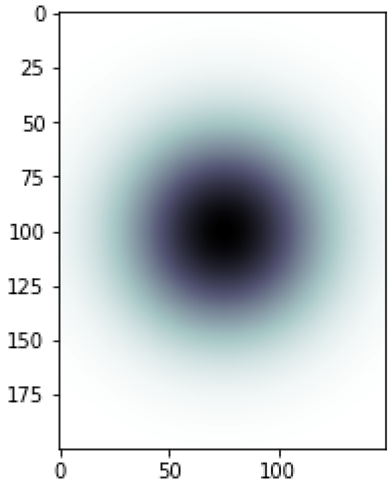
In [305]:

```
for u in range(rows):
    for v in range(cols):
        dist = Distance(rows,cols,u,v)
        H_uv = GHPFTransFunc(D_0,dist)

        ghpf[u][v] = H_uv
```

In [306]:

```
magspec = cv2.magnitude(ghpf[:,:,0],ghpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

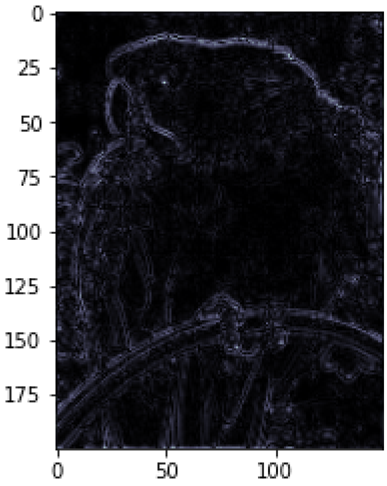


In [307]:

```
fshift = fotrans*ghpf
f_ishift = np.fft.ifftshift(fshift)
imgghpf = cv2.idft(f_ishift)
imgghpf = cv2.magnitude(imgghpf[:,:,0],imgghpf[:,:,1])
```

In [308]:

```
plt.imshow(imgghpf, cmap=plt.cm.bone)
plt.show()
```



For D_0 = 90

In [309]:

```
D_0 = 90
```

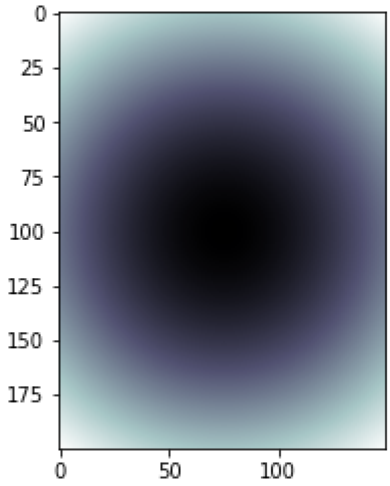
In [310]:

```
for u in range(rows):
    for v in range(cols):
        dist = Distance(rows,cols,u,v)
        H_uv = GHPFTransFunc(D_0,dist)

        ghpf[u][v] = H_uv
```

In [311]:

```
magspec = cv2.magnitude(ghpf[:,:,0],ghpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

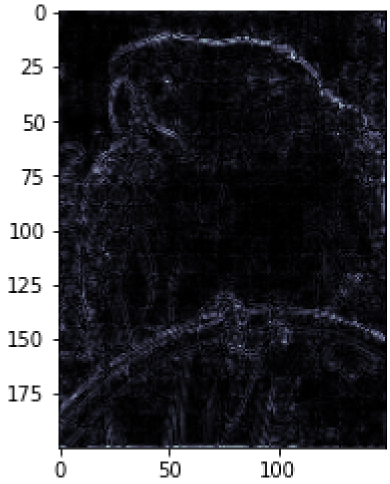


In [312]:

```
fshift = fotrans*ghpf
f_ishift = np.fft.ifftshift(fshift)
imgghpf = cv2.idft(f_ishift)
imgghpf = cv2.magnitude(imgghpf[:,:,0],imgghpf[:,:,1])
```

In [313]:

```
plt.imshow(imgghpf, cmap=plt.cm.bone)
plt.show()
```



For D_0 = 120

In [314]:

```
D_0 = 120
```

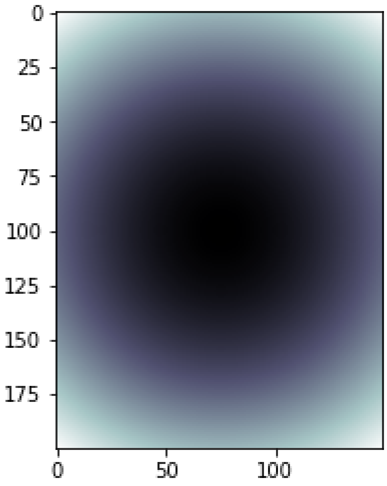
In [315]:

```
for u in range(rows):
    for v in range(cols):
        dist = Distance(rows,cols,u,v)
        H_uv = GHPFTransFunc(D_0,dist)

        ghpf[u][v] = H_uv
```

In [316]:

```
magspec = cv2.magnitude(ghpf[:,:,0],ghpf[:,:,1])
plt.imshow(magspec, cmap=plt.cm.bone)
plt.show()
```

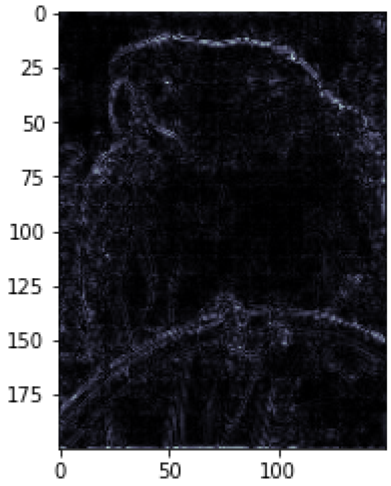


In [317]:

```
fshift = fotrans*ghpf
f_ishift = np.fft.ifftshift(fshift)
imgghpf = cv2.idft(f_ishift)
imgghpf = cv2.magnitude(imgghpf[:,:,0],imgghpf[:,:,1])
```

In [319]:

```
plt.imshow(imgghpf, cmap=plt.cm.bone)
plt.show()
```



In [ ]:

```
```