

Reading Multi Spectral Images

[\(https://nbviewer.jupyter.org/github/thomasaarholt/hyperspy-demos/blob/master/2_SVD_and_BSS.ipynb\)](https://nbviewer.jupyter.org/github/thomasaarholt/hyperspy-demos/blob/master/2_SVD_and_BSS.ipynb)

Multispectral Imagery

Images obtained with a ADC Lite - Tetracam's Lightweight ADC

I made pictures about:

Aluminum , Copper, Brass, Iron, Stainless Steel, Painted Iron

[\(http://tetracam.com/Products-ADC_Lite.htm\)](http://tetracam.com/Products-ADC_Lite.htm)

MRobalinho - 11-05-2019 Version 8

Add Libraries

In [1]:

```
# Add Libraries
import glob, os
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
from PIL import Image, ImageFilter, ImageOps
from openpyxl import load_workbook
```

In [2]:

```
# Clear all
os.system( 'cls' )

# Verify my current folder
currDir = os.path.dirname(os.path.realpath("__file__"))
mypath = currDir
print(currDir)
```

C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook

In [3]:

```
# Path to the image files
folder = "imagedata06"

# Part name of file to filter files
end_file = ".tif"

# Upper End File
#end_file = end_file.upper()
path = currDir + "/" + folder + "/"
end_file
```

Out[3]:

```
'.tif'
```

Read images from folder

In [4]:

```
# Read files from folder
print(path)
print('-')
print(' ---- IMAGES ON THE FOLDER :', folder, '----- *', end_file)

list_of_images = list() # save all images on folder for further processing

for file in os.listdir(path):
    if file.endswith(end_file):
        print(os.path.join(file))
        list_of_images.append(file) # save all images on folder for further processin
g
print('-')
```

```
C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Clas  
sificacao_Sucata\Jupyter_Notebook/imagedata06/  
-  
---- IMAGES ON THE FOLDER : imagedata06 ----- * .tif  
Aluminum_1.tif  
Aluminum_2.tif  
Aluminum_3.tif  
Aluminum_4.tif  
Aluminum_5.tif  
Aluminum_6.tif  
Brass_1.tif  
Brass_2.tif  
Brass_3.tif  
Brass_4.tif  
Brass_5.tif  
Brass_6.tif  
CopperWire_1.tif  
CopperWire_2.tif  
CopperWire_3.tif  
CopperWire_4.tif  
CopperWire_5.tif  
CopperWire_6.tif  
CopperWire_7.tif  
CopperWire_8.tif  
Copper_1.tif  
Copper_2.tif  
Copper_3.tif  
Copper_4.tif  
Iron_1.tif  
Iron_2.tif  
Iron_3.tif  
Iron_4.tif  
PaintedIron_1.tif  
PaintedIron_2.tif  
PaintedIron_3.tif  
PaintedIron_4.tif  
PaintedIron_5.tif  
PaintedIron_6.tif  
PaintedIron_7.tif  
StainlessSteel_1.tif  
StainlessSteel_2.tif  
StainlessSteel_3.tif  
StainlessSteel_4.tif  
StainlessSteel_5.tif  
StainlessSteel_6.tif  
StainlessSteel_7.tif  
StainlessSteel_8.tif  
StainlessSteel_9.tif  
-
```

In [5]:

```
# Create Data Frame with image information  
df_image = []
```

Functions to the work

In [6]:

```
# Read image with PIL
from PIL import Image, ImageFilter, ImageOps
def read_pil_image(file1):
    #print('Reading PIL image:', file1)
    try:
        im_pil = Image.open(file1)
    except:
        print("-->Unable to load image",file1)
    return im_pil
```

In [7]:

```
# Read image with OPENCV
import cv2
def read_cv2_image(file1):
    #print('Reading CV image:',file1)
    try:
        im_cv = cv2.imread(file1)
    except:
        print("-->Unable to load image",file1)
    return im_cv
```

In [8]:

```
# Look from an channel from then image

def channel(img, n):
    """Isolate the nth channel from the image.

    n = 0: red, 1: green, 2: blue
    """
    a = np.array(img)
    a[:, :, (n!=0, n!=1, n!=2)] *= 0
    # a[:, :, n] *= 0
    # print(Image.fromarray(a), 'Get Channel n: ', n)

    print('Get Channel n: ', n)
    return Image.fromarray(a)

# def to resize
# Given parameters : image , number to divide (resize)
def imageResize(img, n):
    width, height = img.size

    print('Original size:', width, '/', height, 'Resize:',n)

    newWidth = int(width / n)
    newHeight = int(height / n)
    img.resize((newWidth, newHeight), Image.ANTIALIAS)
    print('New size:', newWidth, '/', newHeight)
    return img
```

In [9]:

```
# Obtain main color from image
# https://convertingcolors.com/rgb-color-169_171_170.html

def get_main_color(path, file):
    #img = Image.open(path+file)
    file1 = path+file
    # Read image
    img = read_pil_image(file1)
    if img == None:
        print("-->Unable to load image",file1)

    colors = img.getcolors( 1024*1024) #put a higher value if there are many colors in
    your image
    print('Get main Color file:', file)
    max_occurrence, most_present = 0, 0
    try:
        for c in colors:
            if c[0] > max_occurrence:
                (max_occurrence, most_present) = c
    return most_present
except TypeError:
    raise Exception("Too many colors in the image")
```

In [10]:

```

#!/usr/bin/python

# Return one 24-bit color value
def rgbToDecimal(x_rgb):
    r,g,b = rgbToRGB(x_rgb)
    rgb_dec = (r << 16) + (g << 8) + b
    #print('RGB Color:', x_rgb, ' Dec:', rgb_dec)
    return rgb_dec

# Convert 24-bit color value to RGB
def colorToRGB(c):
    r = c >> 16
    c -= r * 65536;
    g = c / 256
    c -= g * 256;
    b = c
    return [r, g, b]

def rgbToRGB(x_rgb):
    x_rgb = list(x_rgb)
    r = x_rgb[0]
    g = x_rgb[1]
    b = x_rgb[2]

    #print('rgbToRGB:',x_rgb, r,g,b)
    return r, g, b

def getRGBfromI(RGBint):
    blue = RGBint & 255
    green = (RGBint >> 8) & 255
    red = (RGBint >> 16) & 255
    return red, green, blue

def getIfromRGB(rgb):
    red = rgb[0]
    green = rgb[1]
    blue = rgb[2]
    #print('getIfromRGB:', red, green, blue)
    RGBint = (red<<16) + (green<<8) + blue
    return RGBint

# RGB to Hex Decimal
def rgb_to_hex(rgb):
    rgb_int = bytes(rgb).hex()
    rgb_hex = '#' + str(rgb_int)
    #print('RGB :',rgb, ' Hex Dec:', rgb_hex)
    return rgb_hex

# Test
#x_rgb = (254, 250, 255)
#rgb_hex = rgb_to_hex(x_rgb)
#rgb_dec = rgbToDecimal(x_rgb)

```

In [11]:

```
# https://github.com/conda-forge/webcolors-feedstock
# conda config --add channels conda-forge
# conda install webcolors
# It is possible to list all of the versions of webcolors available on your platform with:
#       conda search webcolors --channel conda-forge

# COLOR NAME
import webcolors
def get_color_name(rgb_x):
    min_colours = {}
    for key, name in webcolors.css21_hex_to_names.items():
        r_c, g_c, b_c = webcolors.hex_to_rgb(key)
        rd = (r_c - rgb_x[0]) ** 2
        gd = (g_c - rgb_x[1]) ** 2
        bd = (b_c - rgb_x[2]) ** 2
        min_colours[(rd + gd + bd)] = name
    print('Color name from RGB:',rgb_x,' is :',min_colours[min(min_colours.keys())])
    return min_colours[min(min_colours.keys())]
```

In [12]:

```
# Get color name from RGB
# https://stackoverflow.com/questions/2453344/find-the-colour-name-from-a-hexadecimal-colour-code

colorof = {'#F0F8FF': "aliceblue",
 '#FAEBD7': "antiquewhite",
 '#00FFFF': "aqua",
 '#7FFFAD': "aquamarine",
 '#FFFFFF': "azure",
 '#F5F5DC': "beige",
 '#FFE4C4': "bisque",
 '#000000': "black",
 '#FFEBCD': "blanchedalmond",
 '#0000FF': "blue",
 '#8A2BE2': "blueviolet",
 '#A52A2A': "brown",
 '#DEB887': "burlywood",
 '#5F9EA0': "cadetblue",
 '#7FFF00': "chartreuse",
 '#D2691E': "chocolate",
 '#FF7F50': "coral",
 '#6495ED': "cornflowerblue",
 '#FFF8DC': "cornsilk",
 '#DC143C': "crimson",
 '#00FFFF': "cyan",
 '#00008B': "darkblue",
 '#008B8B': "darkcyan",
 '#B8860B': "darkgoldenrod",
 '#A9A9A9': "darkgray",
 '#006400': "darkgreen",
 '#BDB76B': "darkkhaki",
 '#8B008B': "darkmagenta",
 '#556B2F': "darkolivegreen",
 '#FF8C00': "darkorange",
 '#9932CC': "darkorchid",
 '#8B0000': "darkred",
 '#E9967A': "darksalmon",
 '#8FBBC8': "darkseagreen",
 '#483D8B': "darkslateblue",
 '#2F4F4F': "darkslategray",
 '#00CED1': "darkturquoise",
 '#9400D3': "darkviolet",
 '#FF1493': "deeppink",
 '#00BFFF': "deepskyblue",
 '#696969': "dimgray",
 '#1E90FF': "dodgerblue",
 '#B22222': "firebrick",
 '#FFFAF0': "floralwhite",
 '#228B22': "forestgreen",
 '#FF00FF': "fuchsia",
 '#DCDCDC': "gainsboro",
 '#F8F8FF': "ghostwhite",
 '#FFD700': "gold",
 '#DAA520': "goldenrod",
 '#808080': "gray",
 '#008000': "green",
 '#ADFF2F': "greenyellow",
 '#F0FFF0': "honeydew",
 '#FF69B4': "hotpink",}
```

```
'#CD5C5C':"indianred",
'#4B0082':"indigo",
'#FFFFF0':"ivory",
'#F0E68C':"khaki",
'#E6E6FA':"lavender",
'#FFF0F5':"lavenderblush",
'#7CFC00':"lawngreen",
'#FFFACD':"lemonchiffon",
'#ADD8E6':"lightblue",
'#F08080':"lightcoral",
'#E0FFFF':"lightcyan",
'#FAFAD2':"lightgoldenrodyellow",
'#D3D3D3':"lightgray",
'#90EE90':"lightgreen",
'#FFB6C1':"lightpink",
'#FFA07A':"lightsalmon",
'#20B2AA':"lightseagreen",
'#87CEFA':"lightskyblue",
'#778899':"lightslategray",
'#B0C4DE':"lightsteelblue",
'#FFFFE0':"lightyellow",
'#00FF00':"lime",
'#32CD32':"limegreen",
'#FAF0E6':"linen",
'#FF00FF':"magenta",
'#800000':"maroon",
'#66CDAA':"mediumaquamarine",
'#0000CD':"mediumblue",
'#BA55D3':"mediumorchid",
'#9370DB':"mediumpurple",
'#3CB371':"mediumseagreen",
'#7B68EE':"mediumslateblue",
'#00FA9A':"mediumspringgreen",
'#48D1CC':"mediumturquoise",
'#C71585':"mediumvioletred",
'#191970':"midnightblue",
'#F5FFFA':"mintcream",
'#FFE4E1':"mistyrose",
'#FFE4B5':"moccasin",
'#FFDEAD':"navajowhite",
'#000080':"navy",
'#FDF5E6':"oldlace",
'#808000':"olive",
'#6B8E23':"olivedrab",
'#FFA500':"orange",
'#FF4500':"orangered",
'#DA70D6':"orchid",
'#EEE8AA':"palegoldenrod",
'#98FB98':"palegreen",
'#AFEEEE':"paleturquoise",
'#DB7093':"palevioletred",
'#FFEFDD':"papayawhip",
'#FFDAB9':"peachpuff",
'#CD853F':"peru",
'#FFC0CB':"pink",
'#DDA0DD':"plum",
'#B0E0E6':"powderblue",
'#800080':"purple",
'#FF0000':"red",
'#BC8F8F':"rosybrown",
'#4169E1':"royalblue",
```

```
'#8B4513':"saddlebrown",
'#FA8072':"salmon",
'#F4A460':"sandybrown",
'#2E8B57':"seagreen",
'#FFF5EE':"seashell",
'#A0522D':"sienna",
'#C0C0C0':"silver",
'#87CEEB':"skyblue",
'#6A5ACD':"slateblue",
'#708090':"slategray",
'#FFFAFA':"snow",
'#00FF7F':"springgreen",
'#4682B4':"steelblue",
'#D2B48C':"tan",
'#008080':"teal",
'#D8BFD8':"thistle",
'#FF6347':"tomato",
'#40E0D0':"turquoise",
'#EE82EE':"violet",
'#F5DEB3':"wheat",
'#FFFFFF':"white",
'#F5F5F5':"whitesmoke",
'#FFFF00':"yellow",
'#9ACD32':"yellowgreen"}
```

```
def get_rgb_color_name(rgb):

    hex_from_rgb = rgb_to_hex(rgb) # transform RGB into hexadecimal
    hx = hex_from_rgb[1:8]
    #print(hx)
    # if color is found in dict
    if colorof.get(hx):return colorof[hx]

    # else return its closest available color
    m = 16777215
    k = '000000'
    for key in colorof.keys():
        key_color = key[1:8]
        #print(key_color)
        a = int(hx[:2],16)-int(key_color[:2],16)
        b = int(hx[2:4],16)-int(key_color[2:4],16)
        c = int(hx[4:],16)-int(key_color[4:],16)

        v = a*a+b*b+c*c # simple measure for distance between colors
        # v = (r1 - r2)^2 + (g1 - g2)^2 + (b1 - b2)^2

        if v <= m:
            m = v
            k = key

    return colorof[k], hex_from_rgb

# Test
#rgb_1 = (216, 220, 223)
#cname, hexdc = get_rgb_color_name(rgb_1)
#print('Found:', cname, ' Hex:', hexdc)      # found in dict
```

In [13]:

```
# Increase the contrast image
# im - image
# xvalue = contrast value
# https://pillow.readthedocs.io/en/4.0.x/reference/ImageEnhance.html
from PIL import ImageEnhance
# Path + file name + numeric value to enhancement

def contrast(path, xfile, xvalue):
    print('    Enhance image:', xfile, ' Value:', xvalue)
    file1 = path + xfile
    # Read Image
    im = read_pil_image(file1)
    if im == None:
        print("-->Unable to load image",file1)

    enh = ImageEnhance.Contrast(im)
    # enh.enhance(1.0).show("30% more contrast")
    x_enh = enh.enhance(xvalue)
    # Create name file masked
    f2_file = 'Enh_' + xfile
    print('    Save enhanced file :', f2_file)
    x_enh.save(f2_file) # save enhanced file
    return x_enh, f2_file
```

In [14]:

```
# Return RGB separately
def return_rgb_from_RGB(rgb):
    p_rgb = list(rgb)
    red   = p_rgb[0]
    green = p_rgb[1]
    blue  = p_rgb[2]
    return red, green, blue
```

In [15]:

```
# Return distance from 2 colors

# http://hanzratech.in/2015/01/16/color-difference-between-2-colors-using-python.html
# https://python-colormath.readthedocs.io/en/latest/delta_e.html#delta-e-cie-2000

from colormath.color_objects import sRGBColor, LabColor
from colormath.color_conversions import convert_color
from colormath.color_diff import delta_e_cie2000

def delta_2_colors(rgb_1, rgb_2):
    #print(' Delta colors: ', rgb_1, rgb_2)
    #---- first color
    xr, xg, xb = return_rgb_from_RGB(rgb_1)
    # Red Color
    color1_rgb = sRGBColor(xr, xg, xb)

    #--- other color
    rgb_1 = rgb_2
    xr, xg, xb = return_rgb_from_RGB(rgb_1)
    # Blue Color
    color2_rgb = sRGBColor(xr, xg, xb)

    # Convert from RGB to Lab Color Space
    color1_lab = convert_color(color1_rgb, LabColor)

    # Convert from RGB to Lab Color Space
    color2_lab = convert_color(color2_rgb, LabColor)

    # Find the color difference
    delta_e = delta_e_cie2000(color1_lab, color2_lab)

    #print("      The difference between the 2 color = ", delta_e)
    return delta_e
```

In [16]:

```
# Remove Background - Put red background
#https://stackoverflow.com/questions/29313667/how-do-i-remove-the-background-from-this-kind-of-image

import cv2
import numpy as np

def red_background(path, xfile):
    print('  Red background for image:', xfile)
    #== Parameters =====
    ===
    BLUR = 21
    CANNY_THRESH_1 = 10
    CANNY_THRESH_2 = 100
    MASK_DILATE_ITER = 10
    MASK_ERODE_ITER = 10
    MASK_COLOR = (0.0,0.0,1.0) # In BGR format

    #== Processing =====
    ===
    file1 = path + xfile
    #-- Read image -----
    ===
    #img = cv2.imread(file1)
    # Read image
    img = read_cv2_image(file1)
    if img.any() == None:
        print("-->Unable to load image",file1)

    # Create GRAY Image
    gray = cv2.cvtColor(img,cv2.COLOR_BGR2GRAY)

    #-- Edge detection -----
    ===
    edges = cv2.Canny(gray, CANNY_THRESH_1, CANNY_THRESH_2)
    edges = cv2.dilate(edges, None)
    edges = cv2.erode(edges, None)

    #-- Find contours in edges, sort by area -----
    ===
    contour_info = []
    _, contours, _ = cv2.findContours(edges, cv2.RETR_LIST, cv2.CHAIN_APPROX_NONE)
    for c in contours:
        contour_info.append((
            c,
            cv2.isContourConvex(c),
            cv2.contourArea(c),
        ))
    contour_info = sorted(contour_info, key=lambda c: c[2], reverse=True)
    max_contour = contour_info[0]

    #-- Create empty mask, draw filled polygon on it corresponding to largest contour -
    ===
    # Mask is black, polygon is white
    mask = np.zeros(edges.shape)
    for c in contour_info:
        cv2.fillConvexPoly(mask, c[0], (255))

    #-- Smooth mask, then blur it
    ===
```

```

mask = cv2.dilate(mask, None, iterations=MASK_DILATE_ITER)
mask = cv2.erode(mask, None, iterations=MASK_ERODE_ITER)
mask = cv2.GaussianBlur(mask, (BLUR, BLUR), 0)
mask_stack = np.dstack([mask]*3)      # Create 3-channel alpha mask

<-- Blend masked img into MASK_COLOR background
mask_stack = mask_stack.astype('float32') / 255.0
img         = img.astype('float32') / 255.0
masked = (mask_stack * img) + ((1-mask_stack) * MASK_COLOR)
masked = (masked * 255).astype('uint8')

cv2.imwrite(path+"MASK_"+xfile,masked)

# Create name file masked
f2_file = 'Mask_'+xfile
file2 = path + f2_file

# Write masked image on disk
print(' Save masked image with red background:', f2_file)
cv2.imwrite(file2, masked)          # Save
# Return name file masked and image masked
return f2_file, masked

# Test
'''

xfile = 'Brass_001.tif'
f2_file, masked = red_background(path,xfile)
%matplotlib inline
plt.imshow(masked)
plt.title('Remove image background: '+xfile,fontsize=20)
plt.show()
'''

```

Out[16]:

```

"\nxfile = 'Brass_001.tif'\nf2_file, masked = red_background(path,xfile)
\n%matplotlib inline\nplt.imshow(masked)\nplt.title('Remove image backgrou
nd: '+xfile,fontsize=20)\nplt.show()\n"

```

In [17]:

```
# https://convertingcolors.com/rgb-color-169_171_170.html

# return most_present RGB, RGB, color name, List RGB colors without RED, List RGB colors without back

import collections

def get_main_color_without_red_and_floor(path, f2_file):
    print('      Main color from image:', f2_file)
    file1 = path + f2_file

    # Read image
    img = read_pil_image(file1)
    if img == None:
        print("-->Unable to load image",file1)

    colors = img.getcolors( 1024*1024) #put a higher value if there are many colors in your image
    #-----
    # Create list with colors without Background red color (near Background color)
    list_non_back = list()
    list_dec_back = list() # List from decimal colors to list_non_back
    #
    print('... List without excluded colors')
    # Convert list to decimal color
    for color in colors:
        # Diference between colors
        # print(color[1])
        rgb = color[1]

        excluded_rgb = False

        #Verify color name
        xt_color_name , hexdc = get_rgb_color_name(rgb)

        # Exclusion for some colors (Red Backgroud, Black foor, etc)
        if "red" in xt_color_name:
            excluded_rgb = True
        if "black" in xt_color_name:
            excluded_rgb = True
        if "white" in xt_color_name:
            excluded_rgb = True
        if "cream" in xt_color_name:
            excluded_rgb = True

        # Force Only for non-tif files we do not delete anything
        if file.endswith('.tif'):
            excluded_rgb = False

        if excluded_rgb == True:    # Exclude COLOR
            #print("Cor excluida", rgb, xt_color_name )
            excluded_rgb = True
        else:
            # OK COLOR - Save color in the list of correct colors (list_non_back)
            #print("Cor OK", rgb, xt_color_name )
            list_non_back.append(rgb)
            # Decimal color
            rgb_dec      = rgbToDecimal(rgb)
            list_dec_back.append(rgb_dec)
```

```
#-----
# print('Count occurrences for color')
most_present = 0

# Most common color in the list - list_non_back
x = collections.Counter(list_non_back)
print('      4 Most common colors:', x.most_common(4)) # Five most common colors
most_present = x.most_common(1)
xrgb = list_non_back[0] # common color

# ----- color name --
#xt_color_name = get_color_name(xrgb)
print('      Read color name:', xrgb) # Color name from RGB
xt_color_name , hexdc = get_rgb_color_name(xrgb)
print('      Main Color file:', f2_file, ' RGB:', most_present, xrgb, ' Color nam
e:', xt_color_name,' Hex:',hexdc)

return most_present, xrgb, xt_color_name, list_non_back, list_dec_back

# Test
#xfile = 'Copper_001.tif'
#most_present, xrgb, xt_color_name, list_non_back, \
#    list_dec_back = get_main_color_without_red_and_floor(path, xfile)
```

