Lab05-Image Processing and Analysis

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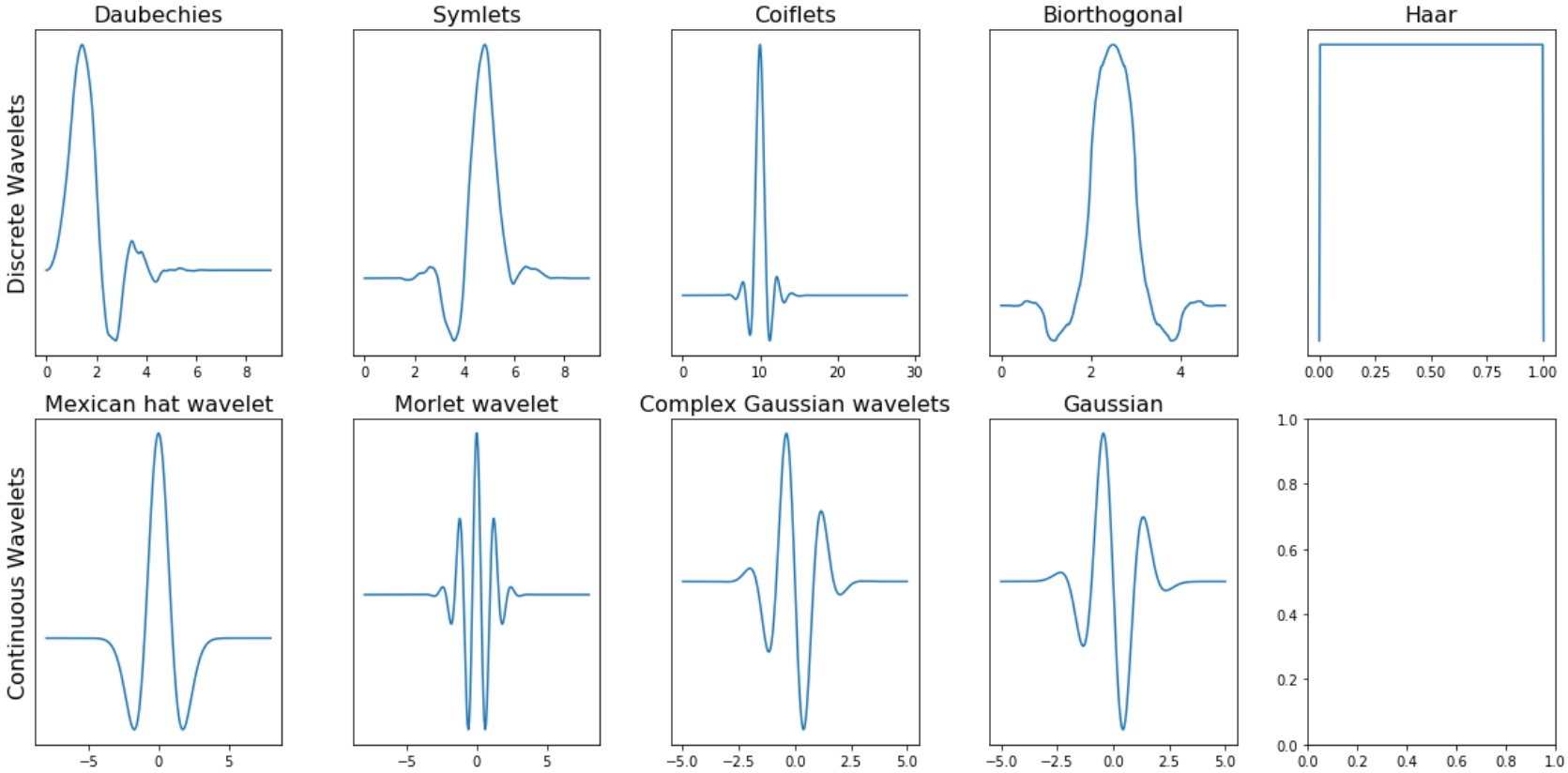
In [1]:
```
import numpy as np
import pandas as pd
import cv2
from matplotlib import pyplot as plt
import matplotlib.cm as cm
import matplotlib.gridspec as gridspec
from pylab import imread
from skimage.color import rgb2gray
```