In [18]:

```
# https://opencv-python-tutorials.readthedocs.io/en/latest/py_tutorials/py_imgproc/py_histograms/py_histogram_begins/py_histogram_begins.html
# Print histogram using Opencv
import cv2
import numpy as np
from matplotlib import pyplot as plt

def print_cv_hist(path, xfile):
    file1 = path + xfile
    print('Cv2 Hist from file:', file1)

    # Read image
    img_cv = read_cv2_image(file1)
    if img_cv.any() == None:
        print("-->Unable to load image", file1)

    # create a mask
    mask = np.zeros(img_cv.shape[:2], np.uint8)

    # define area to extract image from original
    # Left:height , right:Length
    mask[200:1400, 200:1800] = 255
    masked_img = cv2.bitwise_and(img_cv, img_cv, mask = mask)

    # Calculate histogram with mask and without mask
    # Check third argument for mask
    hist_full = cv2.calcHist([img_cv],[0],None,[256],[0,256])
    hist_mask = cv2.calcHist([img_cv],[0],mask,[256],[0,256])

    plt.figure(figsize=(18,5))

    plt.subplot(141), plt.imshow(img_cv, 'gray')
    plt.title("Original")

    plt.subplot(142), plt.imshow(mask,'gray')
    plt.title('Mask')

    plt.subplot(143), plt.imshow(masked_img, 'gray')
    plt.title('Masked image')

    ax=plt.subplot(144), plt.plot(hist_full), plt.plot(hist_mask)
    ax = plt.gca()
    ax.grid(True)
    plt.title('Histogram')
    plt.xlim([0,256])

    plt.suptitle('IMAGE HISTOGRAM', fontsize=18)
    plt.xlabel('Image:' +xfile, fontsize=18)
    plt.ylabel('All channels', fontsize=10)
    plt.savefig(path+'Hist_cv2_'+xfile)  # Save Histogram Figure
    plt.show()
    return

# Test
#xfile = 'Copper_001.tif'
#print_cv_hist(path, xfile)
```

In [19]:

```
# https://opencv-python-tutorials.readthedocs.io/en/latest/py_tutorials/py_imgproc/py_histograms/py_histogram_begins/py_histogram_begins.html
# Print histogram using Opencv and matplotlib

import cv2
import numpy as np
from matplotlib import pyplot as plt

def print_matplot_hist(path, xfile):
    file1 = path + xfile
    print('Matplot Hist from file:', file1)

    # Read image
    img_mp = read_cv2_image(file1)
    if img_mp.any() == None:
        print("-->Unable to load image", file1)

    color = ('b', 'g', 'r')
    ax = plt.figure(figsize=(10,5))
    ax = plt.gca()
    ax.grid(True)

    for i,col in enumerate(color):
        histr = cv2.calcHist([img_mp],[i],None,[256],[0,256])
        plt.plot(histr,color = col, label='Band '+col.upper())
        plt.xlim([0,256])

    plt.title('Histogram of the image', fontsize=20)
    plt.xlabel('Image:' +xfile, fontsize=18)
    plt.ylabel('All channels', fontsize=18)
    plt.legend(bbox_to_anchor=(.90,0.85),bbox_transform=plt.gcf().transFigure)
    plt.savefig(path+'Hist_'+xfile)    # Save Histogram Figure
    plt.show()

    return

# Test
#xfile = 'Copper_1.tif'
#print_matplot_hist(path, xfile)
```

In [20]:

```
# Max and Min value from Histogram and each position
#L = np.array(hist_full).tolist() - Transform array in a List

import cv2
import numpy as np
from matplotlib import pyplot as plt

def histogram_max_min(path, xfile):

    file1 = path+xfile
    print('Histogram analisys:', file1)

    # Read image
    img_h = read_cv2_image(file1)
    if img_h.any() == None:
        print("-->Unable to load image", file1)

    # Calculate histogram without mask
    hist_full = cv2.calcHist([img_h],[0],None,[256],[0,256])

    # Transform array in a List
    hist_list = np.array(hist_full).tolist()

    # Valor maximo e minimo do Histograma e sua posição
    val_max = max(hist_list)
    xval_max = int(val_max[0])

    val_avg = max(hist_list)
    xval_avg = int(val_avg[0]) / len(hist_list)
    xval_avg = int(xval_avg)

    val_min = min(hist_list)
    xval_min = int(val_min[0])

    idx_max = hist_list.index(val_max)
    idx_min = hist_list.index(val_min)

    #print("Valor Max Histograma:", xval_max, ' Posição do valor Max:', idx_max)
    #print("Valor Min Histograma:", xval_min, ' Posição do valor Min:', idx_min)
    #print("Valor Avg Histograma:", xval_avg)

    return xval_max, idx_max, xval_min, idx_min

# Test
#xfile = 'Copper_001.tif'
#_,_,_,_ = histogram_max_min(path, xfile)
```

In [21]:

```
# Read image folder
import glob, os
def get_image_folder(xfile1):
    # Path to the image files
    path = currDir + "/" + folder + "/"
    # File
    file1 = path + xfile1
    print(file1)

    return file1
```

In [22]:

```
# Obtain percentage of channels R,G,B
import matplotlib.image as mpimg
def percent_rgb(path, xfile):
    print('    RGB percent from image:', xfile)
    emptyBlue = []
    emptyGreen= []
    emptyRed= []

    all_path = path + xfile
    # Read file
    img = mpimg.imread(all_path)
    imgplot = plt.imshow(img)
    # Mean of the array of each channel
    RGBtuple = np.array(img).mean(axis=(0,1))

    averageRed = RGBtuple[0]
    averageGreen = RGBtuple[1]
    averageBlue = RGBtuple[2]

    percentageGreen = averageGreen/(averageRed+averageGreen+averageBlue) * 100
    percentageBlue = averageBlue/(averageRed+averageGreen+averageBlue) * 100
    percentageRed = averageRed/(averageRed+averageGreen+averageBlue) * 100

    emptyBlue+=[percentageBlue]
    emptyGreen+=[percentageGreen]
    emptyRed+=[percentageRed]
    print('    -----')
    print('    Percent Red',percentageRed)
    print('    Percent Green',percentageGreen)
    print('    Percent Blue',percentageBlue)
    print('    -----')
    return percentageRed, percentageGreen, percentageBlue
```

In [23]:

```
# Print all the informations from image, and create a pandas data frame with the relevant information

def print_file(path, xfile):
    print('-----')
    file1 = path + xfile

    # Read image
    tif_f1 = read_pil_image(file1)
    if tif_f1 == None:
        print("-->Unable to load image",file1)

    print('Inf.File:',xfile)

    # Transform Image to array
    aArray = np.array(tif_f1)
    # Array sum
    xsum = aArray.sum() / 1000000

    # Get channel 0
    x0_channel = channel(tif_f1, 0)
    aArray = np.array(x0_channel)
    xsum_0 = aArray.sum() / 1000000

    # Get channel 1
    x1_channel = channel(tif_f1, 1)
    aArray = np.array(x1_channel)
    xsum_1 = aArray.sum() / 1000000

    # Get channel 2
    x2_channel = channel(tif_f1, 2)
    aArray = np.array(x2_channel)
    xsum_2 = aArray.sum() / 1000000

    # Histogram from image
    aHist = tif_f1.histogram()
    hsum = sum(aHist) / 100000

    # Histogram channel 0
    aHist_0 = x0_channel.histogram()
    hsum_0 = sum(aHist_0) / 100000

    # Histogram channel 1
    aHist_1 = x1_channel.histogram()
    hsum_1 = sum(aHist_1) / 100000

    # Histogram channel 0
    aHist_2 = x2_channel.histogram()
    hsum_2 = sum(aHist_2) / 100000

    # number elements on list
    nlist = len(aHist)

    # Max and Min from Histogram
    xval_max, idx_max, xval_min, idx_min = histogram_max_min(path, xfile)

    # Percentage RGB
    perc_R, perc_G, perc_B = percent_rgb(path, xfile)
```

```

# Get color
# Enhancement Contrast color for better definition
# f1_file has the file name saved enhanced
xvalue = 2.0
print('Enhancement color:', xfile, ' Value:',xvalue)
x_enh, f1_file = contrast(path, xfile, xvalue)

# Remove Background - Put red background
# f2_file has the file name saved masked

# Only red Background for NON tif files
#xend_file = file.endswith('.TIF').upper()
if file.endswith('.TIF'):
    f2_file = f1_file
    img_masked = tif_f1
else:
    file1 = path+f1_file
    print('Red background:', path, f1_file)
    f2_file, img_masked = red_background(path, f1_file)

# Get Main Color -
print('Most common color:', path, f2_file)

# most present color, RGB from most present color:
# color name , Hex from rgb , list colors without red, list colors without back, decimal list colors without back
most_present, xrgb, xt_color_name, list_non_back, list_dec_back = get_main_color_without_red_and_floor(path, f2_file)

# HEX fom most present color
hex_color = rgb_to_hex(xrgb)

# Decimal from most present color
rgb_dec = rgbToDecimal(xrgb)
-----
# Get Extrems of the image
extr_a = tif_f1.getextrema()
# Transform tuple in a list
extr_b = [x for sets in extr_a for x in sets]
# Sum the list
sum_list = sum(extr_b)
med_extr = sum_list / len(extr_b)
#print('List Extremes:',extr_a,'Sum:',sum_list,'Len:', len(extr_b), 'Med:',med_extr)
r)

# Obtain name file without extension
sample_name = os.path.basename(xfile).split('_')[0]

# Print information
print(sample_name,' Size:',tif_f1.size, ' Format:',tif_f1.format, ' Mode:', tif_f1.mode)
print('           Sum array:',xsum, ' Sum Ch 0:', xsum_0, ' Sum Ch 1:', xsum_1, ' Sum Ch 2:', xsum_2)
print('           Histog  :',hsum , ' N.List elem:', nlist, ' Max:', xval_max, 'Idx Max:', idx_max, ' Min:', xval_min, 'Idx Min:', idx_min )
print('           Color   :',xt_color_name,' RGB   :',xrgb, ' Hex color:', hex_color, ' Dec Color:',rgb_dec)
print('           Extremes :',extr_a, 'Med Extremes:',med_extr)
print('           Percentage R:', perc_R,' Percentage G:', perc_B, ' Percentage B:', perc_B)

```

```
# insert information in a Pandas Data Frame
df_image.append((folder, xfile, sample_name, tif_f1.size, tif_f1.format, tif_f1.mod
e ,
xsum, xsum_0, xsum_1, xsum_2, hsum, nlist, xt_color_name, xrgb,
hex_color,
rgb_dec, med_extr, xval_max, idx_max, xval_min, idx_min,
perc_R, perc_G, perc_B))

return most_present, xrgb, xt_color_name, list_non_back, list_dec_back
```

Starting image analysis

In [24]:

```
# Create Data Frame with image information
df_image = []

xend_file = "*" + end_file
# change work to folder path
os.chdir(path)
print('Analysing Images from:',path, xend_file)

for file in glob.glob(xend_file):
    list_dec_back = list() # List with decimal colors in the image
    print(file)
    most_present, xrgb, xt_color_name, list_non_back, list_dec_back = print_file(path,file)
```

```

Analysing Images from: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/*.tif
Aluminum_1.tif
-----
Inf.File: Aluminum_1.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysis: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Aluminum_1.tif
RGB percent from image: Aluminum_1.tif
-----
Percent Red 33.57960394466849
Percent Green 33.57960394466849
Percent Blue 32.840792110663024
-----
Enhancement color: Aluminum_1.tif Value: 2.0
Enhance image: Aluminum_1.tif Value: 2.0
Save enhanced file : Enh_Aluminum_1.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Aluminum_1.tif
Red background for image: Enh_Aluminum_1.tif
Save masked image with red background: Mask_Enh_Aluminum_1.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_Aluminum_1.tif
Main color from image: Mask_Enh_Aluminum_1.tif
... List without excluded colors
Count occurrences for color
4 Most common colors: [((255, 255, 255), 1), ((243, 229, 223), 1),
((239, 229, 223), 1), ((237, 229, 223), 1)]
Read color name: (255, 255, 255)
Main Color file: Mask_Enh_Aluminum_1.tif RGB: [((255, 255, 255),
1)] (255, 255, 255) Color name: white Hex: #ffffff
Aluminum Size: (2048, 1536) Format: TIFF Mode: RGB
Sum array: 658.137536 Sum Ch 0: 220.999978 Sum Ch 1: 220.99997
8 Sum Ch 2: 216.13758
Histog : 94.37184 N.List elem: 768 Max: 237292 Idx Max: 11
Min: 543 Idx Min: 109
Color : white RGB : (255, 255, 255) Hex color: #fffff
f Dec Color: 16777215
Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
Percentage R: 33.57960394466849 Percentage G: 32.8407921106630
24 Percentage B: 32.840792110663024
Aluminum_2.tif
-----
Inf.File: Aluminum_2.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysis: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Aluminum_2.tif
RGB percent from image: Aluminum_2.tif
-----
Percent Red 33.57823383501651
Percent Green 33.57823383501651

```

Percent Blue 32.84353232996698

Enhancement color: Aluminum_2.tif Value: 2.0

Enhance image: Aluminum_2.tif Value: 2.0

Save enhanced file : Enh_Aluminum_2.tif

Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Aluminum_2.tif

Red background for image: Enh_Aluminum_2.tif

Save masked image with red background: Mask_Enh_Aluminum_2.tif

Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_Aluminum_2.tif

Main color from image: Mask_Enh_Aluminum_2.tif

... List without excluded colors

Count occurrences for color

4 Most common colors: [((255, 255, 255), 1), ((255, 229, 223), 1), ((247, 229, 223), 1), ((243, 229, 223), 1)]

Read color name: (255, 255, 255)

Main Color file: Mask_Enh_Aluminum_2.tif RGB: [((255, 255, 255), 1)] (255, 255, 255) Color name: white Hex: #ffffff

Aluminum Size: (2048, 1536) Format: TIFF Mode: RGB

Sum array: 693.024169 Sum Ch 0: 232.705276 Sum Ch 1: 232.70527

6 Sum Ch 2: 227.613617

Histogram : 94.37184 N.List elem: 768 Max: 280312 Idx Max: 252

Min: 648 Idx Min: 129

Color : white RGB : (255, 255, 255) Hex color: #fffff

f Dec Color: 16777215

Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333

3333333333

Percentage R: 33.57823383501651 Percentage G: 32.8435323299669

8 Percentage B: 32.84353232996698

Aluminum_3.tif

Inf.File: Aluminum_3.tif

Get Channel n: 0

Get Channel n: 1

Get Channel n: 2

Histogram analysis: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Aluminum_3.tif

RGB percent from image: Aluminum_3.tif

Percent Red 33.563387602119285

Percent Green 33.563387602119285

Percent Blue 32.873224795761416

Enhancement color: Aluminum_3.tif Value: 2.0

Enhance image: Aluminum_3.tif Value: 2.0

Save enhanced file : Enh_Aluminum_3.tif

Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Aluminum_3.tif

Red background for image: Enh_Aluminum_3.tif

Save masked image with red background: Mask_Enh_Aluminum_3.tif

Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_Aluminum_3.tif

Main color from image: Mask_Enh_Aluminum_3.tif

... List without excluded colors

Count occurrences for color

```
4 Most common colors: [((255, 255, 255), 1), ((254, 229, 223), 1),
((250, 229, 223), 1), ((248, 229, 223), 1)]
Read color name: (255, 255, 255)
Main Color file: Mask_Enh_Aluminum_3.tif  RGB: [((255, 255, 255),
1)] (255, 255, 255) Color name: white Hex: #ffffff
Aluminum Size: (2048, 1536) Format: TIFF Mode: RGB
Sum array: 696.532319 Sum Ch 0: 233.779842 Sum Ch 1: 233.77984
2 Sum Ch 2: 228.972635
    Histog : 94.37184 N.List elem: 768 Max: 248402 Idx Max: 8
Min: 819 Idx Min: 94
    Color : white RGB : (255, 255, 255) Hex color: #fffff
f Dec Color: 16777215
    Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
    Percentage R: 33.563387602119285 Percentage G: 32.873224795761
416 Percentage B: 32.873224795761416
Aluminum_4.tif
-----
Inf.File: Aluminum_4.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Aluminum_4.tif
RGB percent from image: Aluminum_4.tif
-----
Percent Red 33.57960394466849
Percent Green 33.57960394466849
Percent Blue 32.840792110663024
-----
Enhancement color: Aluminum_4.tif Value: 2.0
Enhance image: Aluminum_4.tif Value: 2.0
Save enhanced file : Enh_Aluminum_4.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Aluminum_4.tif
Red background for image: Enh_Aluminum_4.tif
Save masked image with red background: Mask_Enh_Aluminum_4.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_Aluminum_4.tif
Main color from image: Mask_Enh_Aluminum_4.tif
... List without excluded colors
Count occurrences for color
4 Most common colors: [((255, 255, 255), 1), ((243, 229, 223), 1),
((239, 229, 223), 1), ((237, 229, 223), 1)]
Read color name: (255, 255, 255)
Main Color file: Mask_Enh_Aluminum_4.tif  RGB: [((255, 255, 255),
1)] (255, 255, 255) Color name: white Hex: #ffffff
Aluminum Size: (2048, 1536) Format: TIFF Mode: RGB
Sum array: 658.137536 Sum Ch 0: 220.999978 Sum Ch 1: 220.99997
8 Sum Ch 2: 216.13758
    Histog : 94.37184 N.List elem: 768 Max: 237292 Idx Max: 11
Min: 543 Idx Min: 109
    Color : white RGB : (255, 255, 255) Hex color: #fffff
f Dec Color: 16777215
    Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
    Percentage R: 33.57960394466849 Percentage G: 32.8407921106630
24 Percentage B: 32.840792110663024
```

Aluminum_5.tif

```
-----  
Inf.File: Aluminum_5.tif  
Get Channel n: 0  
Get Channel n: 1  
Get Channel n: 2  
Histogram analysis: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Aluminum_5.tif  
    RGB percent from image: Aluminum_5.tif  
    -----  
    Percent Red 33.57823383501651  
    Percent Green 33.57823383501651  
    Percent Blue 32.84353232996698  
    -----  
Enhancement color: Aluminum_5.tif Value: 2.0  
    Enhance image: Aluminum_5.tif Value: 2.0  
    Save enhanced file : Enh_Aluminum_5.tif  
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Aluminum_5.tif  
    Red background for image: Enh_Aluminum_5.tif  
    Save masked image with red background: Mask_Enh_Aluminum_5.tif  
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_Aluminum_5.tif  
    Main color from image: Mask_Enh_Aluminum_5.tif  
    ... List without excluded colors  
Count occurrences for color  
    4 Most common colors: [((255, 255, 255), 1), ((255, 229, 223), 1),  
    ((247, 229, 223), 1), ((243, 229, 223), 1)]  
    Read color name: (255, 255, 255)  
    Main Color file: Mask_Enh_Aluminum_5.tif RGB: [((255, 255, 255),  
    1)] (255, 255, 255) Color name: white Hex: #ffffff  
Aluminum Size: (2048, 1536) Format: TIFF Mode: RGB  
    Sum array: 693.024169 Sum Ch 0: 232.705276 Sum Ch 1: 232.70527  
6 Sum Ch 2: 227.613617  
    Histog : 94.37184 N.List elem: 768 Max: 280312 Idx Max: 252  
Min: 648 Idx Min: 129  
    Color : white RGB : (255, 255, 255) Hex color: #fffff  
f Dec Color: 16777215  
    Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333  
3333333333  
    Percentage R: 33.57823383501651 Percentage G: 32.8435323299669  
8 Percentage B: 32.84353232996698  
Aluminum_6.tif
```

```
-----  
Inf.File: Aluminum_6.tif  
Get Channel n: 0  
Get Channel n: 1  
Get Channel n: 2  
Histogram analysis: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Aluminum_6.tif  
    RGB percent from image: Aluminum_6.tif  
    -----  
    Percent Red 33.563387602119285  
    Percent Green 33.563387602119285  
    Percent Blue 32.873224795761416  
    -----  
Enhancement color: Aluminum_6.tif Value: 2.0
```

```
Enhance image: Aluminum_6.tif  Value: 2.0
Save enhanced file : Enh_Aluminum_6.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Aluminum_6.tif
    Red background for image: Enh_Aluminum_6.tif
    Save masked image with red background: Mask_Enh_Aluminum_6.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_Aluminum_6.tif
    Main color from image: Mask_Enh_Aluminum_6.tif
... List without excluded colors
Count occurrences for color
    4 Most common colors: [((255, 255, 255), 1), ((254, 229, 223), 1),
((250, 229, 223), 1), ((248, 229, 223), 1)]
    Read color name: (255, 255, 255)
    Main Color file: Mask_Enh_Aluminum_6.tif  RGB: [((255, 255, 255),
1)] (255, 255, 255)  Color name: white  Hex: #ffffff
Aluminum  Size: (2048, 1536)  Format: TIFF  Mode: RGB
    Sum array: 696.532319  Sum Ch 0: 233.779842  Sum Ch 1: 233.77984
2  Sum Ch 2: 228.972635
    Histog : 94.37184  N.List elem: 768  Max: 248402  Idx Max: 8
Min: 819  Idx Min: 94
    Color : white  RGB : (255, 255, 255)  Hex color: #fffff
f  Dec Color: 16777215
    Extremes : ((1, 255), (1, 255), (0, 255))  Med Extremes: 127.8333
3333333333
    Percentage R: 33.563387602119285  Percentage G: 32.873224795761
416  Percentage B: 32.873224795761416
Brass_1.tif
-----
Inf.File: Brass_1.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysis: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Brass_1.tif
    RGB percent from image: Brass_1.tif
-----
    Percent Red 33.63006225345552
    Percent Green 33.63006225345552
    Percent Blue 32.73987549308895
-----
Enhancement color: Brass_1.tif  Value: 2.0
    Enhance image: Brass_1.tif  Value: 2.0
    Save enhanced file : Enh_Brass_1.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Brass_1.tif
    Red background for image: Enh_Brass_1.tif
    Save masked image with red background: Mask_Enh_Brass_1.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_Brass_1.tif
    Main color from image: Mask_Enh_Brass_1.tif
... List without excluded colors
Count occurrences for color
    4 Most common colors: [((255, 255, 255), 1), ((251, 229, 223), 1),
((245, 229, 223), 1), ((237, 229, 223), 1)]
    Read color name: (255, 255, 255)
```

```

Main Color file: Mask_Enh_Brass_1.tif  RGB: [((255, 255, 255), 1)]
(255, 255, 255)  Color name: white  Hex: #ffffff
Brass  Size: (2048, 1536)  Format: TIFF  Mode: RGB
Sum array: 562.098115  Sum Ch 0: 189.033946  Sum Ch 1: 189.03394
6  Sum Ch 2: 184.030223
    Histog : 94.37184  N.List elem: 768  Max: 217593  Idx Max: 252
Min: 249  Idx Min: 0
    Color : white  RGB : (255, 255, 255)  Hex color: #fffff
f  Dec Color: 16777215
    Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
    Percentage R: 33.63006225345552  Percentage G: 32.7398754930889
5  Percentage B: 32.73987549308895
Brass_2.tif
-----
Inf.File: Brass_2.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Brass_2.tif
    RGB percent from image: Brass_2.tif
    -----
    Percent Red 33.677561630800604
    Percent Green 33.677561630800604
    Percent Blue 32.6448767383988
    -----
Enhancement color: Brass_2.tif  Value: 2.0
    Enhance image: Brass_2.tif  Value: 2.0
    Save enhanced file : Enh_Brass_2.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Brass_2.tif
    Red background for image: Enh_Brass_2.tif
    Save masked image with red background: Mask_Enh_Brass_2.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_Brass_2.tif
    Main color from image: Mask_Enh_Brass_2.tif
...  List without excluded colors
Count occurrences for color
    4 Most common colors: [((255, 255, 255), 1), ((249, 229, 223), 1),
((247, 229, 223), 1), ((245, 229, 223), 1)]
    Read color name: (255, 255, 255)
    Main Color file: Mask_Enh_Brass_2.tif  RGB: [((255, 255, 255), 1)]
(255, 255, 255)  Color name: white  Hex: #ffffff
Brass  Size: (2048, 1536)  Format: TIFF  Mode: RGB
Sum array: 449.396523  Sum Ch 0: 151.345791  Sum Ch 1: 151.34579
1  Sum Ch 2: 146.704941
    Histog : 94.37184  N.List elem: 768  Max: 179424  Idx Max: 19
Min: 252  Idx Min: 0
    Color : white  RGB : (255, 255, 255)  Hex color: #fffff
f  Dec Color: 16777215
    Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
    Percentage R: 33.677561630800604  Percentage G: 32.644876738398
8  Percentage B: 32.6448767383988
Brass_3.tif
-----
Inf.File: Brass_3.tif