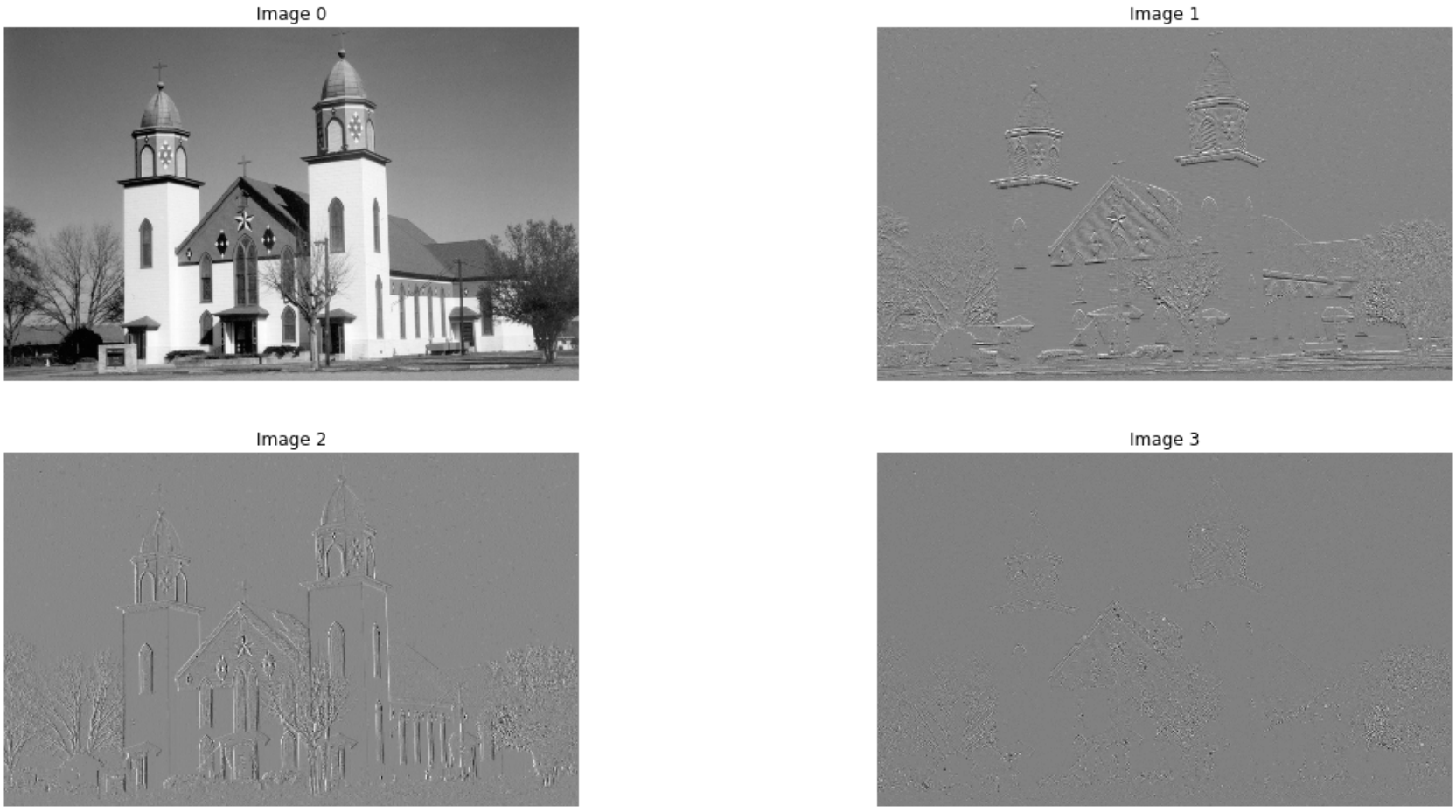
In [2]:
```
def ShowImage(ImageList, nRows = 1, nCols = 2, WidthSpace = 0.00, HeightSpace = 0.00):
    from matplotlib import pyplot as plt
    import matplotlib.gridspec as gridspec

    gs = gridspec.GridSpec(nRows, nCols)
    gs.update(wspace=WidthSpace, hspace=HeightSpace) # set the spacing between axes.
    plt.figure(figsize=(20,10))
    for i in range(len(ImageList)):
        ax1 = plt.subplot(gs[i])
        ax1.set_xticklabels([])
        ax1.set_yticklabels([])
        ax1.set_aspect('equal')

        plt.subplot(nRows, nCols,i+1)

        image = ImageList[i].copy()
        if (len(image.shape) < 3):
            plt.imshow(image, plt.cm.gray)
        else:
            plt.imshow(image)
        plt.title("Image " + str(i))
        plt.axis('off')

    plt.show()
```