```

```
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Brass_3.tif
    RGB percent from image: Brass_3.tif
    -----
    Percent Red 33.70125013816265
    Percent Green 33.70125013816265
    Percent Blue 32.597499723674694
    -----
Enhancement color: Brass_3.tif Value: 2.0
    Enhance image: Brass_3.tif Value: 2.0
    Save enhanced file : Enh_Brass_3.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Brass_3.tif
    Red background for image: Enh_Brass_3.tif
    Save masked image with red background: Mask_Enh_Brass_3.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_Brass_3.tif
    Main color from image: Mask_Enh_Brass_3.tif
    ... List without excluded colors
Count occurrences for color
    4 Most common colors: [((255, 255, 255), 1), ((254, 229, 223), 1),
    ((248, 229, 223), 1), ((242, 229, 223), 1)]
    Read color name: (255, 255, 255)
    Main Color file: Mask_Enh_Brass_3.tif RGB: [((255, 255, 255), 1)]
    (255, 255, 255) Color name: white Hex: #ffffff
Brass Size: (2048, 1536) Format: TIFF Mode: RGB
    Sum array: 469.763357 Sum Ch 0: 158.316124 Sum Ch 1: 158.31612
4 Sum Ch 2: 153.131109
    Histog : 94.37184 N.List elem: 768 Max: 201117 Idx Max: 14
Min: 314 Idx Min: 255
    Color : white RGB : (255, 255, 255) Hex color: #fffff
f Dec Color: 16777215
    Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
    Percentage R: 33.70125013816265 Percentage G: 32.5974997236746
94 Percentage B: 32.597499723674694
Brass_4.tif
    -----
Inf.File: Brass_4.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Brass_4.tif
    RGB percent from image: Brass_4.tif
    -----
    Percent Red 33.63006225345552
    Percent Green 33.63006225345552
    Percent Blue 32.73987549308895
    -----
Enhancement color: Brass_4.tif Value: 2.0
    Enhance image: Brass_4.tif Value: 2.0
    Save enhanced file : Enh_Brass_4.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/Multiespectral_8.ipyn... 32/135
```

```
abalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Brass_4.tif
```

```
    Red background for image: Enh_Brass_4.tif
```

```
    Save masked image with red background: Mask_Enh_Brass_4.tif
```

```
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_Brass_4.tif
```

```
    Main color from image: Mask_Enh_Brass_4.tif
```

```
... List without excluded colors
```

```
Count occurrences for color
```

```
    4 Most common colors: [((255, 255, 255), 1), ((251, 229, 223), 1),
```

```
((245, 229, 223), 1), ((237, 229, 223), 1)]
```

```
    Read color name: (255, 255, 255)
```

```
    Main Color file: Mask_Enh_Brass_4.tif RGB: [((255, 255, 255), 1)]
```

```
(255, 255, 255) Color name: white Hex: #ffffff
```

```
Brass Size: (2048, 1536) Format: TIFF Mode: RGB
```

```
    Sum array: 562.098115 Sum Ch 0: 189.033946 Sum Ch 1: 189.03394
```

```
6 Sum Ch 2: 184.030223
```

```
    Histog : 94.37184 N.List elem: 768 Max: 217593 Idx Max: 252
```

```
Min: 249 Idx Min: 0
```

```
    Color : white RGB : (255, 255, 255) Hex color: #fffff
```

```
f Dec Color: 16777215
```

```
    Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
```

```
3333333333
```

```
    Percentage R: 33.63006225345552 Percentage G: 32.7398754930889
```

```
5 Percentage B: 32.73987549308895
```

```
Brass_5.tif
```

```
-----
```

```
Inf.File: Brass_5.tif
```

```
Get Channel n: 0
```

```
Get Channel n: 1
```

```
Get Channel n: 2
```

```
Histogram analysys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Brass_5.tif
```

```
RGB percent from image: Brass_5.tif
```

```
-----
```

```
Percent Red 33.677561630800604
```

```
Percent Green 33.677561630800604
```

```
Percent Blue 32.6448767383988
```

```
-----
```

```
Enhancement color: Brass_5.tif Value: 2.0
```

```
    Enhance image: Brass_5.tif Value: 2.0
```

```
    Save enhanced file : Enh_Brass_5.tif
```

```
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Brass_5.tif
```

```
    Red background for image: Enh_Brass_5.tif
```

```
    Save masked image with red background: Mask_Enh_Brass_5.tif
```

```
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_Brass_5.tif
```

```
    Main color from image: Mask_Enh_Brass_5.tif
```

```
... List without excluded colors
```

```
Count occurrences for color
```

```
    4 Most common colors: [((255, 255, 255), 1), ((249, 229, 223), 1),
```

```
((247, 229, 223), 1), ((245, 229, 223), 1)]
```

```
    Read color name: (255, 255, 255)
```

```
    Main Color file: Mask_Enh_Brass_5.tif RGB: [((255, 255, 255), 1)]
```

```
(255, 255, 255) Color name: white Hex: #ffffff
```

```
Brass Size: (2048, 1536) Format: TIFF Mode: RGB
```

```

        Sum array: 449.396523  Sum Ch 0: 151.345791  Sum Ch 1: 151.34579
1  Sum Ch 2: 146.704941
        Histog   : 94.37184  N.List elem: 768  Max: 179424  Idx Max: 19
Min: 252 Idx Min: 0
        Color   : white    RGB   : (255, 255, 255)    Hex color: #fffff
f  Dec Color: 16777215
        Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
        Percentage R: 33.677561630800604  Percentage G: 32.644876738398
8  Percentage B: 32.6448767383988
Brass_6.tif
-----
Inf.File: Brass_6.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Brass_6.tif
RGB percent from image: Brass_6.tif
-----
Percent Red 33.70125013816265
Percent Green 33.70125013816265
Percent Blue 32.597499723674694
-----
Enhancement color: Brass_6.tif  Value: 2.0
Enhance image: Brass_6.tif  Value: 2.0
Save enhanced file : Enh_Brass_6.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Brass_6.tif
Red background for image: Enh_Brass_6.tif
Save masked image with red background: Mask_Enh_Brass_6.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_Brass_6.tif
Main color from image: Mask_Enh_Brass_6.tif
... List without excluded colors
Count occurrences for color
4 Most common colors: [((255, 255, 255), 1), ((254, 229, 223), 1),
((248, 229, 223), 1), ((242, 229, 223), 1)]
Read color name: (255, 255, 255)
Main Color file: Mask_Enh_Brass_6.tif  RGB: [((255, 255, 255), 1)]
(255, 255, 255) Color name: white Hex: #ffffff
Brass Size: (2048, 1536) Format: TIFF Mode: RGB
Sum array: 469.763357  Sum Ch 0: 158.316124  Sum Ch 1: 158.31612
4  Sum Ch 2: 153.131109
        Histog   : 94.37184  N.List elem: 768  Max: 201117  Idx Max: 14
Min: 314 Idx Min: 255
        Color   : white    RGB   : (255, 255, 255)    Hex color: #fffff
f  Dec Color: 16777215
        Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
        Percentage R: 33.70125013816265  Percentage G: 32.5974997236746
94  Percentage B: 32.597499723674694
CopperWire_1.tif
-----
Inf.File: CopperWire_1.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2

```

```

Histogram analisys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/CopperWire_1.tif
    RGB percent from image: CopperWire_1.tif
    -----
    Percent Red 33.65505173811915
    Percent Green 33.65505173811915
    Percent Blue 32.689896523761696
    -----
Enhancement color: CopperWire_1.tif  Value: 2.0
    Enhance image: CopperWire_1.tif  Value: 2.0
    Save enhanced file : Enh_CopperWire_1.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_CopperWire_1.tif
    Red background for image: Enh_CopperWire_1.tif
    Save masked image with red background: Mask_Enh_CopperWire_1.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_CopperWire_1.tif
    Main color from image: Mask_Enh_CopperWire_1.tif
... List without excluded colors
Count occurrences for color
    4 Most common colors: [((255, 255, 255), 1), ((239, 229, 223), 1),
((231, 229, 223), 1), ((229, 229, 223), 1)]
    Read color name: (255, 255, 255)
    Main Color file: Mask_Enh_CopperWire_1.tif  RGB: [((255, 255, 255),
1)] (255, 255, 255)  Color name: white  Hex: #ffffff
CopperWire  Size: (2048, 1536)  Format: TIFF  Mode: RGB
    Sum array: 521.051218  Sum Ch 0: 175.360057  Sum Ch 1: 175.36005
7  Sum Ch 2: 170.331104
    Histog : 94.37184  N.List elem: 768  Max: 219734  Idx Max: 252
Min: 65  Idx Min: 255
    Color : white  RGB : (255, 255, 255)  Hex color: #fffff
f  Dec Color: 16777215
    Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
    Percentage R: 33.65505173811915  Percentage G: 32.6898965237616
96  Percentage B: 32.689896523761696
CopperWire_2.tif
    -----
Inf.File: CopperWire_2.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analisys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/CopperWire_2.tif
    RGB percent from image: CopperWire_2.tif
    -----
    Percent Red 33.60618855121713
    Percent Green 33.60618855121713
    Percent Blue 32.78762289756573
    -----
Enhancement color: CopperWire_2.tif  Value: 2.0
    Enhance image: CopperWire_2.tif  Value: 2.0
    Save enhanced file : Enh_CopperWire_2.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_CopperWire_2.tif
    Red background for image: Enh_CopperWire_2.tif

```

```

Save masked image with red background: Mask_Enh_CopperWire_2.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense
\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_En
h_CopperWire_2.tif
    Main color from image: Mask_Enh_CopperWire_2.tif
... List without excluded colors
Count occurrences for color
    4 Most common colors: [((255, 255, 255), 1), ((237, 229, 223), 1),
((233, 229, 223), 1), ((245, 228, 223), 1)]
        Read color name: (255, 255, 255)
        Main Color file: Mask_Enh_CopperWire_2.tif  RGB: [((255, 255,
1)] (255, 255, 255) Color name: white Hex: #ffffff
CopperWire Size: (2048, 1536) Format: TIFF Mode: RGB
            Sum array: 634.394685 Sum Ch 0: 213.195874 Sum Ch 1: 213.19587
4 Sum Ch 2: 208.002937
            Histog : 94.37184 N.List elem: 768 Max: 319958 Idx Max: 252
Min: 205 Idx Min: 156
            Color : white RGB : (255, 255, 255) Hex color: #fffff
f Dec Color: 16777215
            Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
            Percentage R: 33.60618855121713 Percentage G: 32.7876228975657
3 Percentage B: 32.78762289756573
CopperWire_3.tif
-----
Inf.File: CopperWire_3.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalens
e\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/CopperW
ire_3.tif
    RGB percent from image: CopperWire_3.tif
    -----
    Percent Red 33.671812077620764
    Percent Green 33.671812077620764
    Percent Blue 32.656375844758465
    -----
Enhancement color: CopperWire_3.tif Value: 2.0
    Enhance image: CopperWire_3.tif Value: 2.0
    Save enhanced file : Enh_CopperWire_3.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Tr
abalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Copper
Wire_3.tif
    Red background for image: Enh_CopperWire_3.tif
    Save masked image with red background: Mask_Enh_CopperWire_3.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense
\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_En
h_CopperWire_3.tif
    Main color from image: Mask_Enh_CopperWire_3.tif
... List without excluded colors
Count occurrences for color
    4 Most common colors: [((255, 255, 255), 1), ((233, 229, 223), 1),
((231, 229, 223), 1), ((229, 229, 223), 1)]
        Read color name: (255, 255, 255)
        Main Color file: Mask_Enh_CopperWire_3.tif  RGB: [((255, 255,
1)] (255, 255, 255) Color name: white Hex: #ffffff
CopperWire Size: (2048, 1536) Format: TIFF Mode: RGB
            Sum array: 481.236521 Sum Ch 0: 162.041057 Sum Ch 1: 162.04105
7 Sum Ch 2: 157.154407
            Histog : 94.37184 N.List elem: 768 Max: 139122 Idx Max: 253

```

```
Min: 118 Idx Min: 255
      Color : white    RGB : (255, 255, 255)    Hex color: #fffff
f  Dec Color: 16777215
      Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
      Percentage R: 33.671812077620764    Percentage G: 32.656375844758
465    Percentage B: 32.656375844758465
CopperWire_4.tif
-----
Inf.File: CopperWire_4.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analisys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense
e\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/CopperW
ire_4.tif
RGB percent from image: CopperWire_4.tif
-----
Percent Red 33.6085797831091
Percent Green 33.6085797831091
Percent Blue 32.78284043378181
-----
Enhancement color: CopperWire_4.tif  Value: 2.0
Enhance image: CopperWire_4.tif  Value: 2.0
Save enhanced file : Enh_CopperWire_4.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Tr
abalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Copper
Wire_4.tif
Red background for image: Enh_CopperWire_4.tif
Save masked image with red background: Mask_Enh_CopperWire_4.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense
\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_En
h_CopperWire_4.tif
Main color from image: Mask_Enh_CopperWire_4.tif
... List without excluded colors
Count occurrences for color
4 Most common colors: [((255, 255, 255), 1), ((230, 229, 223), 1),
((255, 227, 223), 1), ((250, 227, 223), 1)]
Read color name: (255, 255, 255)
Main Color file: Mask_Enh_CopperWire_4.tif  RGB: [((255, 255, 255),
1)] (255, 255, 255) Color name: white Hex: #ffffff
CopperWire Size: (2048, 1536) Format: TIFF Mode: RGB
Sum array: 564.848218 Sum Ch 0: 189.837464 Sum Ch 1: 189.83746
4 Sum Ch 2: 185.17329
Histog : 94.37184 N.List elem: 768 Max: 98434 Idx Max: 51
Min: 41 Idx Min: 255
      Color : white    RGB : (255, 255, 255)    Hex color: #fffff
f  Dec Color: 16777215
      Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
      Percentage R: 33.6085797831091    Percentage G: 32.78284043378181
Percentage B: 32.78284043378181
CopperWire_5.tif
-----
Inf.File: CopperWire_5.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analisys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense
e\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/CopperW
ire_5.tif
```

```
RGB percent from image: CopperWire_5.tif
-----
Percent Red 33.65505173811915
Percent Green 33.65505173811915
Percent Blue 32.689896523761696
-----
Enhancement color: CopperWire_5.tif  Value: 2.0
  Enhance image: CopperWire_5.tif  Value: 2.0
  Save enhanced file : Enh_CopperWire_5.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_CopperWire_5.tif
  Red background for image: Enh_CopperWire_5.tif
  Save masked image with red background: Mask_Enh_CopperWire_5.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_CopperWire_5.tif
  Main color from image: Mask_Enh_CopperWire_5.tif
... List without excluded colors
Count occurrences for color
  4 Most common colors: [((255, 255, 255), 1), ((239, 229, 223), 1),
((231, 229, 223), 1), ((229, 229, 223), 1)]
  Read color name: (255, 255, 255)
  Main Color file: Mask_Enh_CopperWire_5.tif  RGB: [((255, 255, 255),
1)] (255, 255, 255)  Color name: white  Hex: #ffffff
CopperWire Size: (2048, 1536) Format: TIFF Mode: RGB
  Sum array: 521.051218  Sum Ch 0: 175.360057  Sum Ch 1: 175.36005
7  Sum Ch 2: 170.331104
  Histog : 94.37184  N.List elem: 768  Max: 219734  Idx Max: 252
Min: 65  Idx Min: 255
  Color : white  RGB : (255, 255, 255)  Hex color: #fffff
f  Dec Color: 16777215
  Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
  Percentage R: 33.65505173811915  Percentage G: 32.6898965237616
96  Percentage B: 32.689896523761696
CopperWire_6.tif
-----
Inf.File: CopperWire_6.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/CopperWire_6.tif
  RGB percent from image: CopperWire_6.tif
-----
Percent Red 33.60618855121713
Percent Green 33.60618855121713
Percent Blue 32.78762289756573
-----
Enhancement color: CopperWire_6.tif  Value: 2.0
  Enhance image: CopperWire_6.tif  Value: 2.0
  Save enhanced file : Enh_CopperWire_6.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_CopperWire_6.tif
  Red background for image: Enh_CopperWire_6.tif
  Save masked image with red background: Mask_Enh_CopperWire_6.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_CopperWire_6.tif
```

```
h_CopperWire_6.tif
    Main color from image: Mask_Enh_CopperWire_6.tif
    ... List without excluded colors
    Count occurrences for color
        4 Most common colors: [((255, 255, 255), 1), ((237, 229, 223), 1),
        ((233, 229, 223), 1), ((245, 228, 223), 1)]
        Read color name: (255, 255, 255)
        Main Color file: Mask_Enh_CopperWire_6.tif RGB: [((255, 255, 255),
        1)] (255, 255, 255) Color name: white Hex: #ffffff
        CopperWire Size: (2048, 1536) Format: TIFF Mode: RGB
            Sum array: 634.394685 Sum Ch 0: 213.195874 Sum Ch 1: 213.19587
        4 Sum Ch 2: 208.002937
            Histog : 94.37184 N.List elem: 768 Max: 319958 Idx Max: 252
            Min: 205 Idx Min: 156
                Color : white RGB : (255, 255, 255) Hex color: #fffff
f Dec Color: 16777215
            Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
            Percentage R: 33.60618855121713 Percentage G: 32.7876228975657
3 Percentage B: 32.78762289756573
CopperWire_7.tif
-----
Inf.File: CopperWire_7.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/CopperWire_7.tif
    RGB percent from image: CopperWire_7.tif
-----
    Percent Red 33.671812077620764
    Percent Green 33.671812077620764
    Percent Blue 32.656375844758465
-----
Enhancement color: CopperWire_7.tif Value: 2.0
    Enhance image: CopperWire_7.tif Value: 2.0
    Save enhanced file : Enh_CopperWire_7.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_CopperWire_7.tif
    Red background for image: Enh_CopperWire_7.tif
    Save masked image with red background: Mask_Enh_CopperWire_7.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_CopperWire_7.tif
    Main color from image: Mask_Enh_CopperWire_7.tif
    ... List without excluded colors
    Count occurrences for color
        4 Most common colors: [((255, 255, 255), 1), ((233, 229, 223), 1),
        ((231, 229, 223), 1), ((229, 229, 223), 1)]
        Read color name: (255, 255, 255)
        Main Color file: Mask_Enh_CopperWire_7.tif RGB: [((255, 255, 255),
        1)] (255, 255, 255) Color name: white Hex: #ffffff
        CopperWire Size: (2048, 1536) Format: TIFF Mode: RGB
            Sum array: 481.236521 Sum Ch 0: 162.041057 Sum Ch 1: 162.04105
        7 Sum Ch 2: 157.154407
            Histog : 94.37184 N.List elem: 768 Max: 139122 Idx Max: 253
            Min: 118 Idx Min: 255
                Color : white RGB : (255, 255, 255) Hex color: #fffff
f Dec Color: 16777215
```

Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333

Percentage R: 33.671812077620764 Percentage G: 32.656375844758

465 Percentage B: 32.656375844758465

CopperWire_8.tif

Inf.File: CopperWire_8.tif

Get Channel n: 0

Get Channel n: 1

Get Channel n: 2

Histogram analisys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/CopperWire_8.tif

RGB percent from image: CopperWire_8.tif

Percent Red 33.6085797831091

Percent Green 33.6085797831091

Percent Blue 32.78284043378181

Enhancement color: CopperWire_8.tif Value: 2.0

Enhance image: CopperWire_8.tif Value: 2.0

Save enhanced file : Enh_CopperWire_8.tif

Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_CopperWire_8.tif

Red background for image: Enh_CopperWire_8.tif

Save masked image with red background: Mask_Enh_CopperWire_8.tif

Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_CopperWire_8.tif

Main color from image: Mask_Enh_CopperWire_8.tif

... List without excluded colors

Count occurrences for color

4 Most common colors: [((255, 255, 255), 1), ((230, 229, 223), 1), ((255, 227, 223), 1), ((250, 227, 223), 1)]

Read color name: (255, 255, 255)

Main Color file: Mask_Enh_CopperWire_8.tif RGB: [((255, 255, 255), 1)] (255, 255, 255) Color name: white Hex: #ffffff

CopperWire Size: (2048, 1536) Format: TIFF Mode: RGB

Sum array: 564.848218 Sum Ch 0: 189.837464 Sum Ch 1: 189.83746

4 Sum Ch 2: 185.17329

Histog : 94.37184 N.List elem: 768 Max: 98434 Idx Max: 51

Min: 41 Idx Min: 255

Color : white RGB : (255, 255, 255) Hex color: #fffff

f Dec Color: 16777215

Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333

3333333333

Percentage R: 33.6085797831091 Percentage G: 32.78284043378181

Percentage B: 32.78284043378181

Copper_1.tif

Inf.File: Copper_1.tif

Get Channel n: 0

Get Channel n: 1

Get Channel n: 2

Histogram analisys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Copper_1.tif

RGB percent from image: Copper_1.tif

Percent Red 33.68795564293108

```
Percent Green 33.68795564293108
Percent Blue 32.624088714137834
-----
Enhancement color: Copper_1.tif  Value: 2.0
  Enhance image: Copper_1.tif  Value: 2.0
  Save enhanced file : Enh_Copper_1.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Copper_1.tif
  Red background for image: Enh_Copper_1.tif
  Save masked image with red background: Mask_Enh_Copper_1.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_Copper_1.tif
  Main color from image: Mask_Enh_Copper_1.tif
...  List without excluded colors
Count occurrences for color
  4 Most common colors: [((255, 255, 255), 1), ((249, 229, 223), 1),
((247, 229, 223), 1), ((245, 229, 223), 1)]
  Read color name: (255, 255, 255)
  Main Color file: Mask_Enh_Copper_1.tif  RGB: [((255, 255, 255), 1)]
(255, 255, 255)  Color name: white  Hex: #ffffff
Copper Size: (2048, 1536)  Format: TIFF  Mode: RGB
  Sum array: 447.139193  Sum Ch 0: 150.632053  Sum Ch 1: 150.63205
3  Sum Ch 2: 145.875087
  Histog : 94.37184  N.List elem: 768  Max: 176926  Idx Max: 15
Min: 289  Idx Min: 255
  Color : white  RGB : (255, 255, 255)  Hex color: #fffff
f  Dec Color: 16777215
  Extremes : ((1, 255), (1, 255), (0, 255))  Med Extremes: 127.8333
3333333333
  Percentage R: 33.68795564293108  Percentage G: 32.6240887141378
34  Percentage B: 32.624088714137834
Copper_2.tif
-----
Inf.File: Copper_2.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysis: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Copper_2.tif
  RGB percent from image: Copper_2.tif
-----
  Percent Red 33.60516338022042
  Percent Green 33.60516338022042
  Percent Blue 32.78967323955916
-----
Enhancement color: Copper_2.tif  Value: 2.0
  Enhance image: Copper_2.tif  Value: 2.0
  Save enhanced file : Enh_Copper_2.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Copper_2.tif
  Red background for image: Enh_Copper_2.tif
  Save masked image with red background: Mask_Enh_Copper_2.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_Copper_2.tif
  Main color from image: Mask_Enh_Copper_2.tif
...  List without excluded colors
```

```

Count occurrences for color
  4 Most common colors: [((255, 255, 255), 1), ((254, 229, 223), 1),
((248, 229, 223), 1), ((244, 229, 223), 1)]
    Read color name: (255, 255, 255)
      Main Color file: Mask_Enh_Copper_2.tif  RGB: [((255, 255, 255), 1)]
(255, 255, 255)  Color name: white Hex: #ffffff
Copper Size: (2048, 1536) Format: TIFF Mode: RGB
    Sum array: 588.109624  Sum Ch 0: 197.6352  Sum Ch 1: 197.6352  S
um Ch 2: 192.839224
    Histog : 94.37184  N.List elem: 768  Max: 179730  Idx Max: 253
Min: 552  Idx Min: 0
    Color : white  RGB : (255, 255, 255)  Hex color: #fffff
f  Dec Color: 16777215
    Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
    Percentage R: 33.60516338022042  Percentage G: 32.7896732395591
6  Percentage B: 32.78967323955916
Copper_3.tif
-----
Inf.File: Copper_3.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Copper_3.tif
RGB percent from image: Copper_3.tif
-----
Percent Red 33.68795564293108
Percent Green 33.68795564293108
Percent Blue 32.624088714137834
-----
Enhancement color: Copper_3.tif  Value: 2.0
  Enhance image: Copper_3.tif  Value: 2.0
  Save enhanced file : Enh_Copper_3.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Copper_3.tif
  Red background for image: Enh_Copper_3.tif
  Save masked image with red background: Mask_Enh_Copper_3.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_Copper_3.tif
  Main color from image: Mask_Enh_Copper_3.tif
... List without excluded colors
Count occurrences for color
  4 Most common colors: [((255, 255, 255), 1), ((249, 229, 223), 1),
((247, 229, 223), 1), ((245, 229, 223), 1)]
    Read color name: (255, 255, 255)
      Main Color file: Mask_Enh_Copper_3.tif  RGB: [((255, 255, 255), 1)]
(255, 255, 255)  Color name: white Hex: #ffffff
Copper Size: (2048, 1536) Format: TIFF Mode: RGB
    Sum array: 447.139193  Sum Ch 0: 150.632053  Sum Ch 1: 150.63205
3  Sum Ch 2: 145.875087
    Histog : 94.37184  N.List elem: 768  Max: 176926  Idx Max: 15
Min: 289  Idx Min: 255
    Color : white  RGB : (255, 255, 255)  Hex color: #fffff
f  Dec Color: 16777215
    Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
    Percentage R: 33.68795564293108  Percentage G: 32.6240887141378

```

34 Percentage B: 32.624088714137834
Copper_4.tif

Inf.File: Copper_4.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysis: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Copper_4.tif

RGB percent from image: Copper_4.tif

Percent Red 33.60516338022042
Percent Green 33.60516338022042
Percent Blue 32.78967323955916

Enhancement color: Copper_4.tif Value: 2.0

Enhance image: Copper_4.tif Value: 2.0

Save enhanced file : Enh_Copper_4.tif

Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Copper_4.tif

Red background for image: Enh_Copper_4.tif

Save masked image with red background: Mask_Enh_Copper_4.tif

Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_Copper_4.tif

Main color from image: Mask_Enh_Copper_4.tif

... List without excluded colors

Count occurrences for color

4 Most common colors: [((255, 255, 255), 1), ((254, 229, 223), 1), ((248, 229, 223), 1), ((244, 229, 223), 1)]

Read color name: (255, 255, 255)

Main Color file: Mask_Enh_Copper_4.tif RGB: [((255, 255, 255), 1)]

(255, 255, 255) Color name: white Hex: #ffffff

Copper Size: (2048, 1536) Format: TIFF Mode: RGB

Sum array: 588.109624 Sum Ch 0: 197.6352 Sum Ch 1: 197.6352 Sum Ch 2: 192.839224

Histogram : 94.37184 N.List elem: 768 Max: 179730 Idx Max: 253

Min: 552 Idx Min: 0

Color : white RGB : (255, 255, 255) Hex color: #ffffff

f Dec Color: 16777215

Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333

3333333333

Percentage R: 33.60516338022042 Percentage G: 32.7896732395591

6 Percentage B: 32.78967323955916

Iron_1.tif

Inf.File: Iron_1.tif

Get Channel n: 0

Get Channel n: 1

Get Channel n: 2

Histogram analysis: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Iron_1.tif

RGB percent from image: Iron_1.tif

Percent Red 33.60090837851171
Percent Green 33.60090837851171
Percent Blue 32.79818324297658

```
Enhancement color: Iron_1.tif  Value: 2.0
  Enhance image: Iron_1.tif  Value: 2.0
  Save enhanced file : Enh_Iron_1.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Iron_1.tif
  Red background for image: Enh_Iron_1.tif
  Save masked image with red background: Mask_Enh_Iron_1.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_Iron_1.tif
  Main color from image: Mask_Enh_Iron_1.tif
... List without excluded colors
Count occurrences for color
  4 Most common colors: [((255, 255, 255), 1), ((252, 229, 223), 1),
((240, 229, 223), 1), ((234, 229, 223), 1)]
  Read color name: (255, 255, 255)
  Main Color file: Mask_Enh_Iron_1.tif  RGB: [((255, 255, 255), 1)] (2
55, 255, 255)  Color name: white  Hex: #ffffff
Iron Size: (2048, 1536) Format: TIFF Mode: RGB
  Sum array: 641.517597  Sum Ch 0: 215.55574  Sum Ch 1: 215.55574
Sum Ch 2: 210.406117
  Histog : 94.37184  N.List elem: 768  Max: 295179  Idx Max: 252
Min: 407  Idx Min: 0
  Color : white  RGB : (255, 255, 255)  Hex color: #fffff
f  Dec Color: 16777215
  Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
  Percentage R: 33.60090837851171  Percentage G: 32.7981832429765
8  Percentage B: 32.79818324297658
Iron_2.tif
-----
Inf.File: Iron_2.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysis: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Iron_2.tif
  RGB percent from image: Iron_2.tif
-----
  Percent Red 33.60090837851171
  Percent Green 33.60090837851171
  Percent Blue 32.79818324297658
-----
Enhancement color: Iron_2.tif  Value: 2.0
  Enhance image: Iron_2.tif  Value: 2.0
  Save enhanced file : Enh_Iron_2.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Iron_2.tif
  Red background for image: Enh_Iron_2.tif
  Save masked image with red background: Mask_Enh_Iron_2.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_Iron_2.tif
  Main color from image: Mask_Enh_Iron_2.tif
... List without excluded colors
Count occurrences for color
  4 Most common colors: [((255, 255, 255), 1), ((252, 229, 223), 1),
((240, 229, 223), 1), ((234, 229, 223), 1)]
```

```
    Read color name: (255, 255, 255)
    Main Color file: Mask_Enh_Iron_2.tif  RGB: [((255, 255, 255), 1)] (2
55, 255, 255)  Color name: white  Hex: #ffffff
Iron  Size: (2048, 1536)  Format: TIFF  Mode: RGB
        Sum array: 641.517597  Sum Ch 0: 215.55574  Sum Ch 1: 215.55574
Sum Ch 2: 210.406117
        Histog : 94.37184  N.List elem: 768  Max: 295179  Idx Max: 252
Min: 407  Idx Min: 0
        Color : white  RGB : (255, 255, 255)  Hex color: #fffff
f  Dec Color: 16777215
        Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
        Percentage R: 33.60090837851171  Percentage G: 32.7981832429765
8  Percentage B: 32.79818324297658
Iron_3.tif
-----
Inf.File: Iron_3.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalens
e\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Iron_3.
tif
    RGB percent from image: Iron_3.tif
-----
    Percent Red 33.629611471923226
    Percent Green 33.629611471923226
    Percent Blue 32.74077705615355
-----
Enhancement color: Iron_3.tif  Value: 2.0
    Enhance image: Iron_3.tif  Value: 2.0
    Save enhanced file : Enh_Iron_3.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Tr
abalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Iron_
3.tif
    Red background for image: Enh_Iron_3.tif
    Save masked image with red background: Mask_Enh_Iron_3.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\
\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_En
h_Iron_3.tif
    Main color from image: Mask_Enh_Iron_3.tif
...  List without excluded colors
Count occurrences for color
    4 Most common colors: [((255, 255, 255), 1), ((254, 229, 223), 1),
((242, 229, 223), 1), ((238, 229, 223), 1)]
    Read color name: (255, 255, 255)
    Main Color file: Mask_Enh_Iron_3.tif  RGB: [((255, 255, 255), 1)] (2
55, 255, 255)  Color name: white  Hex: #ffffff
Iron  Size: (2048, 1536)  Format: TIFF  Mode: RGB
        Sum array: 601.674947  Sum Ch 0: 202.340947  Sum Ch 1: 202.34094
7  Sum Ch 2: 196.993053
        Histog : 94.37184  N.List elem: 768  Max: 326204  Idx Max: 252
Min: 303  Idx Min: 255
        Color : white  RGB : (255, 255, 255)  Hex color: #fffff
f  Dec Color: 16777215
        Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
        Percentage R: 33.629611471923226  Percentage G: 32.740777056153
55  Percentage B: 32.74077705615355
Iron_4.tif
-----
```

```
Inf.File: Iron_4.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysis: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalens
e\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Iron_4.
tif
RGB percent from image: Iron_4.tif
-----
Percent Red 33.62871679731947
Percent Green 33.62871679731947
Percent Blue 32.74256640536107
-----
Enhancement color: Iron_4.tif Value: 2.0
Enhance image: Iron_4.tif Value: 2.0
Save enhanced file : Enh_Iron_4.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Tr
abalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Iron_
4.tif
Red background for image: Enh_Iron_4.tif
Save masked image with red background: Mask_Enh_Iron_4.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense
\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_En
h_Iron_4.tif
Main color from image: Mask_Enh_Iron_4.tif
... List without excluded colors
Count occurrences for color
4 Most common colors: [((255, 255, 255), 1), ((253, 229, 223), 1),
((249, 229, 223), 1), ((247, 229, 223), 1)]
Read color name: (255, 255, 255)
Main Color file: Mask_Enh_Iron_4.tif RGB: [((255, 255, 255), 1)] (2
55, 255, 255) Color name: white Hex: #ffffff
Iron Size: (2048, 1536) Format: TIFF Mode: RGB
Sum array: 575.482113 Sum Ch 0: 193.52725 Sum Ch 1: 193.52725
Sum Ch 2: 188.427613
Histog : 94.37184 N.List elem: 768 Max: 297351 Idx Max: 252
Min: 413 Idx Min: 255
Color : white RGB : (255, 255, 255) Hex color: #fffff
f Dec Color: 16777215
Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
Percentage R: 33.62871679731947 Percentage G: 32.7425664053610
7 Percentage B: 32.74256640536107
PaintedIron_1.tif
-----
Inf.File: PaintedIron_1.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysis: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalens
e\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Painted
Iron_1.tif
RGB percent from image: PaintedIron_1.tif
-----
Percent Red 33.66666144410743
Percent Green 33.66666144410743
Percent Blue 32.666677111785134
-----
Enhancement color: PaintedIron_1.tif Value: 2.0
Enhance image: PaintedIron_1.tif Value: 2.0
Save enhanced file : Enh_PaintedIron_1.tif
```

```
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_PaintedIron_1.tif
    Red background for image: Enh_PaintedIron_1.tif
    Save masked image with red background: Mask_Enh_PaintedIron_1.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_PaintedIron_1.tif
    Main color from image: Mask_Enh_PaintedIron_1.tif
... List without excluded colors
Count occurrences for color
    4 Most common colors: [((255, 255, 255), 1), ((226, 225, 223), 1),
((255, 223, 223), 1), ((250, 223, 223), 1)]
    Read color name: (255, 255, 255)
    Main Color file: Mask_Enh_PaintedIron_1.tif  RGB: [((255, 255, 255),
1)] (255, 255, 255)  Color name: white  Hex: #ffffff
PaintedIron Size: (2048, 1536) Format: TIFF Mode: RGB
    Sum array: 495.478663  Sum Ch 0: 166.811124  Sum Ch 1: 166.81112
4 Sum Ch 2: 161.856415
    Histog : 94.37184  N.List elem: 768  Max: 221927  Idx Max: 253
Min: 65 Idx Min: 176
    Color : white  RGB : (255, 255, 255)  Hex color: #fffff
f Dec Color: 16777215
    Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
    Percentage R: 33.66666144410743  Percentage G: 32.6666771117851
34 Percentage B: 32.666677111785134
PaintedIron_2.tif
-----
Inf.File: PaintedIron_2.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/PaintedIron_2.tif
    RGB percent from image: PaintedIron_2.tif
-----
    Percent Red 33.60762875637241
    Percent Green 33.60762875637241
    Percent Blue 32.78474248725517
-----
Enhancement color: PaintedIron_2.tif  Value: 2.0
    Enhance image: PaintedIron_2.tif  Value: 2.0
    Save enhanced file : Enh_PaintedIron_2.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_PaintedIron_2.tif
    Red background for image: Enh_PaintedIron_2.tif
    Save masked image with red background: Mask_Enh_PaintedIron_2.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_PaintedIron_2.tif
    Main color from image: Mask_Enh_PaintedIron_2.tif
... List without excluded colors
Count occurrences for color
    4 Most common colors: [((255, 255, 255), 1), ((242, 229, 223), 1),
((234, 229, 223), 1), ((230, 229, 223), 1)]
    Read color name: (255, 255, 255)
    Main Color file: Mask_Enh_PaintedIron_2.tif  RGB: [((255, 255, 255),
1)] (255, 255, 255)  Color name: white  Hex: #ffffff
```

```
PaintedIron Size: (2048, 1536) Format: TIFF Mode: RGB
    Sum array: 606.481866 Sum Ch 0: 203.824174 Sum Ch 1: 203.82417
4 Sum Ch 2: 198.833518
    Histog : 94.37184 N.List elem: 768 Max: 438426 Idx Max: 253
Min: 132 Idx Min: 120
    Color : white RGB : (255, 255, 255) Hex color: #fffff
f Dec Color: 16777215
    Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
    Percentage R: 33.60762875637241 Percentage G: 32.7847424872551
7 Percentage B: 32.78474248725517
PaintedIron_3.tif
-----
Inf.File: PaintedIron_3.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysis: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalens
e\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Painted
Iron_3.tif
    RGB percent from image: PaintedIron_3.tif
-----
    Percent Red 33.62127297548277
    Percent Green 33.62127297548277
    Percent Blue 32.757454049034465
-----
Enhancement color: PaintedIron_3.tif Value: 2.0
    Enhance image: PaintedIron_3.tif Value: 2.0
    Save enhanced file : Enh_PaintedIron_3.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Tr
abalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Painte
dIron_3.tif
    Red background for image: Enh_PaintedIron_3.tif
    Save masked image with red background: Mask_Enh_PaintedIron_3.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense
\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_En
h_PaintedIron_3.tif
    Main color from image: Mask_Enh_PaintedIron_3.tif
... List without excluded colors
Count occurrences for color
    4 Most common colors: [((255, 255, 255), 1), ((233, 229, 223), 1),
((231, 229, 223), 1), ((229, 229, 223), 1)]
    Read color name: (255, 255, 255)
    Main Color file: Mask_Enh_PaintedIron_3.tif RGB: [((255, 255, 255),
1)] (255, 255, 255) Color name: white Hex: #fffff
PaintedIron Size: (2048, 1536) Format: TIFF Mode: RGB
    Sum array: 573.56847 Sum Ch 0: 192.841021 Sum Ch 1: 192.841021
Sum Ch 2: 187.886428
    Histog : 94.37184 N.List elem: 768 Max: 374673 Idx Max: 253
Min: 183 Idx Min: 117
    Color : white RGB : (255, 255, 255) Hex color: #fffff
f Dec Color: 16777215
    Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
    Percentage R: 33.62127297548277 Percentage G: 32.7574540490344
65 Percentage B: 32.757454049034465
PaintedIron_4.tif
-----
Inf.File: PaintedIron_4.tif
Get Channel n: 0
Get Channel n: 1
```

```
Get Channel n: 2
Histogram analisys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalens
e\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Painted
Iron_4.tif
    RGB percent from image: PaintedIron_4.tif
    -----
    Percent Red 33.66666144410743
    Percent Green 33.66666144410743
    Percent Blue 32.666677111785134
    -----
Enhancement color: PaintedIron_4.tif  Value: 2.0
    Enhance image: PaintedIron_4.tif  Value: 2.0
    Save enhanced file : Enh_PaintedIron_4.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Tr
abalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Painte
dIron_4.tif
    Red background for image: Enh_PaintedIron_4.tif
    Save masked image with red background: Mask_Enh_PaintedIron_4.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense
\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_En
h_PaintedIron_4.tif
    Main color from image: Mask_Enh_PaintedIron_4.tif
... List without excluded colors
Count occurrences for color
    4 Most common colors: [((255, 255, 255), 1), ((226, 225, 223), 1),
((255, 223, 223), 1), ((250, 223, 223), 1)]
    Read color name: (255, 255, 255)
    Main Color file: Mask_Enh_PaintedIron_4.tif  RGB: [((255, 255, 255),
1)] (255, 255, 255)  Color name: white  Hex: #ffffff
PaintedIron  Size: (2048, 1536)  Format: TIFF  Mode: RGB
    Sum array: 495.478663  Sum Ch 0: 166.811124  Sum Ch 1: 166.81112
4  Sum Ch 2: 161.856415
    Histog : 94.37184  N.List elem: 768  Max: 221927  Idx Max: 253
Min: 65  Idx Min: 176
    Color : white  RGB : (255, 255, 255)  Hex color: #fffff
f  Dec Color: 16777215
    Extremes : ((1, 255), (1, 255), (0, 255))  Med Extremes: 127.8333
3333333333
    Percentage R: 33.66666144410743  Percentage G: 32.6666771117851
34  Percentage B: 32.666677111785134
PaintedIron_5.tif
    -----
Inf.File: PaintedIron_5.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analisys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalens
e\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Painted
Iron_5.tif
    RGB percent from image: PaintedIron_5.tif
    -----
    Percent Red 33.60762875637241
    Percent Green 33.60762875637241
    Percent Blue 32.78474248725517
    -----
Enhancement color: PaintedIron_5.tif  Value: 2.0
    Enhance image: PaintedIron_5.tif  Value: 2.0
    Save enhanced file : Enh_PaintedIron_5.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Tr
abalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Painte
dIron_5.tif
```

```
Red background for image: Enh_PaintedIron_5.tif
Save masked image with red background: Mask_Enh_PaintedIron_5.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense
\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_En
h_PaintedIron_5.tif
    Main color from image: Mask_Enh_PaintedIron_5.tif
... List without excluded colors
Count occurrences for color
    4 Most common colors: [((255, 255, 255), 1), ((242, 229, 223), 1),
((234, 229, 223), 1), ((230, 229, 223), 1)]
    Read color name: (255, 255, 255)
    Main Color file: Mask_Enh_PaintedIron_5.tif  RGB: [((255, 255, 255),
1)] (255, 255, 255) Color name: white Hex: #ffffff
PaintedIron Size: (2048, 1536) Format: TIFF Mode: RGB
    Sum array: 606.481866 Sum Ch 0: 203.824174 Sum Ch 1: 203.82417
4 Sum Ch 2: 198.833518
    Histog : 94.37184 N.List elem: 768 Max: 438426 Idx Max: 253
Min: 132 Idx Min: 120
    Color : white RGB : (255, 255, 255) Hex color: #fffff
f Dec Color: 16777215
    Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
    Percentage R: 33.60762875637241 Percentage G: 32.7847424872551
7 Percentage B: 32.78474248725517
PaintedIron_6.tif
-----
Inf.File: PaintedIron_6.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysis: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalens
e\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Painted
Iron_6.tif
    RGB percent from image: PaintedIron_6.tif
-----
Percent Red 33.62127297548277
Percent Green 33.62127297548277
Percent Blue 32.757454049034465
-----
Enhancement color: PaintedIron_6.tif Value: 2.0
    Enhance image: PaintedIron_6.tif Value: 2.0
    Save enhanced file : Enh_PaintedIron_6.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Tr
abalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Painte
dIron_6.tif
    Red background for image: Enh_PaintedIron_6.tif
    Save masked image with red background: Mask_Enh_PaintedIron_6.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense
\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_En
h_PaintedIron_6.tif
    Main color from image: Mask_Enh_PaintedIron_6.tif
... List without excluded colors
Count occurrences for color
    4 Most common colors: [((255, 255, 255), 1), ((233, 229, 223), 1),
((231, 229, 223), 1), ((229, 229, 223), 1)]
    Read color name: (255, 255, 255)
    Main Color file: Mask_Enh_PaintedIron_6.tif  RGB: [((255, 255, 255),
1)] (255, 255, 255) Color name: white Hex: #ffffff
PaintedIron Size: (2048, 1536) Format: TIFF Mode: RGB
    Sum array: 573.56847 Sum Ch 0: 192.841021 Sum Ch 1: 192.841021
Sum Ch 2: 187.886428
```

```

        Histog   : 94.37184  N.List elem: 768  Max: 374673  Idx Max: 253
Min: 183 Idx Min: 117
        Color   : white    RGB   : (255, 255, 255)    Hex color: #fffff
f  Dec Color: 16777215
        Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
        Percentage R: 33.62127297548277  Percentage G: 32.7574540490344
65  Percentage B: 32.757454049034465
PaintedIron_7.tif
-----
Inf.File: PaintedIron_7.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/PaintedIron_7.tif
RGB percent from image: PaintedIron_7.tif
-----
Percent Red 33.60762875637241
Percent Green 33.60762875637241
Percent Blue 32.78474248725517
-----
Enhancement color: PaintedIron_7.tif  Value: 2.0
Enhance image: PaintedIron_7.tif  Value: 2.0
Save enhanced file : Enh_PaintedIron_7.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_PaintedIron_7.tif
Red background for image: Enh_PaintedIron_7.tif
Save masked image with red background: Mask_Enh_PaintedIron_7.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_PaintedIron_7.tif
Main color from image: Mask_Enh_PaintedIron_7.tif
... List without excluded colors
Count occurrences for color
4 Most common colors: [((255, 255, 255), 1), ((242, 229, 223), 1),
((234, 229, 223), 1), ((230, 229, 223), 1)]
Read color name: (255, 255, 255)
Main Color file: Mask_Enh_PaintedIron_7.tif  RGB: [((255, 255, 255),
1)] (255, 255, 255) Color name: white Hex: #fffff
PaintedIron Size: (2048, 1536) Format: TIFF Mode: RGB
Sum array: 606.481866 Sum Ch 0: 203.824174 Sum Ch 1: 203.82417
4 Sum Ch 2: 198.833518
        Histog   : 94.37184  N.List elem: 768  Max: 438426  Idx Max: 253
Min: 132 Idx Min: 120
        Color   : white    RGB   : (255, 255, 255)    Hex color: #fffff
f  Dec Color: 16777215
        Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
        Percentage R: 33.60762875637241  Percentage G: 32.7847424872551
7  Percentage B: 32.78474248725517
StainlessSteel_1.tif
-----
Inf.File: StainlessSteel_1.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Stainle