In [26]:
```
discrete_wavelets = ['db5', 'sym5', 'coif5', 'bior1.3', 'haar']
continuous_wavelets = ['mexh', 'morl', 'cgau5', 'gaus5']

list_list_wavelets = [discrete_wavelets, continuous_wavelets]
list_funcs = [pywt.Wavelet, pywt.ContinuousWavelet]

fig, axarr = plt.subplots(nrows=2, ncols=5, figsize=(16,8))
for ii, list_wavelets in enumerate(list_list_wavelets):
    func = list_funcs[ii]
    row_no = ii
    for col_no, waveletname in enumerate(list_wavelets):
        wavelet = func(waveletname)
        family_name = wavelet.family_name
        biorthogonal = wavelet.biorthogonal
        orthogonal = wavelet.orthogonal
        symmetry = wavelet.symmetry
        if ii == 0:
            _ = wavelet.wavefun()
            wavelet_function = _[0]
            x_values = _[-1]
        else:
            wavelet_function, x_values = wavelet.wavefun()
        if col_no == 0 and ii == 0:
            axarr[row_no, col_no].set_ylabel("Discrete Wavelets", fontsize=16)
        if col_no == 0 and ii == 1:
            axarr[row_no, col_no].set_ylabel("Continuous Wavelets", fontsize=16)
        axarr[row_no, col_no].set_title("{}".format(family_name), fontsize=16)
        axarr[row_no, col_no].plot(x_values, wavelet_function)
        axarr[row_no, col_no].set_yticks([])
        axarr[row_no, col_no].set_yticklabels([])

plt.tight_layout()
plt.show()
```

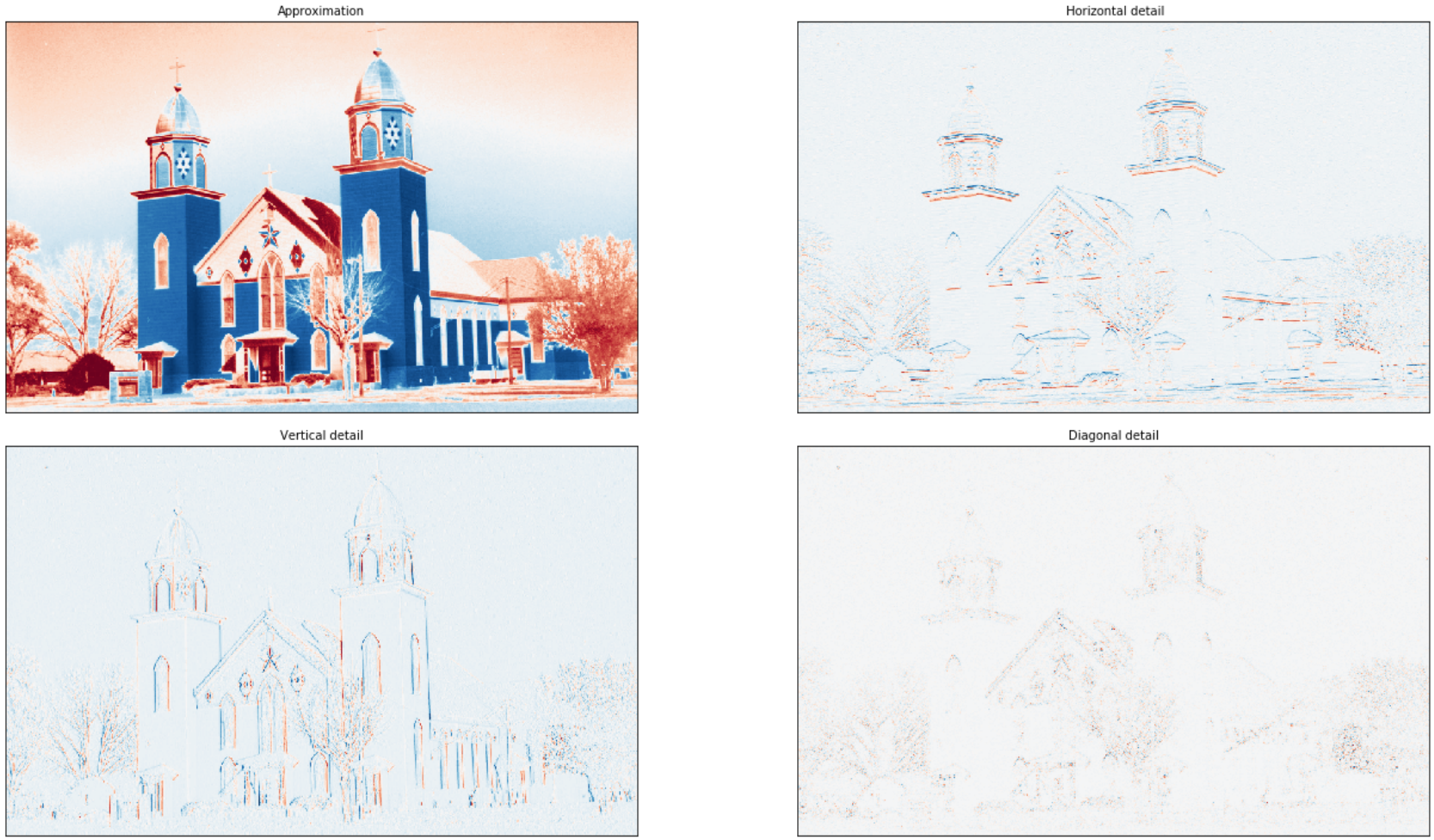

Daubechies
Symlets
Coiflets
Biorthogonal
Haar
Discrete Wavelets
Mexican hat wavelet
Morlet wavelet
Complex Gaussian wavelets
Gaussian
Continuous Wavelets

In [12]:
```
# Read Image
image_color = imread("Sample06/church.jpg")
# Convert Image into Gray
image_gray = cv2.cvtColor(image_color, cv2.COLOR_RGB2GRAY)

# Display Image
ShowImage([image_color, image_gray], 1, 2)
```

In [21]:
```
import pywt
import pywt.data
from pywt import dwt2, idwt2

# Wavelet transform of image, and plot approximation and details
titles = ['Approximation', ' Horizontal detail',
          'Vertical detail', 'Diagonal detail']
coeffs2 = dwt2(image_gray, discrete_wavelets[3])
LL, (LH, HL, HH) = coeffs2

# Display Image
ShowImage([LL, LH, HL, HH], 2, 2)
```