```

```
ssSteel_1.tif
RGB percent from image: StainlessSteel_1.tif
-----
Percent Red 33.58207473185194
Percent Green 33.58207473185194
Percent Blue 32.835850536296114
-----
Enhancement color: StainlessSteel_1.tif  Value: 2.0
  Enhance image: StainlessSteel_1.tif  Value: 2.0
  Save enhanced file : Enh_StainlessSteel_1.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_StainlessSteel_1.tif
  Red background for image: Enh_StainlessSteel_1.tif
  Save masked image with red background: Mask_Enh_StainlessSteel_1.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_StainlessSteel_1.tif
  Main color from image: Mask_Enh_StainlessSteel_1.tif
... List without excluded colors
Count occurrences for color
  4 Most common colors: [((255, 255, 255), 1), ((255, 229, 223), 1),
((251, 229, 223), 1), ((249, 229, 223), 1)]
  Read color name: (255, 255, 255)
  Main Color file: Mask_Enh_StainlessSteel_1.tif  RGB: [((255, 255, 255), 1) (255, 255, 255) Color name: white Hex: #ffffff
StainlessSteel Size: (2048, 1536) Format: TIFF Mode: RGB
  Sum array: 654.906666  Sum Ch 0: 219.931246  Sum Ch 1: 219.93124
6  Sum Ch 2: 215.044174
  Histog : 94.37184  N.List elem: 768  Max: 366933  Idx Max: 253
Min: 386  Idx Min: 255
  Color : white  RGB : (255, 255, 255)  Hex color: #fffff
f  Dec Color: 16777215
  Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
  Percentage R: 33.58207473185194  Percentage G: 32.8358505362961
14  Percentage B: 32.835850536296114
StainlessSteel_2.tif
-----
Inf.File: StainlessSteel_2.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/StainlessSteel_2.tif
  RGB percent from image: StainlessSteel_2.tif
-----
Percent Red 33.61617790672816
Percent Green 33.61617790672816
Percent Blue 32.76764418654368
-----
Enhancement color: StainlessSteel_2.tif  Value: 2.0
  Enhance image: StainlessSteel_2.tif  Value: 2.0
  Save enhanced file : Enh_StainlessSteel_2.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_StainlessSteel_2.tif
  Red background for image: Enh_StainlessSteel_2.tif
  Save masked image with red background: Mask_Enh_StainlessSteel_2.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense
```

```
\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_StainlessSteel_2.tif
    Main color from image: Mask_Enh_StainlessSteel_2.tif
... List without excluded colors
Count occurrences for color
    4 Most common colors: [((255, 255, 255), 1), ((251, 229, 223), 1),
((245, 229, 223), 1), ((243, 229, 223), 1)]
    Read color name: (255, 255, 255)
    Main Color file: Mask_Enh_StainlessSteel_2.tif  RGB: [((255, 255, 255), 1) (255, 255, 255) Color name: white Hex: #ffffff
StainlessSteel Size: (2048, 1536) Format: TIFF Mode: RGB
    Sum array: 573.675257  Sum Ch 0: 192.847695  Sum Ch 1: 192.84769
5  Sum Ch 2: 187.979867
    Histog : 94.37184  N.List elem: 768  Max: 356158 Idx Max: 253
Min: 460 Idx Min: 237
    Color : white  RGB : (255, 255, 255)  Hex color: #fffff
f  Dec Color: 16777215
    Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
    Percentage R: 33.61617790672816  Percentage G: 32.7676441865436
8  Percentage B: 32.76764418654368
StainlessSteel_3.tif
-----
Inf.File: StainlessSteel_3.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysis: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/StainlessSteel_3.tif
RGB percent from image: StainlessSteel_3.tif
-----
Percent Red 33.58207473185194
Percent Green 33.58207473185194
Percent Blue 32.835850536296114
-----
Enhancement color: StainlessSteel_3.tif  Value: 2.0
Enhance image: StainlessSteel_3.tif  Value: 2.0
Save enhanced file : Enh_StainlessSteel_3.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_StainlessSteel_3.tif
    Red background for image: Enh_StainlessSteel_3.tif
    Save masked image with red background: Mask_Enh_StainlessSteel_3.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_StainlessSteel_3.tif
    Main color from image: Mask_Enh_StainlessSteel_3.tif
... List without excluded colors
Count occurrences for color
    4 Most common colors: [((255, 255, 255), 1), ((255, 229, 223), 1),
((251, 229, 223), 1), ((249, 229, 223), 1)]
    Read color name: (255, 255, 255)
    Main Color file: Mask_Enh_StainlessSteel_3.tif  RGB: [((255, 255, 255), 1) (255, 255, 255) Color name: white Hex: #ffffff
StainlessSteel Size: (2048, 1536) Format: TIFF Mode: RGB
    Sum array: 654.906666  Sum Ch 0: 219.931246  Sum Ch 1: 219.93124
6  Sum Ch 2: 215.044174
    Histog : 94.37184  N.List elem: 768  Max: 366933 Idx Max: 253
Min: 386 Idx Min: 255
    Color : white  RGB : (255, 255, 255)  Hex color: #fffff
```

```
f Dec Color: 16777215
    Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
    Percentage R: 33.58207473185194    Percentage G: 32.8358505362961
14 Percentage B: 32.835850536296114
StainlessSteel_4.tif
-----
Inf.File: StainlessSteel_4.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/StainlessSteel_4.tif
    RGB percent from image: StainlessSteel_4.tif
-----
Percent Red 33.61617790672816
Percent Green 33.61617790672816
Percent Blue 32.76764418654368
-----
Enhancement color: StainlessSteel_4.tif    Value: 2.0
    Enhance image: StainlessSteel_4.tif    Value: 2.0
    Save enhanced file : Enh_StainlessSteel_4.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_StainlessSteel_4.tif
    Red background for image: Enh_StainlessSteel_4.tif
    Save masked image with red background: Mask_Enh_StainlessSteel_4.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_StainlessSteel_4.tif
    Main color from image: Mask_Enh_StainlessSteel_4.tif
... List without excluded colors
Count occurrences for color
    4 Most common colors: [((255, 255, 255), 1), ((251, 229, 223), 1),
((245, 229, 223), 1), ((243, 229, 223), 1)]
    Read color name: (255, 255, 255)
    Main Color file: Mask_Enh_StainlessSteel_4.tif    RGB: [((255, 255, 255), 1) (255, 255, 255)] Color name: white Hex: #ffffff
StainlessSteel Size: (2048, 1536) Format: TIFF Mode: RGB
    Sum array: 573.675257    Sum Ch 0: 192.847695    Sum Ch 1: 192.84769
5 Sum Ch 2: 187.979867
    Histog : 94.37184    N.List elem: 768    Max: 356158    Idx Max: 253
Min: 460 Idx Min: 237
    Color : white    RGB : (255, 255, 255)    Hex color: #fffff
f Dec Color: 16777215
    Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
    Percentage R: 33.61617790672816    Percentage G: 32.76764418654368
8 Percentage B: 32.76764418654368
StainlessSteel_5.tif
-----
Inf.File: StainlessSteel_5.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/StainlessSteel_5.tif
    RGB percent from image: StainlessSteel_5.tif
-----
```

```
Percent Red 33.60690411510592
Percent Green 33.60690411510592
Percent Blue 32.78619176978816
-----
Enhancement color: StainlessSteel_5.tif  Value: 2.0
  Enhance image: StainlessSteel_5.tif  Value: 2.0
  Save enhanced file : Enh_StainlessSteel_5.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_StainlessSteel_5.tif
  Red background for image: Enh_StainlessSteel_5.tif
  Save masked image with red background: Mask_Enh_StainlessSteel_5.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_StainlessSteel_5.tif
  Main color from image: Mask_Enh_StainlessSteel_5.tif
... List without excluded colors
Count occurrences for color
  4 Most common colors: [((255, 255, 255), 1), ((243, 229, 223), 1),
((235, 229, 223), 1), ((233, 229, 223), 1)]
  Read color name: (255, 255, 255)
  Main Color file: Mask_Enh_StainlessSteel_5.tif  RGB: [((255, 255, 255), 1) (255, 255, 255) Color name: white Hex: #ffffff
StainlessSteel  Size: (2048, 1536) Format: TIFF Mode: RGB
  Sum array: 638.936045  Sum Ch 0: 214.726624  Sum Ch 1: 214.72662
4  Sum Ch 2: 209.482797
  Histog : 94.37184  N.List elem: 768  Max: 370886  Idx Max: 252
Min: 461 Idx Min: 255
  Color : white  RGB : (255, 255, 255)  Hex color: #fffff
f  Dec Color: 16777215
  Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
  Percentage R: 33.60690411510592  Percentage G: 32.7861917697881
6  Percentage B: 32.78619176978816
StainlessSteel_6.tif
-----
Inf.File: StainlessSteel_6.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysis: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/StainlessSteel_6.tif
  RGB percent from image: StainlessSteel_6.tif
-----
  Percent Red 33.58479745441777
  Percent Green 33.58479745441777
  Percent Blue 32.83040509116447
-----
Enhancement color: StainlessSteel_6.tif  Value: 2.0
  Enhance image: StainlessSteel_6.tif  Value: 2.0
  Save enhanced file : Enh_StainlessSteel_6.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_StainlessSteel_6.tif
  Red background for image: Enh_StainlessSteel_6.tif
  Save masked image with red background: Mask_Enh_StainlessSteel_6.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_StainlessSteel_6.tif
  Main color from image: Mask_Enh_StainlessSteel_6.tif
```

```

... List without excluded colors
Count occurrences for color
    4 Most common colors: [((255, 255, 255), 1), ((249, 229, 223), 1),
    ((245, 229, 223), 1), ((241, 229, 223), 1)]
    Read color name: (255, 255, 255)
    Main Color file: Mask_Enh_StainlessSteel_6.tif  RGB: [((255, 255, 255), 1)] (255, 255, 255)  Color name: white  Hex: #ffffff
StainlessSteel  Size: (2048, 1536)  Format: TIFF  Mode: RGB
                Sum array: 731.365569  Sum Ch 0: 245.627645  Sum Ch 1: 245.62764
5  Sum Ch 2: 240.110279
                Histog : 94.37184  N.List elem: 768  Max: 497534  Idx Max: 252
Min: 236 Idx Min: 255
                Color : white  RGB : (255, 255, 255)  Hex color: #ffffff
f  Dec Color: 16777215
                Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
                Percentage R: 33.58479745441777  Percentage G: 32.8304050911644
7  Percentage B: 32.83040509116447
StainlessSteel_7.tif
-----
Inf.File: StainlessSteel_7.tif
Get Channel n: 0
Get Channel n: 1
Get Channel n: 2
Histogram analysis: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/StainlessSteel_7.tif
RGB percent from image: StainlessSteel_7.tif
-----
Percent Red 33.60334018475968
Percent Green 33.60334018475968
Percent Blue 32.793319630480624
-----
Enhancement color: StainlessSteel_7.tif  Value: 2.0
Enhance image: StainlessSteel_7.tif  Value: 2.0
Save enhanced file : Enh_StainlessSteel_7.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_StainlessSteel_7.tif
Red background for image: Enh_StainlessSteel_7.tif
Save masked image with red background: Mask_Enh_StainlessSteel_7.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_StainlessSteel_7.tif
Main color from image: Mask_Enh_StainlessSteel_7.tif
... List without excluded colors
Count occurrences for color
    4 Most common colors: [((255, 255, 255), 1), ((249, 229, 223), 1),
    ((245, 229, 223), 1), ((239, 229, 223), 1)]
    Read color name: (255, 255, 255)
    Main Color file: Mask_Enh_StainlessSteel_7.tif  RGB: [((255, 255, 255), 1)] (255, 255, 255)  Color name: white  Hex: #ffffff
StainlessSteel  Size: (2048, 1536)  Format: TIFF  Mode: RGB
                Sum array: 595.649206  Sum Ch 0: 200.158029  Sum Ch 1: 200.15802
9  Sum Ch 2: 195.333148
                Histog : 94.37184  N.List elem: 768  Max: 326367  Idx Max: 253
Min: 673 Idx Min: 139
                Color : white  RGB : (255, 255, 255)  Hex color: #ffffff
f  Dec Color: 16777215
                Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333

```

Percentage R: 33.60334018475968 Percentage G: 32.7933196304806

24 Percentage B: 32.793319630480624

StainlessSteel_8.tif

Inf.File: StainlessSteel_8.tif

Get Channel n: 0

Get Channel n: 1

Get Channel n: 2

Histogram analisys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalens e\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Stainle ssSteel_8.tif

RGB percent from image: StainlessSteel_8.tif

Percent Red 33.59733292716074

Percent Green 33.59733292716074

Percent Blue 32.80533414567851

Enhancement color: StainlessSteel_8.tif Value: 2.0

Enhance image: StainlessSteel_8.tif Value: 2.0

Save enhanced file : Enh_StainlessSteel_8.tif

Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Tr abalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_Stainl essSteel_8.tif

Red background for image: Enh_StainlessSteel_8.tif

Save masked image with red background: Mask_Enh_StainlessSteel_8.tif

Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense \Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_En h_StainlessSteel_8.tif

Main color from image: Mask_Enh_StainlessSteel_8.tif

... List without excluded colors

Count occurrences for color

4 Most common colors: [((255, 255, 255), 1), ((245, 229, 223), 1), ((243, 229, 223), 1), ((241, 229, 223), 1)]

Read color name: (255, 255, 255)

Main Color file: Mask_Enh_StainlessSteel_8.tif RGB: [((255, 255, 25

5, 1)] (255, 255, 255) Color name: white Hex: #ffffff

StainlessSteel Size: (2048, 1536) Format: TIFF Mode: RGB

Sum array: 611.667734 Sum Ch 0: 205.504045 Sum Ch 1: 205.50404

5 Sum Ch 2: 200.659644

Histogram : 94.37184 N.List elem: 768 Max: 357902 Idx Max: 253

Min: 581 Idx Min: 255

Color : white RGB : (255, 255, 255) Hex color: #fffff

f Dec Color: 16777215

Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333

3333333333

Percentage R: 33.59733292716074 Percentage G: 32.8053341456785

1 Percentage B: 32.80533414567851

StainlessSteel_9.tif

Inf.File: StainlessSteel_9.tif

Get Channel n: 0

Get Channel n: 1

Get Channel n: 2

Histogram analisys: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalens e\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Stainle ssSteel_9.tif

RGB percent from image: StainlessSteel_9.tif

Percent Red 33.528715186138044

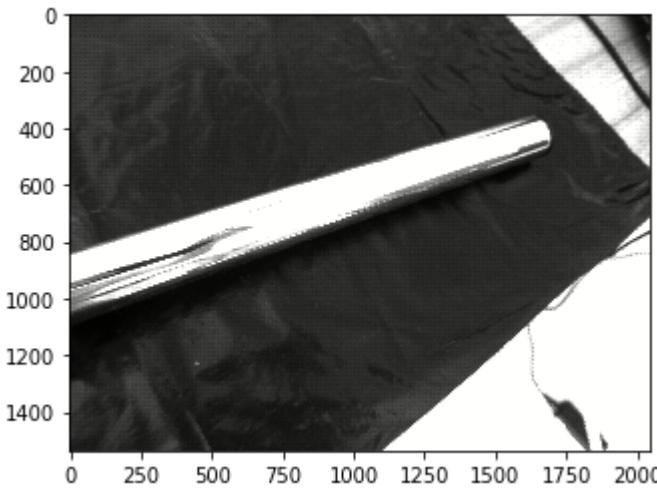
Percent Green 33.528715186138044

Percent Blue 32.94256962772391

```

-----
Enhancement color: StainlessSteel_9.tif  Value: 2.0
  Enhance image: StainlessSteel_9.tif  Value: 2.0
  Save enhanced file : Enh_StainlessSteel_9.tif
Red background: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Enh_StainlessSteel_9.tif
  Red background for image: Enh_StainlessSteel_9.tif
  Save masked image with red background: Mask_Enh_StainlessSteel_9.tif
Most common color: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/ Mask_Enh_StainlessSteel_9.tif
  Main color from image: Mask_Enh_StainlessSteel_9.tif
... List without excluded colors
Count occurrences for color
  4 Most common colors: [((255, 255, 255), 1), ((249, 229, 223), 1),
((243, 229, 223), 1), ((239, 229, 223), 1)]
  Read color name: (255, 255, 255)
  Main Color file: Mask_Enh_StainlessSteel_9.tif  RGB: [((255, 255, 255), 1) (255, 255, 255) Color name: white Hex: #ffffff
StainlessSteel Size: (2048, 1536) Format: TIFF Mode: RGB
  Sum array: 860.058381  Sum Ch 0: 288.366525  Sum Ch 1: 288.36652
5  Sum Ch 2: 283.325331
  Histog : 94.37184  N.List elem: 768  Max: 601745  Idx Max: 253
Min: 458  Idx Min: 108
  Color : white  RGB : (255, 255, 255)  Hex color: #fffff
f  Dec Color: 16777215
  Extremes : ((1, 255), (1, 255), (0, 255)) Med Extremes: 127.8333
3333333333
  Percentage R: 33.528715186138044  Percentage G: 32.942569627723
91  Percentage B: 32.94256962772391