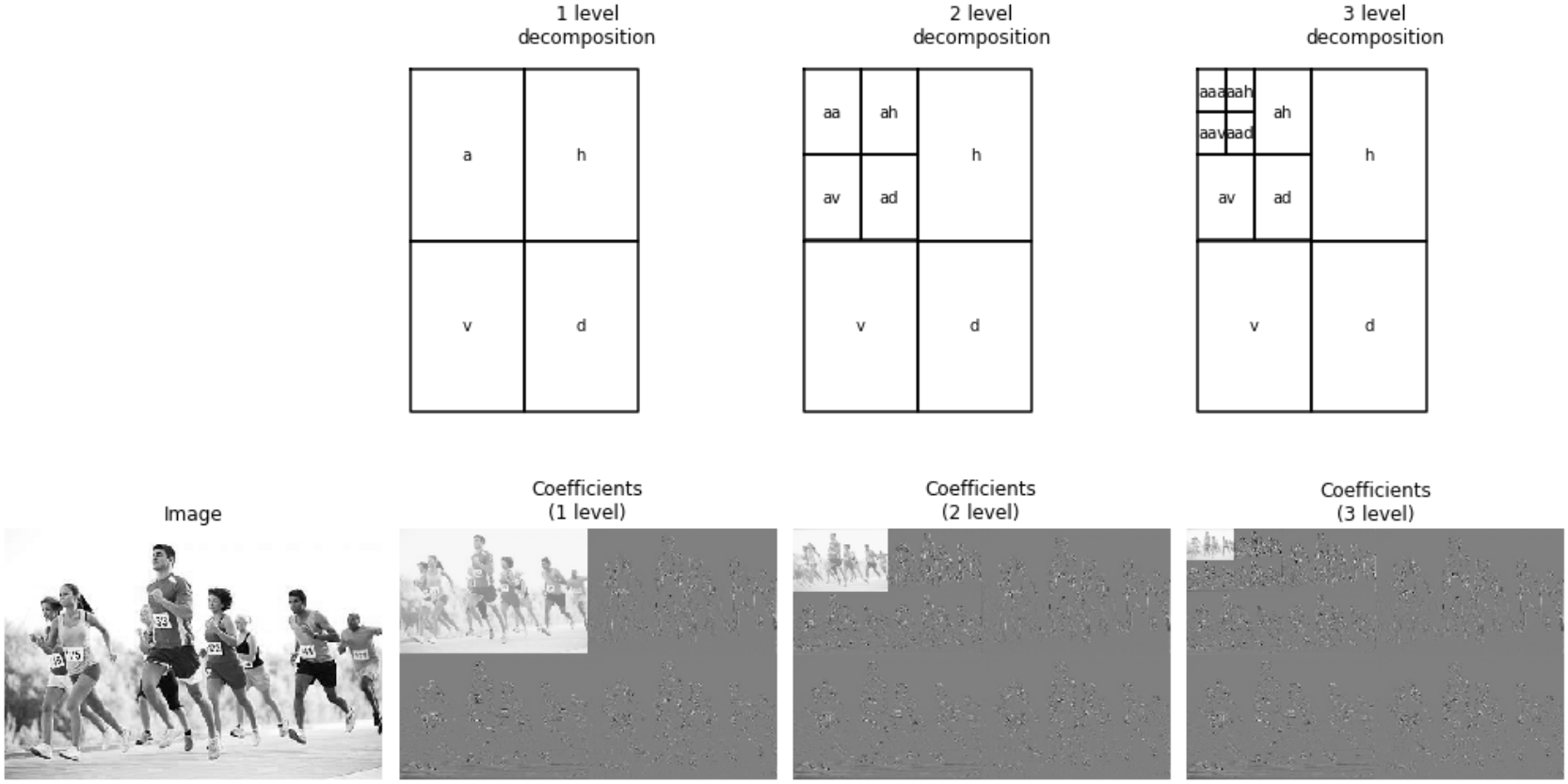


In [18]:
```
cmapList = [cm.gray, cm.jet, cm.rainbow, cm.viridis, cm.cubehelix, cm.RdBu]
fig = plt.figure(figsize=(20,10))
for i, a in enumerate([LL, LH, HL, HH]):
    ax = fig.add_subplot(2, 2, i + 1)
    ax.imshow(a, interpolation="nearest", cmap=cmapList[5])
    ax.set_title(titles[i], fontsize=10)
    ax.set_xticks([])
    ax.set_yticks([])

fig.tight_layout()
plt.show()
```