```



In [26]:

```
#List_dec_back ordered
order_list_dec = sorted(list_dec_back, key=int)
#order_list_dec
#list_non_back
```

In [27]:

```
...
TESTS
# Read all List to see the color - obtain RGB from int
for x in order_list_dec:
    #print(x)
    # Get RGB from INT
    xrgb = getRGBfromI(x)
    #print('Int:, x, ' RGB: ',xrgb)
    xt_color_name , hexdc = get_rgb_color_name(xrgb)
    print('Int:', x, ' RGB: ', xrgb, xt_color_name)
...
...
```

Out[27]:

```
"\nTESTS\n# Read all list to see the color - obtain RGB from int\nfor x in\norder_list_dec:\n    #print(x)\n    # Get RGB from INT\n    xrgb = getRGBf\nromI(x)\n    #print('Int:, x, ' RGB: ',xrgb)\n    xt_color_name , hexdc =\nget_rgb_color_name(xrgb)\n    print('Int:', x, ' RGB: ', xrgb, xt_color_na\nme)\n"
```

In [28]:

```
df = pd.DataFrame(df_image,columns=['Folder','File','Material','Size','Format','Mode',
                                     'All_Bands', 'Sum_Ch0','Sum_Ch1','Sum_Ch2',
                                     'Histogram','Number_elements',
                                     'Color','Color_RGB', 'Color_hex','Color_dec','Med_E
xtrems',
                                     'Max_Histog', 'Idx_Max_Histog','Min_Histog', 'Idx_M
in_Histog',
                                     'perc_R', 'perc_G', 'perc_B'])

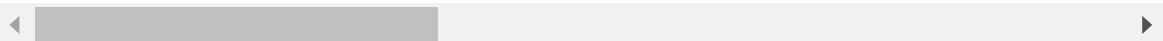
df.head(50)
```

Out[28]:

	Folder	File	Material	Size	Format	Mode	All_Bands	Sum_1
0	imagedata06	Aluminum_1.tif	Aluminum	(2048, 1536)	TIFF	RGB	658.137536	220.999
1	imagedata06	Aluminum_2.tif	Aluminum	(2048, 1536)	TIFF	RGB	693.024169	232.705
2	imagedata06	Aluminum_3.tif	Aluminum	(2048, 1536)	TIFF	RGB	696.532319	233.779
3	imagedata06	Aluminum_4.tif	Aluminum	(2048, 1536)	TIFF	RGB	658.137536	220.999
4	imagedata06	Aluminum_5.tif	Aluminum	(2048, 1536)	TIFF	RGB	693.024169	232.705
5	imagedata06	Aluminum_6.tif	Aluminum	(2048, 1536)	TIFF	RGB	696.532319	233.779
6	imagedata06	Brass_1.tif	Brass	(2048, 1536)	TIFF	RGB	562.098115	189.033
7	imagedata06	Brass_2.tif	Brass	(2048, 1536)	TIFF	RGB	449.396523	151.345
8	imagedata06	Brass_3.tif	Brass	(2048, 1536)	TIFF	RGB	469.763357	158.316
9	imagedata06	Brass_4.tif	Brass	(2048, 1536)	TIFF	RGB	562.098115	189.033
10	imagedata06	Brass_5.tif	Brass	(2048, 1536)	TIFF	RGB	449.396523	151.345
11	imagedata06	Brass_6.tif	Brass	(2048, 1536)	TIFF	RGB	469.763357	158.316
12	imagedata06	CopperWire_1.tif	CopperWire	(2048, 1536)	TIFF	RGB	521.051218	175.360
13	imagedata06	CopperWire_2.tif	CopperWire	(2048, 1536)	TIFF	RGB	634.394685	213.195
14	imagedata06	CopperWire_3.tif	CopperWire	(2048, 1536)	TIFF	RGB	481.236521	162.041
15	imagedata06	CopperWire_4.tif	CopperWire	(2048, 1536)	TIFF	RGB	564.848218	189.837
16	imagedata06	CopperWire_5.tif	CopperWire	(2048, 1536)	TIFF	RGB	521.051218	175.360
17	imagedata06	CopperWire_6.tif	CopperWire	(2048, 1536)	TIFF	RGB	634.394685	213.195
18	imagedata06	CopperWire_7.tif	CopperWire	(2048, 1536)	TIFF	RGB	481.236521	162.041
19	imagedata06	CopperWire_8.tif	CopperWire	(2048, 1536)	TIFF	RGB	564.848218	189.837
20	imagedata06	Copper_1.tif	Copper	(2048, 1536)	TIFF	RGB	447.139193	150.632
21	imagedata06	Copper_2.tif	Copper	(2048, 1536)	TIFF	RGB	588.109624	197.635
22	imagedata06	Copper_3.tif	Copper	(2048, 1536)	TIFF	RGB	447.139193	150.632
23	imagedata06	Copper_4.tif	Copper	(2048, 1536)	TIFF	RGB	588.109624	197.635

	Folder	File	Material	Size	Format	Mode	All_Bands	Sum_(%)
24	imagedata06	Iron_1.tif	Iron	(2048, 1536)	TIFF	RGB	641.517597	215.555
25	imagedata06	Iron_2.tif	Iron	(2048, 1536)	TIFF	RGB	641.517597	215.555
26	imagedata06	Iron_3.tif	Iron	(2048, 1536)	TIFF	RGB	601.674947	202.340
27	imagedata06	Iron_4.tif	Iron	(2048, 1536)	TIFF	RGB	575.482113	193.527
28	imagedata06	PaintedIron_1.tif	PaintedIron	(2048, 1536)	TIFF	RGB	495.478663	166.811
29	imagedata06	PaintedIron_2.tif	PaintedIron	(2048, 1536)	TIFF	RGB	606.481866	203.824
30	imagedata06	PaintedIron_3.tif	PaintedIron	(2048, 1536)	TIFF	RGB	573.568470	192.841
31	imagedata06	PaintedIron_4.tif	PaintedIron	(2048, 1536)	TIFF	RGB	495.478663	166.811
32	imagedata06	PaintedIron_5.tif	PaintedIron	(2048, 1536)	TIFF	RGB	606.481866	203.824
33	imagedata06	PaintedIron_6.tif	PaintedIron	(2048, 1536)	TIFF	RGB	573.568470	192.841
34	imagedata06	PaintedIron_7.tif	PaintedIron	(2048, 1536)	TIFF	RGB	606.481866	203.824
35	imagedata06	StainlessSteel_1.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	654.906666	219.931
36	imagedata06	StainlessSteel_2.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	573.675257	192.847
37	imagedata06	StainlessSteel_3.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	654.906666	219.931
38	imagedata06	StainlessSteel_4.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	573.675257	192.847
39	imagedata06	StainlessSteel_5.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	638.936045	214.726
40	imagedata06	StainlessSteel_6.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	731.365569	245.627
41	imagedata06	StainlessSteel_7.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	595.649206	200.158
42	imagedata06	StainlessSteel_8.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	611.667734	205.504
43	imagedata06	StainlessSteel_9.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	860.058381	288.366

44 rows × 24 columns



In [29]:

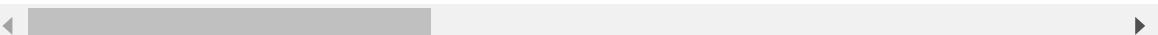
```
# Delete junk records
df = df[df.Material != 'MASK']
df = df[df.Material != 'Enh']
df
```

Out[29]:

	Folder	File	Material	Size	Format	Mode	All_Bands	Sum_1
0	imagedata06	Aluminum_1.tif	Aluminum	(2048, 1536)	TIFF	RGB	658.137536	220.999
1	imagedata06	Aluminum_2.tif	Aluminum	(2048, 1536)	TIFF	RGB	693.024169	232.705
2	imagedata06	Aluminum_3.tif	Aluminum	(2048, 1536)	TIFF	RGB	696.532319	233.779
3	imagedata06	Aluminum_4.tif	Aluminum	(2048, 1536)	TIFF	RGB	658.137536	220.999
4	imagedata06	Aluminum_5.tif	Aluminum	(2048, 1536)	TIFF	RGB	693.024169	232.705
5	imagedata06	Aluminum_6.tif	Aluminum	(2048, 1536)	TIFF	RGB	696.532319	233.779
6	imagedata06	Brass_1.tif	Brass	(2048, 1536)	TIFF	RGB	562.098115	189.033
7	imagedata06	Brass_2.tif	Brass	(2048, 1536)	TIFF	RGB	449.396523	151.345
8	imagedata06	Brass_3.tif	Brass	(2048, 1536)	TIFF	RGB	469.763357	158.316
9	imagedata06	Brass_4.tif	Brass	(2048, 1536)	TIFF	RGB	562.098115	189.033
10	imagedata06	Brass_5.tif	Brass	(2048, 1536)	TIFF	RGB	449.396523	151.345
11	imagedata06	Brass_6.tif	Brass	(2048, 1536)	TIFF	RGB	469.763357	158.316
12	imagedata06	CopperWire_1.tif	CopperWire	(2048, 1536)	TIFF	RGB	521.051218	175.360
13	imagedata06	CopperWire_2.tif	CopperWire	(2048, 1536)	TIFF	RGB	634.394685	213.195
14	imagedata06	CopperWire_3.tif	CopperWire	(2048, 1536)	TIFF	RGB	481.236521	162.041
15	imagedata06	CopperWire_4.tif	CopperWire	(2048, 1536)	TIFF	RGB	564.848218	189.837
16	imagedata06	CopperWire_5.tif	CopperWire	(2048, 1536)	TIFF	RGB	521.051218	175.360
17	imagedata06	CopperWire_6.tif	CopperWire	(2048, 1536)	TIFF	RGB	634.394685	213.195
18	imagedata06	CopperWire_7.tif	CopperWire	(2048, 1536)	TIFF	RGB	481.236521	162.041
19	imagedata06	CopperWire_8.tif	CopperWire	(2048, 1536)	TIFF	RGB	564.848218	189.837
20	imagedata06	Copper_1.tif	Copper	(2048, 1536)	TIFF	RGB	447.139193	150.632
21	imagedata06	Copper_2.tif	Copper	(2048, 1536)	TIFF	RGB	588.109624	197.635
22	imagedata06	Copper_3.tif	Copper	(2048, 1536)	TIFF	RGB	447.139193	150.632
23	imagedata06	Copper_4.tif	Copper	(2048, 1536)	TIFF	RGB	588.109624	197.635

	Folder	File	Material	Size	Format	Mode	All_Bands	Sum_(%)
24	imagedata06	Iron_1.tif	Iron	(2048, 1536)	TIFF	RGB	641.517597	215.555
25	imagedata06	Iron_2.tif	Iron	(2048, 1536)	TIFF	RGB	641.517597	215.555
26	imagedata06	Iron_3.tif	Iron	(2048, 1536)	TIFF	RGB	601.674947	202.340
27	imagedata06	Iron_4.tif	Iron	(2048, 1536)	TIFF	RGB	575.482113	193.527
28	imagedata06	PaintedIron_1.tif	PaintedIron	(2048, 1536)	TIFF	RGB	495.478663	166.811
29	imagedata06	PaintedIron_2.tif	PaintedIron	(2048, 1536)	TIFF	RGB	606.481866	203.824
30	imagedata06	PaintedIron_3.tif	PaintedIron	(2048, 1536)	TIFF	RGB	573.568470	192.841
31	imagedata06	PaintedIron_4.tif	PaintedIron	(2048, 1536)	TIFF	RGB	495.478663	166.811
32	imagedata06	PaintedIron_5.tif	PaintedIron	(2048, 1536)	TIFF	RGB	606.481866	203.824
33	imagedata06	PaintedIron_6.tif	PaintedIron	(2048, 1536)	TIFF	RGB	573.568470	192.841
34	imagedata06	PaintedIron_7.tif	PaintedIron	(2048, 1536)	TIFF	RGB	606.481866	203.824
35	imagedata06	StainlessSteel_1.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	654.906666	219.931
36	imagedata06	StainlessSteel_2.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	573.675257	192.847
37	imagedata06	StainlessSteel_3.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	654.906666	219.931
38	imagedata06	StainlessSteel_4.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	573.675257	192.847
39	imagedata06	StainlessSteel_5.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	638.936045	214.726
40	imagedata06	StainlessSteel_6.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	731.365569	245.627
41	imagedata06	StainlessSteel_7.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	595.649206	200.158
42	imagedata06	StainlessSteel_8.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	611.667734	205.504
43	imagedata06	StainlessSteel_9.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	860.058381	288.366

44 rows × 24 columns



Write statistics in excel book

In [30]:

```
# Verify my current folder
path = mypath + r"/upt_data.xlsx"
print('Write statistics into file :', path)

# Block to Read excel old excel file
book = load_workbook(path)
writer = pd.ExcelWriter(path, engine = 'openpyxl')
writer.book = book
# -------

# Write statistics into excel file
#writer = pd.ExcelWriter(path, engine = 'xlsxwriter') # only for new excelfile
df.to_excel(writer, sheet_name = folder)
writer.save()
writer.close()
```

```
Write statistics into file : C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/upt_data.xlsx
```

Plot

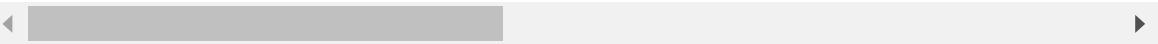
In [31]:

```
df_plot = pd.DataFrame(df, columns=["Material", "All_Bands", "Sum_Ch0", "Sum_Ch1", "Sum_Ch2",
                                     "Color", "Color_RGB", "Color_hex", "Color_dec",
                                     "Med_Extrems", "Max_Histog", "Idx_Max_Histog", "Min_Histog",
                                     "Idx_Min_Histog", "perc_R", "perc_G", "perc_B"])
df_plot
```

Out[31]:

	Material	All_Bands	Sum_Ch0	Sum_Ch1	Sum_Ch2	Color	Color_RGB	Color_
0	Aluminum	658.137536	220.999978	220.999978	216.137580	white	(255, 255, 255)	#
1	Aluminum	693.024169	232.705276	232.705276	227.613617	white	(255, 255, 255)	#
2	Aluminum	696.532319	233.779842	233.779842	228.972635	white	(255, 255, 255)	#
3	Aluminum	658.137536	220.999978	220.999978	216.137580	white	(255, 255, 255)	#
4	Aluminum	693.024169	232.705276	232.705276	227.613617	white	(255, 255, 255)	#
5	Aluminum	696.532319	233.779842	233.779842	228.972635	white	(255, 255, 255)	#
6	Brass	562.098115	189.033946	189.033946	184.030223	white	(255, 255, 255)	#
7	Brass	449.396523	151.345791	151.345791	146.704941	white	(255, 255, 255)	#
8	Brass	469.763357	158.316124	158.316124	153.131109	white	(255, 255, 255)	#
9	Brass	562.098115	189.033946	189.033946	184.030223	white	(255, 255, 255)	#
10	Brass	449.396523	151.345791	151.345791	146.704941	white	(255, 255, 255)	#
11	Brass	469.763357	158.316124	158.316124	153.131109	white	(255, 255, 255)	#
12	CopperWire	521.051218	175.360057	175.360057	170.331104	white	(255, 255, 255)	#
13	CopperWire	634.394685	213.195874	213.195874	208.002937	white	(255, 255, 255)	#
14	CopperWire	481.236521	162.041057	162.041057	157.154407	white	(255, 255, 255)	#
15	CopperWire	564.848218	189.837464	189.837464	185.173290	white	(255, 255, 255)	#
16	CopperWire	521.051218	175.360057	175.360057	170.331104	white	(255, 255, 255)	#
17	CopperWire	634.394685	213.195874	213.195874	208.002937	white	(255, 255, 255)	#
18	CopperWire	481.236521	162.041057	162.041057	157.154407	white	(255, 255, 255)	#
19	CopperWire	564.848218	189.837464	189.837464	185.173290	white	(255, 255, 255)	#
20	Copper	447.139193	150.632053	150.632053	145.875087	white	(255, 255, 255)	#
21	Copper	588.109624	197.635200	197.635200	192.839224	white	(255, 255, 255)	#
22	Copper	447.139193	150.632053	150.632053	145.875087	white	(255, 255, 255)	#
23	Copper	588.109624	197.635200	197.635200	192.839224	white	(255, 255, 255)	#

	Material	All_Bands	Sum_Ch0	Sum_Ch1	Sum_Ch2	Color	Color_RGB	Color_
24	Iron	641.517597	215.555740	215.555740	210.406117	white	(255, 255, 255)	#
25	Iron	641.517597	215.555740	215.555740	210.406117	white	(255, 255, 255)	#
26	Iron	601.674947	202.340947	202.340947	196.993053	white	(255, 255, 255)	#
27	Iron	575.482113	193.527250	193.527250	188.427613	white	(255, 255, 255)	#
28	PaintedIron	495.478663	166.811124	166.811124	161.856415	white	(255, 255, 255)	#
29	PaintedIron	606.481866	203.824174	203.824174	198.833518	white	(255, 255, 255)	#
30	PaintedIron	573.568470	192.841021	192.841021	187.886428	white	(255, 255, 255)	#
31	PaintedIron	495.478663	166.811124	166.811124	161.856415	white	(255, 255, 255)	#
32	PaintedIron	606.481866	203.824174	203.824174	198.833518	white	(255, 255, 255)	#
33	PaintedIron	573.568470	192.841021	192.841021	187.886428	white	(255, 255, 255)	#
34	PaintedIron	606.481866	203.824174	203.824174	198.833518	white	(255, 255, 255)	#
35	StainlessSteel	654.906666	219.931246	219.931246	215.044174	white	(255, 255, 255)	#
36	StainlessSteel	573.675257	192.847695	192.847695	187.979867	white	(255, 255, 255)	#
37	StainlessSteel	654.906666	219.931246	219.931246	215.044174	white	(255, 255, 255)	#
38	StainlessSteel	573.675257	192.847695	192.847695	187.979867	white	(255, 255, 255)	#
39	StainlessSteel	638.936045	214.726624	214.726624	209.482797	white	(255, 255, 255)	#
40	StainlessSteel	731.365569	245.627645	245.627645	240.110279	white	(255, 255, 255)	#
41	StainlessSteel	595.649206	200.158029	200.158029	195.333148	white	(255, 255, 255)	#
42	StainlessSteel	611.667734	205.504045	205.504045	200.659644	white	(255, 255, 255)	#
43	StainlessSteel	860.058381	288.366525	288.366525	283.325331	white	(255, 255, 255)	#



In [32]:

```
# Adjust values to plot
df_plot.Sum_Ch0      = df_plot.Sum_Ch0 + 500 # to have difference lines during plot
df_plot.Sum_Ch1      = df_plot.Sum_Ch1 + 1000
df_plot.Sum_Ch2      = df_plot.Sum_Ch2 + 1500
df_plot.All_Bands    = df_plot.All_Bands + 2000

df_plot.Color_dec    = df_plot.Color_dec / 1000
df_plot.Color_dec    = df_plot.Color_dec - 10000
df_plot.Med_Extrems  = df_plot.Med_Extrems + 500
df_plot.Max_Histog   = df_plot.Max_Histog / 1000
df_plot.Idx_Max_Histog = df_plot.Idx_Max_Histog + 1000
df_plot.Min_Histog   = df_plot.Min_Histog * 100
df_plot.Idx_Min_Histog = df_plot.Idx_Min_Histog * 10

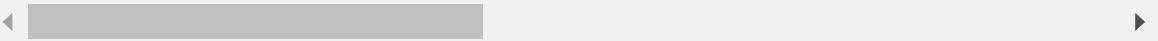
df_plot.perc_R = df_plot.perc_R + 1000
df_plot.perc_G = df_plot.perc_G + 1100
df_plot.perc_B = df_plot.perc_B + 1200

df_plot
```

Out[32]:

	Material	All_Bands	Sum_Ch0	Sum_Ch1	Sum_Ch2	Color	Color_RGB	Co
0	Aluminum	2658.137536	720.999978	1220.999978	1716.137580	white	(255, 255, 255)	
1	Aluminum	2693.024169	732.705276	1232.705276	1727.613617	white	(255, 255, 255)	
2	Aluminum	2696.532319	733.779842	1233.779842	1728.972635	white	(255, 255, 255)	
3	Aluminum	2658.137536	720.999978	1220.999978	1716.137580	white	(255, 255, 255)	
4	Aluminum	2693.024169	732.705276	1232.705276	1727.613617	white	(255, 255, 255)	
5	Aluminum	2696.532319	733.779842	1233.779842	1728.972635	white	(255, 255, 255)	
6	Brass	2562.098115	689.033946	1189.033946	1684.030223	white	(255, 255, 255)	
7	Brass	2449.396523	651.345791	1151.345791	1646.704941	white	(255, 255, 255)	
8	Brass	2469.763357	658.316124	1158.316124	1653.131109	white	(255, 255, 255)	
9	Brass	2562.098115	689.033946	1189.033946	1684.030223	white	(255, 255, 255)	
10	Brass	2449.396523	651.345791	1151.345791	1646.704941	white	(255, 255, 255)	
11	Brass	2469.763357	658.316124	1158.316124	1653.131109	white	(255, 255, 255)	
12	CopperWire	2521.051218	675.360057	1175.360057	1670.331104	white	(255, 255, 255)	
13	CopperWire	2634.394685	713.195874	1213.195874	1708.002937	white	(255, 255, 255)	
14	CopperWire	2481.236521	662.041057	1162.041057	1657.154407	white	(255, 255, 255)	
15	CopperWire	2564.848218	689.837464	1189.837464	1685.173290	white	(255, 255, 255)	
16	CopperWire	2521.051218	675.360057	1175.360057	1670.331104	white	(255, 255, 255)	
17	CopperWire	2634.394685	713.195874	1213.195874	1708.002937	white	(255, 255, 255)	
18	CopperWire	2481.236521	662.041057	1162.041057	1657.154407	white	(255, 255, 255)	
19	CopperWire	2564.848218	689.837464	1189.837464	1685.173290	white	(255, 255, 255)	
20	Copper	2447.139193	650.632053	1150.632053	1645.875087	white	(255, 255, 255)	
21	Copper	2588.109624	697.635200	1197.635200	1692.839224	white	(255, 255, 255)	
22	Copper	2447.139193	650.632053	1150.632053	1645.875087	white	(255, 255, 255)	
23	Copper	2588.109624	697.635200	1197.635200	1692.839224	white	(255, 255, 255)	

	Material	All_Bands	Sum_Ch0	Sum_Ch1	Sum_Ch2	Color	Color_RGB	Co
24	Iron	2641.517597	715.555740	1215.555740	1710.406117	white	(255, 255, 255)	
25	Iron	2641.517597	715.555740	1215.555740	1710.406117	white	(255, 255, 255)	
26	Iron	2601.674947	702.340947	1202.340947	1696.993053	white	(255, 255, 255)	
27	Iron	2575.482113	693.527250	1193.527250	1688.427613	white	(255, 255, 255)	
28	PaintedIron	2495.478663	666.811124	1166.811124	1661.856415	white	(255, 255, 255)	
29	PaintedIron	2606.481866	703.824174	1203.824174	1698.833518	white	(255, 255, 255)	
30	PaintedIron	2573.568470	692.841021	1192.841021	1687.886428	white	(255, 255, 255)	
31	PaintedIron	2495.478663	666.811124	1166.811124	1661.856415	white	(255, 255, 255)	
32	PaintedIron	2606.481866	703.824174	1203.824174	1698.833518	white	(255, 255, 255)	
33	PaintedIron	2573.568470	692.841021	1192.841021	1687.886428	white	(255, 255, 255)	
34	PaintedIron	2606.481866	703.824174	1203.824174	1698.833518	white	(255, 255, 255)	
35	StainlessSteel	2654.906666	719.931246	1219.931246	1715.044174	white	(255, 255, 255)	
36	StainlessSteel	2573.675257	692.847695	1192.847695	1687.979867	white	(255, 255, 255)	
37	StainlessSteel	2654.906666	719.931246	1219.931246	1715.044174	white	(255, 255, 255)	
38	StainlessSteel	2573.675257	692.847695	1192.847695	1687.979867	white	(255, 255, 255)	
39	StainlessSteel	2638.936045	714.726624	1214.726624	1709.482797	white	(255, 255, 255)	
40	StainlessSteel	2731.365569	745.627645	1245.627645	1740.110279	white	(255, 255, 255)	
41	StainlessSteel	2595.649206	700.158029	1200.158029	1695.333148	white	(255, 255, 255)	
42	StainlessSteel	2611.667734	705.504045	1205.504045	1700.659644	white	(255, 255, 255)	
43	StainlessSteel	2860.058381	788.366525	1288.366525	1783.325331	white	(255, 255, 255)	

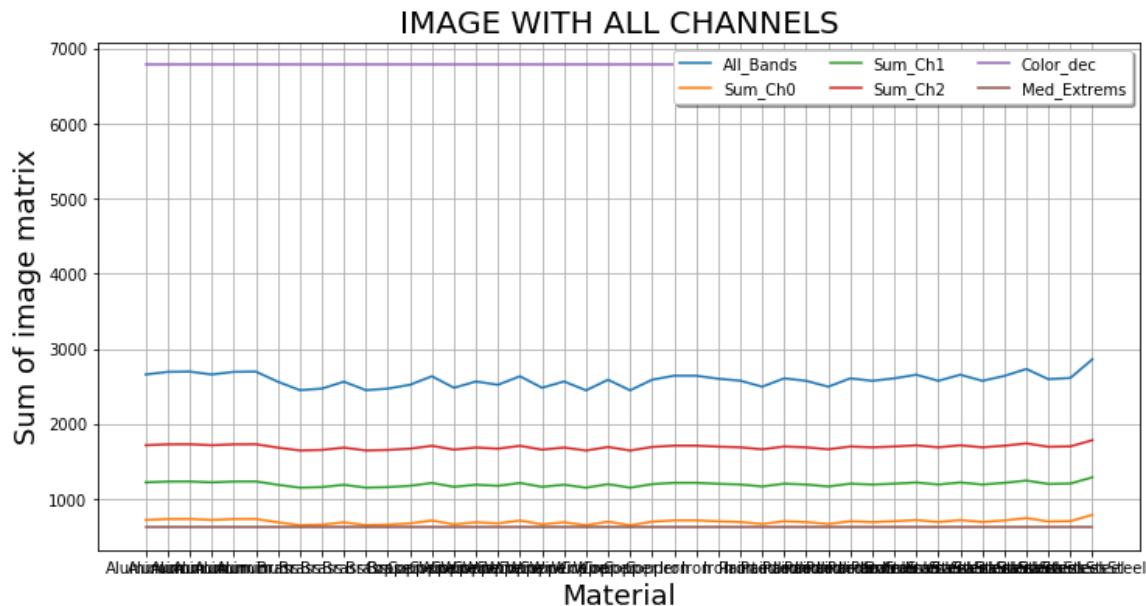


In [33]:

```
df_plot.plot(y=["All_Bands", "Sum_Ch0", "Sum_Ch1", "Sum_Ch2", "Color_dec", "Med_Extrems"], figsize=(12,6), grid=True)

# Obtain Legend (xticks) for X axis
loc_Array_sum = np.arange(len(df_plot.index))
# Position of X labels
xtick_loc = list(loc_Array_sum)
# Name of x Labels
xticks = list(df_plot.Material)
#-----

# plt.plot(df_plot.Array_sum)
plt.title('IMAGE WITH ALL CHANNELS', fontsize=20)
plt.ylabel('Sum of image matrix', fontsize=18)
plt.xticks(xtick_loc, df_plot.Material, rotation=0)
plt.xlabel('Material', fontsize=18)
plt.legend(loc='upper right', ncol=3, fancybox=True, shadow=True)
plt.savefig(folder+"_Line Graph all channels information.png")
plt.show()
```



In [34]:

```
df_plot.perc_R = df_plot.perc_R - 1000
df_plot.perc_G = df_plot.perc_G - 1100
df_plot.perc_B = df_plot.perc_B - 1200
```

In [35]:

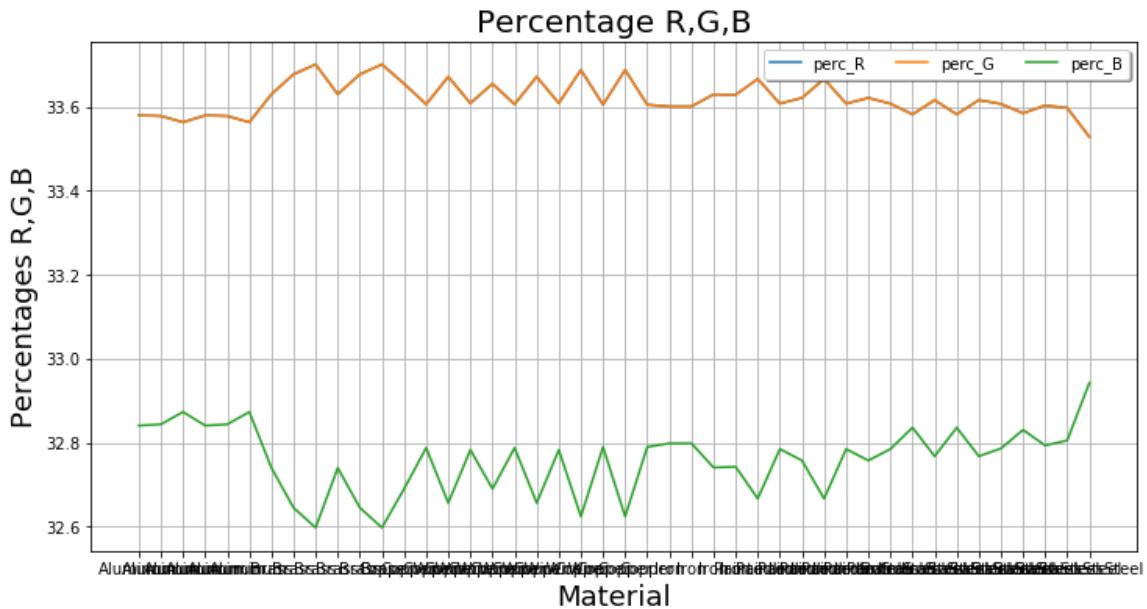
```

df_plot.plot(y=["perc_R", "perc_G", "perc_B"],
             figsize=(12,6), grid=True )

# Obtain legend (xticks) for X axis
loc_Array_sum = np.arange(len(df_plot.index))
# Position of X Labels
xtick_loc = list(loc_Array_sum)
# Name of x Labels
xticks = list(df_plot.Material)
#-----

# plt.plot(df_plot.Array_sum)
plt.title('Percentage R,G,B', fontsize=20)
plt.ylabel('Percentages R,G,B', fontsize=18)
plt.xticks(xtick_loc, df_plot.Material, rotation=0)
plt.xlabel('Material', fontsize=18)
plt.legend(loc='upper right', ncol=3, fancybox=True, shadow=True)
plt.savefig(folder+"_Line Graph Percentage RGB.png")
plt.show()

```



In [36]:

```
# Create pivot table
df_plot1 = df_plot.groupby('Material')[['All_Bands', 'Sum_Ch0', 'Sum_Ch1', 'Sum_Ch2', 'Color_dec',
                                         'Med_Extrems', 'Max_Histog', 'Idx_Max_Histog', 'M
                                         in_Histog',
                                         'Idx_Min_Histog', 'perc_R', 'perc_G', 'perc_B']].mea
n()
df_plot1
```

Out[36]:

Material	All_Bands	Sum_Ch0	Sum_Ch1	Sum_Ch2	Color_dec	Med_Extrems
Aluminum	2682.564675	729.161699	1229.161699	1724.241277	6777.215	627.833333
Brass	2493.752665	666.231954	1166.231954	1661.288758	6777.215	627.833333
Copper	2517.624408	674.133626	1174.133626	1669.357156	6777.215	627.833333
CopperWire	2550.382660	685.108613	1185.108613	1680.165434	6777.215	627.833333
Iron	2615.048063	706.744919	1206.744919	1701.558225	6777.215	627.833333
PaintedIron	2565.362838	690.110973	1190.110973	1685.140891	6777.215	627.833333
StainlessSteel	2654.982309	719.993417	1219.993417	1714.995476	6777.215	627.833333

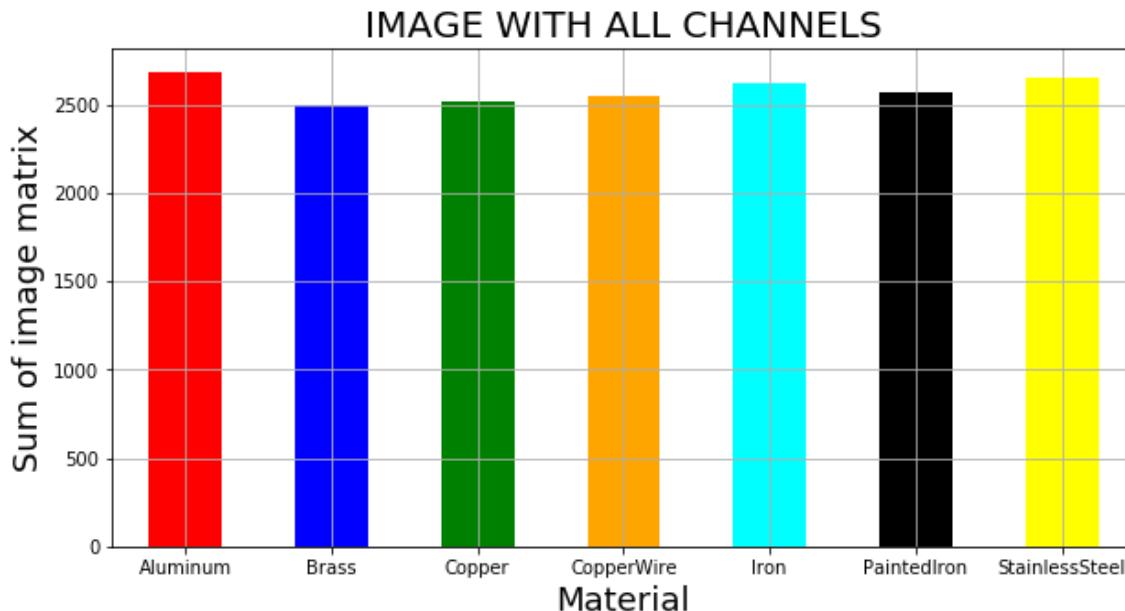
In [37]:

```
color = ['red', 'blue', 'green', 'orange', 'cyan', 'black', 'yellow']
```

In [38]:

```
df_All_Bands = pd.DataFrame(df_plot1.All_Bands)

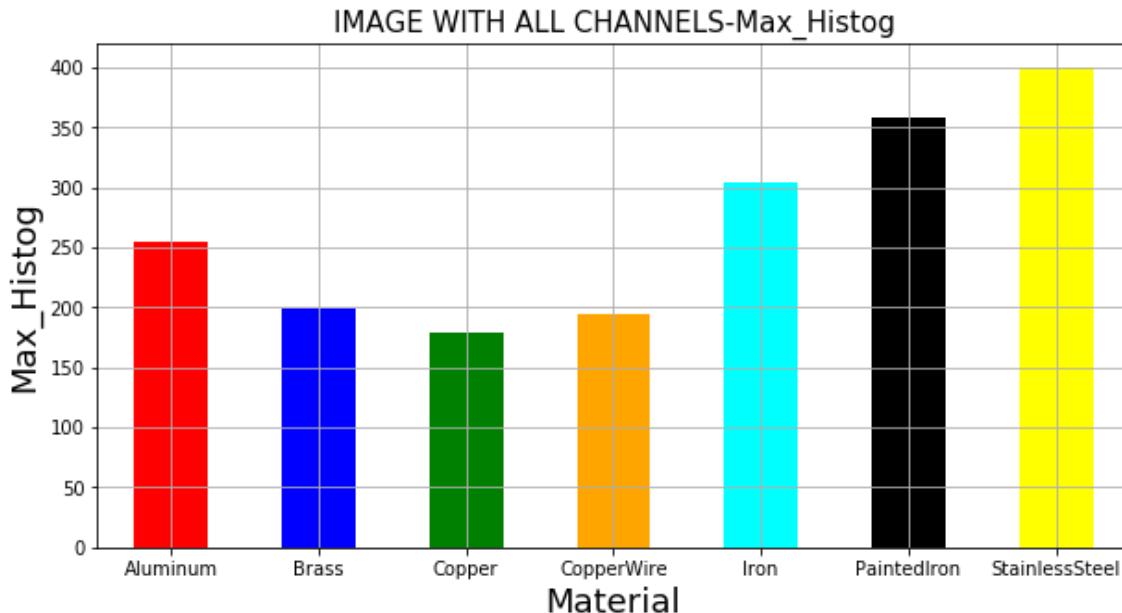
df_All_Bands.plot(kind='bar', y=0, color=color, legend=False, rot=0, figsize=(10,5))
plt.title('IMAGE WITH ALL CHANNELS', fontsize=20)
plt.grid(True)
plt.xlabel('Material', fontsize=18)
plt.ylabel('Sum of image matrix', fontsize=18)
plt.savefig(folder+"_Sum of image matrix.png")
plt.show()
```



In [39]:

```
df_Max_Histog = pd.DataFrame(df_plot1.Max_Histog)

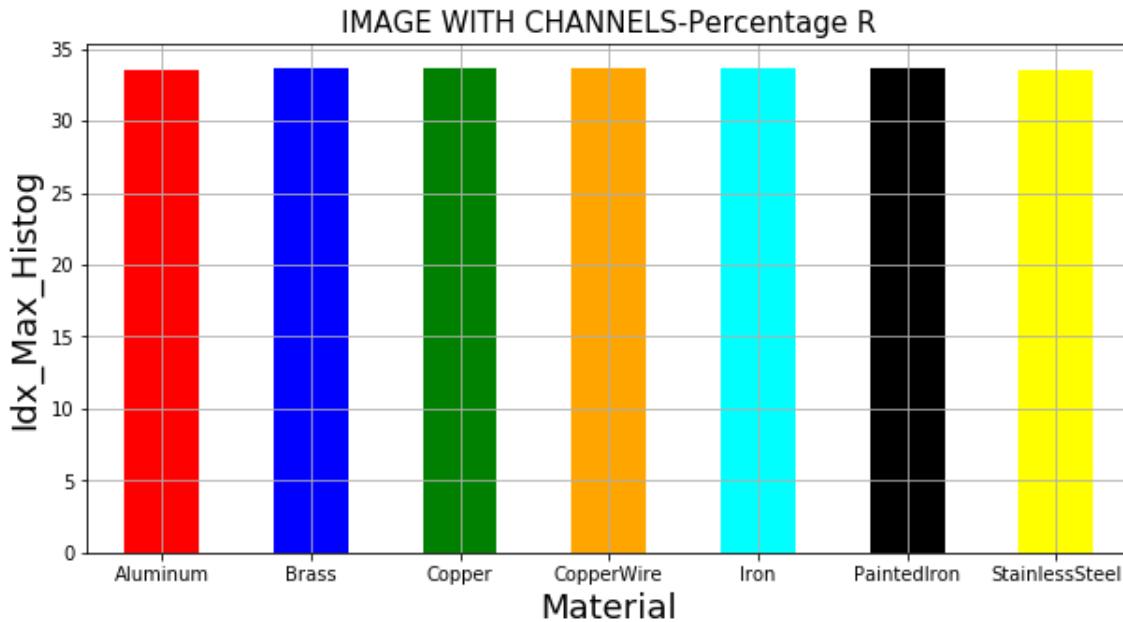
df_Max_Histog.plot(kind='bar', y=0, color=color, legend=False, rot=0, figsize=(10,5))
plt.title('IMAGE WITH ALL CHANNELS-Max_Histog', fontsize=15)
plt.grid(True)
plt.xlabel('Material', fontsize=18)
plt.ylabel('Max_Histog', fontsize=18)
plt.savefig(folder+"_Max_Histog.png")
plt.show()
```



In [40]:

```
df_perc = pd.DataFrame(df_plot1.perc_R)

df_perc.plot(kind='bar', y=0, color=color, legend=False, rot=0, figsize=(10,5))
plt.title('IMAGE WITH CHANNELS-Percentage R', fontsize=15)
plt.grid(True)
plt.xlabel('Material', fontsize=18)
plt.ylabel('Idx_Max_Histog', fontsize=18)
plt.show()
```



In [41]:

```

loc_Array_sum = np.arange(len(df_plot1.index))+0.1 # Offsetting the tick-label location

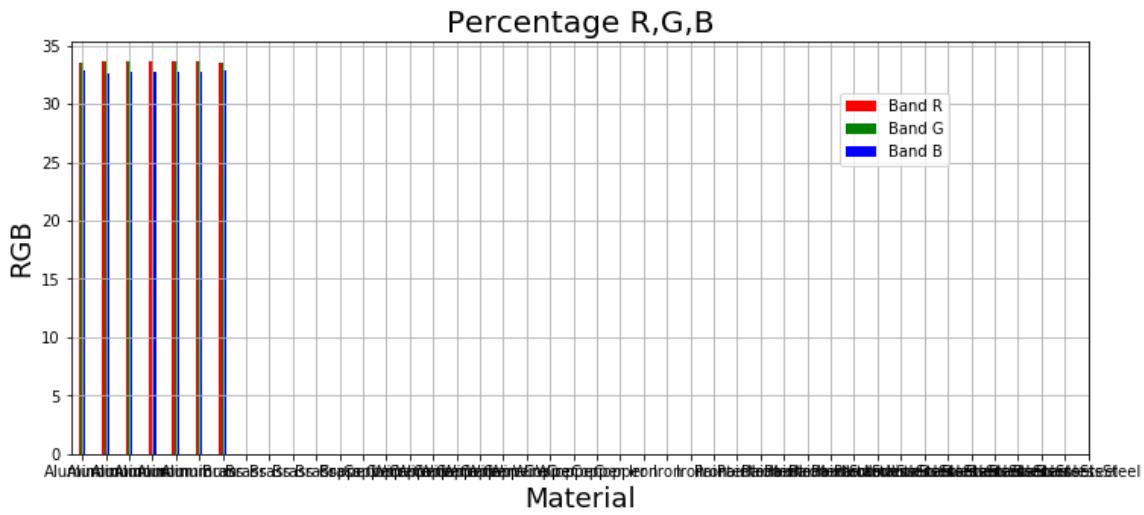
loc_r = np.arange(len(df_plot1.index))-0.1 # Offsetting the tick-label location
loc_g = np.arange(len(df_plot1.index))-0.0 # Offsetting the tick-label location
loc_b = np.arange(len(df_plot1.index))+0.1 # Offsetting the tick-label location

#xtick_loc = list(loc_Array_sum) + list(loc_r) + list(loc_g) + list(loc_b)
#xticks = list(selected.keys())+ list(rejected.keys())
colors = ['darkred','red','green','blue','orange','cyan','black','yellow']
plt.figure(figsize=(12,5))

plt.bar(loc_r, df_plot1.perc_R, color='red', width=0.1, label='Band R')
plt.bar(loc_g, df_plot1.perc_G, color='green', width=0.1, label='Band G')
plt.bar(loc_b, df_plot1.perc_B, color='blue', width=0.1, label='Band B')

plt.title('Percentage R,G,B', fontsize=20)
plt.xlabel('Material', fontsize=18)
plt.ylabel('RGB', fontsize=18)
plt.grid(True)
plt.xticks(xtick_loc, xticks, rotation=0)
plt.legend(bbox_to_anchor=(.8,.8),\n          bbox_transform=plt.gcf().transFigure)
plt.savefig(folder+"_Bar Diagram_perc_RGB.png")
plt.show()

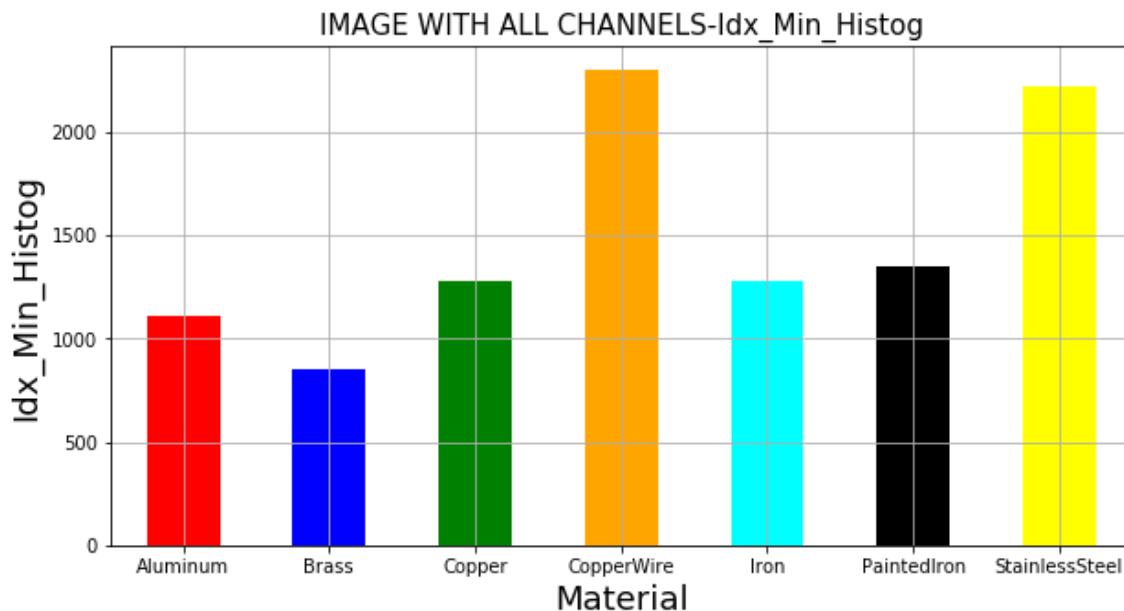
```