In [6]:
```
# Read Image
image_color = imread("Sample06/marathon.jpg")
# Convert Image into Gray
image_gray = cv2.cvtColor(image_color, cv2.COLOR_RGB2GRAY)

# Display Image
ShowImage([image_color, image_gray], 1, 2)
```

In [7]:
```
from pywt._doc_utils import wavedec2_keys, draw_2d_wp_basis

x = image_gray.astype(np.float32)
shape = x.shape


max_lev = 3       # how many levels of decomposition to draw
label_levels = 3  # how many levels to explicitly label on the plots

fig, axes = plt.subplots(2, 4, figsize=[14, 8])
for level in range(0, max_lev + 1):
    if level == 0:
        # show the original image before decomposition
        axes[0, 0].set_axis_off()
        axes[1, 0].imshow(x, cmap=plt.cm.gray)
        axes[1, 0].set_title('Image')
        axes[1, 0].set_axis_off()
        continue

    # plot subband boundaries of a standard DWT basis
    draw_2d_wp_basis(shape, wavedec2_keys(level), ax=axes[0, level],
                     label_levels=label_levels)
    axes[0, level].set_title('{} level\ndecomposition'.format(level))

    # compute the 2D DWT
    c = pywt.wavedec2(x, 'db2', mode='periodization', level=level)
    # normalize each coefficient array independently for better visibility
    c[0] /= np.abs(c[0]).max()
    for detail_level in range(level):
        c[detail_level + 1] = [d/np.abs(d).max() for d in c[detail_level + 1]]
    # show the normalized coefficients
    arr, slices = pywt.coeffs_to_array(c)
    axes[1, level].imshow(arr, cmap=plt.cm.gray)
    axes[1, level].set_title('Coefficients\n({} level)'.format(level))
    axes[1, level].set_axis_off()

plt.tight_layout()
plt.show()
```


1 level
decomposition
a
h
v
d
2 level
decomposition
aa
ah
av
ad
h
v
d
3 level
decomposition
aaaaah
aaavaaad
ah
av
ad
h
v
d
Image
Coefficients
(1 level)
Coefficients
(2 level)
Coefficients
(3 level)

In [28]:
```
# Read Image
image_color = imread("Sample06/drawing.jpg")
# Convert Image into Gray
image_gray = cv2.cvtColor(image_color, cv2.COLOR_RGB2GRAY)

# Display Image
ShowImage([image_color, image_gray], 1, 2)
```

In [29]:
```
coeffs2 = dwt2(image_gray, discrete_wavelets[4])
LL, (LH, HL, HH) = coeffs2

# Display Image
ShowImage([LL, LH, HL, HH], 2, 2)

cmapList = [cm.gray, cm.jet, cm.rainbow, cm.viridis, cm.cubehelix, cm.RdBu]
fig = plt.figure(figsize=(20,10))
for i, a in enumerate([LL, LH, HL, HH]):
    ax = fig.add_subplot(2, 2, i + 1)
    ax.imshow(a, interpolation="nearest", cmap=cmapList[5])
    ax.set_title(titles[i], fontsize=10)
    ax.set_xticks([])
    ax.set_yticks([])

fig.tight_layout()
plt.show()
```

Image 0

Image 1

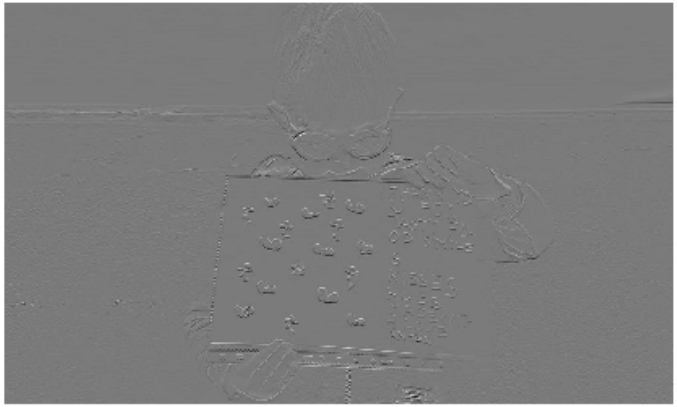


Image 2

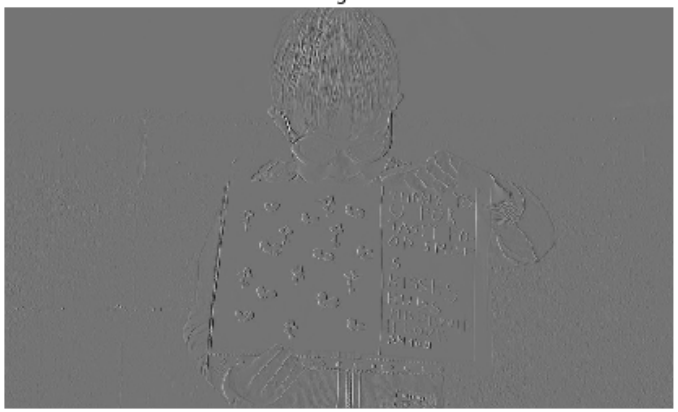
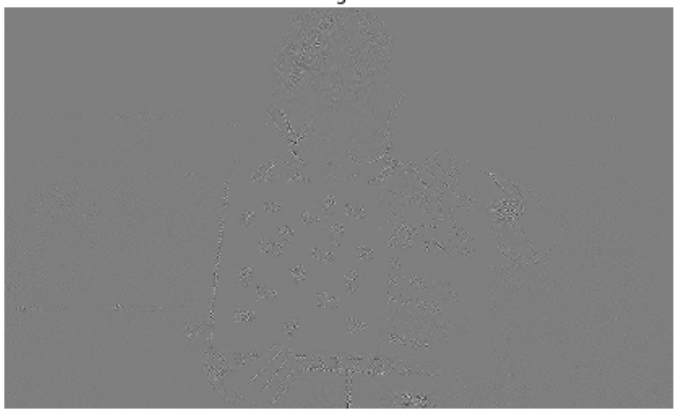
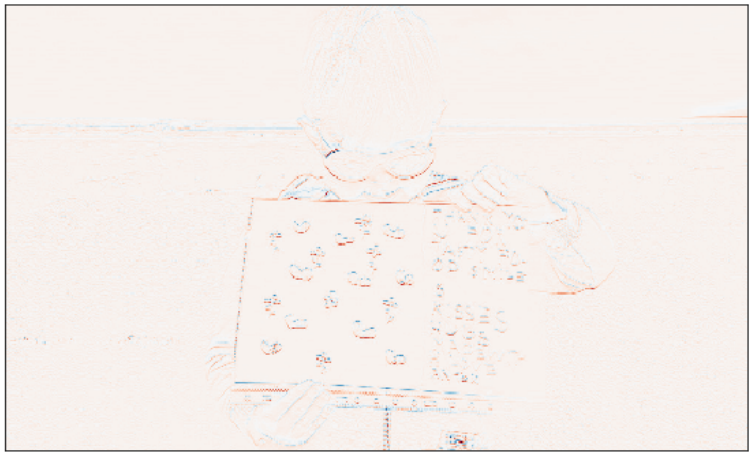


Image 3



Approximation

Horizontal detail



Vertical detail

Diagonal detail