In [42]:

```
df_Idx_Min_Histog = pd.DataFrame(df_plot1.Idx_Min_Histog)

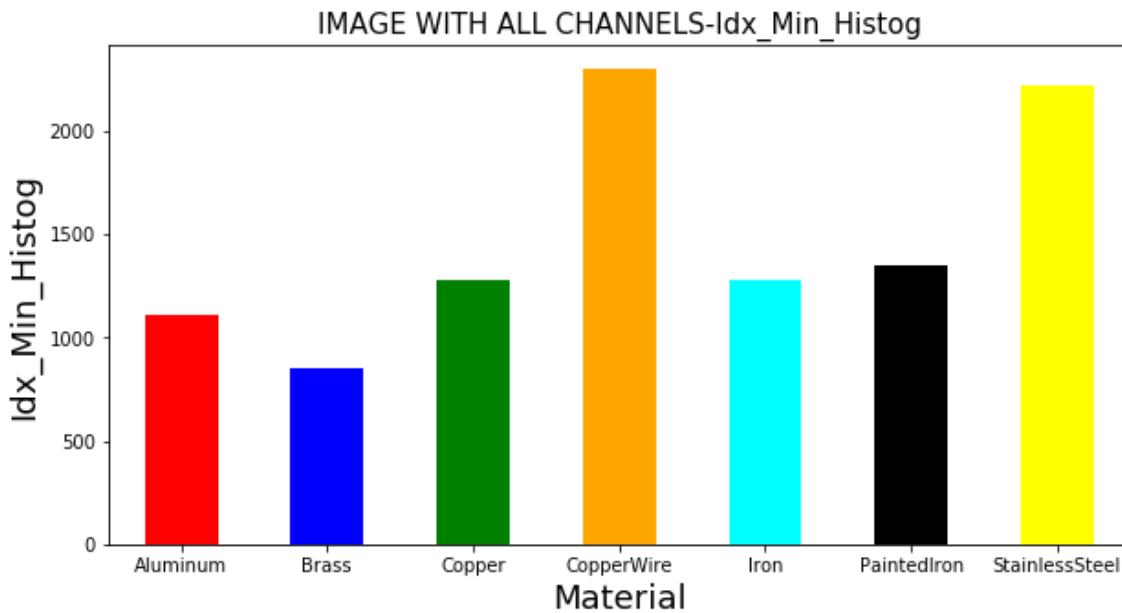
df_Idx_Min_Histog.plot(kind='bar', y=0, color=color, legend=False, rot=0, figsize=(10,5))
plt.title('IMAGE WITH ALL CHANNELS-Idx_Min_Histog', fontsize=15)
plt.grid(True)
plt.xlabel('Material', fontsize=18)
plt.ylabel('Idx_Min_Histog', fontsize=18)
plt.savefig(folder+_Idx_Min_Histogram.png")
plt.show()
```



In [43]:

```
df_Idx_Min_Histog = pd.DataFrame(df_plot1.Idx_Min_Histog)

df_Idx_Min_Histog.plot(kind='bar', y=0, color=color, legend=False, rot=0, figsize=(10,5))
plt.title('IMAGE WITH ALL CHANNELS-Idx_Min_Histog', fontsize=15)
plt.xlabel('Material', fontsize=18)
plt.ylabel('Idx_Min_Histog', fontsize=18)
plt.show()
```



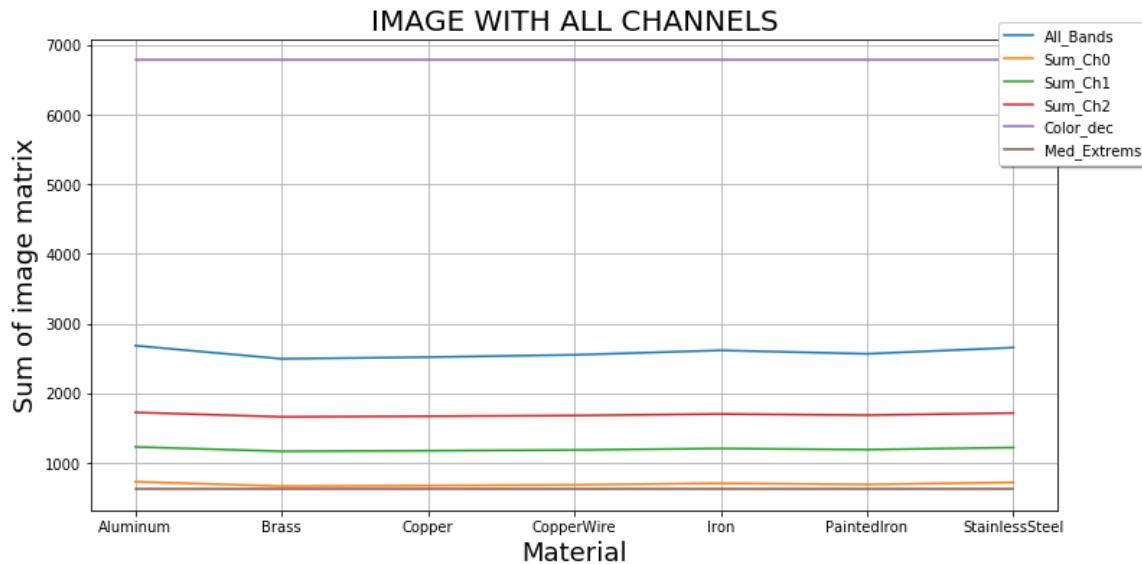
In [44]:

```

loc_Array_sum = np.arange(len(df_plot1.index))
xtick_loc = list(loc_Array_sum)
xticks = list(df_plot1.index)

df_plot1.plot( y=[ "All_Bands", "Sum_Ch0", "Sum_Ch1", "Sum_Ch2", "Color_dec", "Med_Extrems" ],
                figsize=(12,6), grid=True )
plt.xticks(xtick_loc, df_plot1.index, rotation=0)
plt.title('IMAGE WITH ALL CHANNELS', fontsize=20)
plt.xlabel('Material', fontsize=18)
plt.ylabel('Sum of image matrix', fontsize=18)
plt.legend(loc='upper right', ncol=1, fancybox=True, shadow=True, bbox_to_anchor=(1.1, 1.05))
plt.savefig(folder+"_resume all channels.png")
plt.show()

```



In [45]:

df_plot1

Out[45]:

Material	All_Bands	Sum_Ch0	Sum_Ch1	Sum_Ch2	Color_dec	Med_Extrems
Aluminum	2682.564675	729.161699	1229.161699	1724.241277	6777.215	627.833333
Brass	2493.752665	666.231954	1166.231954	1661.288758	6777.215	627.833333
Copper	2517.624408	674.133626	1174.133626	1669.357156	6777.215	627.833333
CopperWire	2550.382660	685.108613	1185.108613	1680.165434	6777.215	627.833333
Iron	2615.048063	706.744919	1206.744919	1701.558225	6777.215	627.833333
PaintedIron	2565.362838	690.110973	1190.110973	1685.140891	6777.215	627.833333
StainlessSteel	2654.982309	719.993417	1219.993417	1714.995476	6777.215	627.833333

In [46]:

```
# Copy dataframe to arrange values
df_plot2 = df_plot1.copy()
df_plot2
```

Out[46]:

Material	All_Bands	Sum_Ch0	Sum_Ch1	Sum_Ch2	Color_dec	Med_Extremes
Aluminum	2682.564675	729.161699	1229.161699	1724.241277	6777.215	627.833333
Brass	2493.752665	666.231954	1166.231954	1661.288758	6777.215	627.833333
Copper	2517.624408	674.133626	1174.133626	1669.357156	6777.215	627.833333
CopperWire	2550.382660	685.108613	1185.108613	1680.165434	6777.215	627.833333
Iron	2615.048063	706.744919	1206.744919	1701.558225	6777.215	627.833333
PaintedIron	2565.362838	690.110973	1190.110973	1685.140891	6777.215	627.833333
StainlessSteel	2654.982309	719.993417	1219.993417	1714.995476	6777.215	627.833333

In [47]:

```
df_plot2.Med_Extremes      = df_plot2.Med_Extremes + 2000
df_plot2.Max_Histog        = df_plot2.Max_Histog   + 1500
df_plot2.Idx_Max_Histog   = df_plot2.Idx_Max_Histog + 1000
df_plot2.Min_Histog        = df_plot2.Min_Histog  + 500
df_plot2.Idx_Min_Histog   = df_plot2.Idx_Min_Histog - 1000
df_plot2.head()
```

Out[47]:

Material	All_Bands	Sum_Ch0	Sum_Ch1	Sum_Ch2	Color_dec	Med_Extremes	N
Aluminum	2682.564675	729.161699	1229.161699	1724.241277	6777.215	2627.833333	1
Brass	2493.752665	666.231954	1166.231954	1661.288758	6777.215	2627.833333	1
Copper	2517.624408	674.133626	1174.133626	1669.357156	6777.215	2627.833333	1
CopperWire	2550.382660	685.108613	1185.108613	1680.165434	6777.215	2627.833333	1
Iron	2615.048063	706.744919	1206.744919	1701.558225	6777.215	2627.833333	1

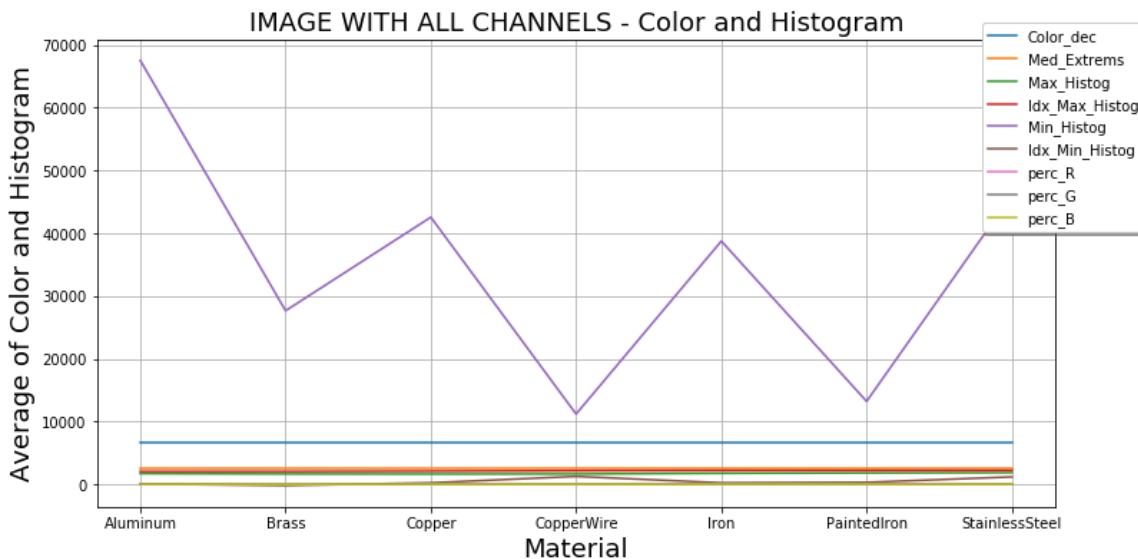
In [48]:

```

loc_Array_sum = np.arange(len(df_plot2.index))
xtick_loc = list(loc_Array_sum)
xticks = list(df_plot1.index)

df_plot2.plot( y=['Color_dec', 'Med_Extrems', 'Max_Histog', 'Idx_Max_Histog',
                  'Min_Histog', 'Idx_Min_Histog', 'perc_R', 'perc_G', 'perc_B'], figsize=(12
,6), grid=True )
plt.xticks(xtick_loc, df_plot2.index, rotation=0)
plt.title('IMAGE WITH ALL CHANNELS - Color and Histogram', fontsize=18)
plt.xlabel('Material', fontsize=18)
plt.ylabel('Average of Color and Histogram', fontsize=18)
plt.legend(loc='upper right', ncol=1, fancybox=True, shadow=True, bbox_to_anchor=(1.1,
1.05))
plt.savefig(folder+"_color_and_histogram.png")
plt.show()

```



In [49]:

```

# Create XLabels
loc_Array_sum = np.arange(len(df_plot1.index))+0.0 # Offsetting the tick-label location
loc_r = np.arange(len(df_plot1.index))+0.1 # Offsetting the tick-label location
loc_g = np.arange(len(df_plot1.index))-0.0 # Offsetting the tick-label location
loc_b = np.arange(len(df_plot1.index))-0.1 # Offsetting the tick-label location

xtick_loc = list(loc_g)
xticks = list(df_plot1.index)

```

In [50]:

Plot

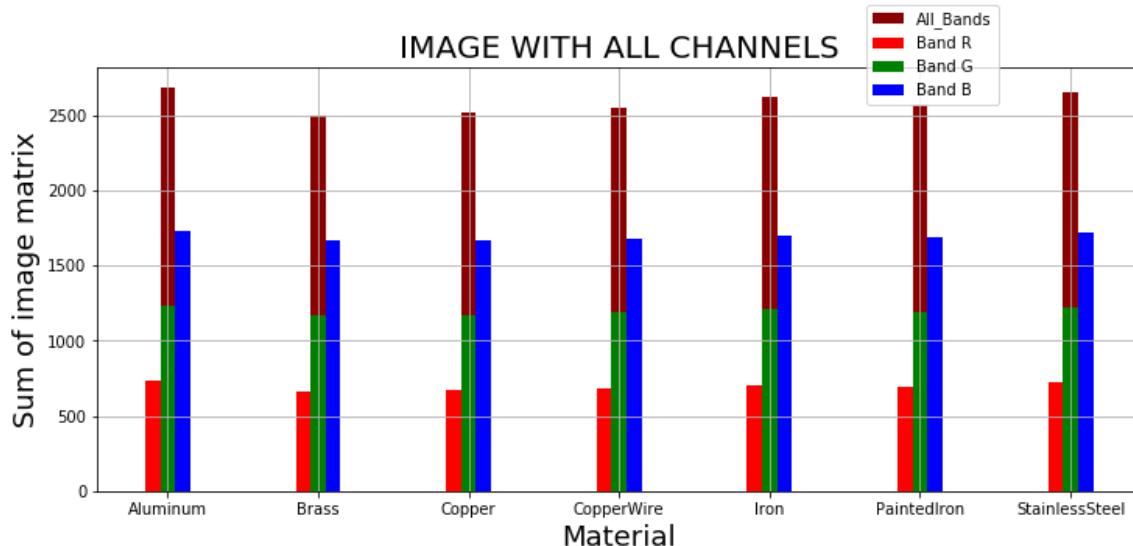
In [51]:

```
# Plot Bar Graph
#df_plot1.plot(kind='bar', figsize=(12,5), grid=True, color='darkred', fontsize=18)
loc_Array_sum = np.arange(len(df_plot1.index))+0.0 # Offsetting the tick-label location
loc_b = np.arange(len(df_plot1.index))+0.1 # Offsetting the tick-label location
loc_g = np.arange(len(df_plot1.index))-0.0 # Offsetting the tick-label location
loc_r = np.arange(len(df_plot1.index))-0.1 # Offsetting the tick-label location

#xtick_loc = list(loc_Array_sum) + list(loc_r) + list(loc_g) + list(loc_b)
#xticks = list(selected.keys())+ list(rejected.keys())
colors = ['darkred','red','green','blue','orange','cyan','black','yellow']
plt.figure(figsize=(12,5))

plt.bar(loc_Array_sum, df_plot1.All_Bands, color=colors[0], width=0.1, label='All_Bands')
plt.bar(loc_r, df_plot1.Sum_Ch0, color=colors[1], width=0.1, label='Band R')
plt.bar(loc_g, df_plot1.Sum_Ch1, color=colors[2], width=0.1, label='Band G')
plt.bar(loc_b, df_plot1.Sum_Ch2, color=colors[3], width=0.1, label='Band B')

plt.title('IMAGE WITH ALL CHANNELS', fontsize=20)
plt.grid(True)
plt.xlabel('Material', fontsize=18)
plt.ylabel('Sum of image matrix', fontsize=18)
plt.xticks(xtick_loc, xticks, rotation=0)
plt.legend(bbox_to_anchor=(.8,0.8),\n    bbox_transform=plt.gcf().transFigure)
plt.savefig(folder+"_all bands.png")
plt.show()
```



In [53]:

```

plt.figure(1)
plt.figure(figsize=(17, 4))
plt.tight_layout()
plt.subplot(231)
plt.title('IMAGE CHANNEL 0')
plt.xticks(rotation=45)
plt.grid(True)
plt.plot(df_plot1.Sum_Ch0, 'k--')

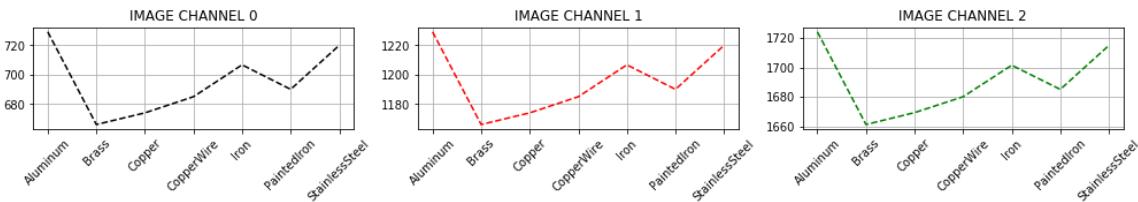
plt.subplot(232)
plt.title('IMAGE CHANNEL 1')
plt.xticks(rotation=45)
plt.grid(True)
plt.plot(df_plot1.Sum_Ch1, 'r--')

plt.subplot(233)
plt.title('IMAGE CHANNEL 2')
plt.xticks(rotation=45)
plt.plot(df_plot1.Sum_Ch2, 'g--')
plt.grid(True)
plt.suptitle('Sum Matrix of channels', fontsize=20, y=1.08)
# plt.tight_layout()
plt.subplots_adjust(top=0.8)
plt.savefig(folder+"_Sum Matrix of channels.png")
plt.show()

```

<Figure size 432x288 with 0 Axes>

Sum Matrix of channels



In [55]:

```
# Percentage of R,G,B
plt.figure(1)
plt.figure(figsize=(17, 4))
plt.tight_layout()
plt.subplot(231)
plt.title('IMAGE CHANNEL R')
plt.xticks(rotation=45)
plt.grid(True)
plt.plot(df_plot1.perc_R, 'r--')

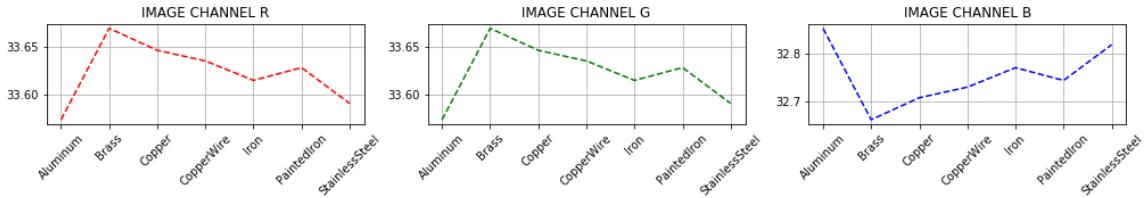
plt.subplot(232)
plt.title('IMAGE CHANNEL G')
plt.xticks(rotation=45)
plt.grid(True)
plt.plot(df_plot1.perc_G, 'g--')

plt.subplot(233)
plt.title('IMAGE CHANNEL B')
plt.xticks(rotation=45)
plt.plot(df_plot1.perc_B, 'b--')
plt.grid(True)

plt.suptitle('Percentage of R,G,B', fontsize=20, y=1.08)
# plt.tight_layout()
plt.subplots_adjust(top=0.8)
plt.savefig(folder + '_Percentage_RGB.png', bbox_inches='tight', pad_inches=0.0)
plt.show()
```

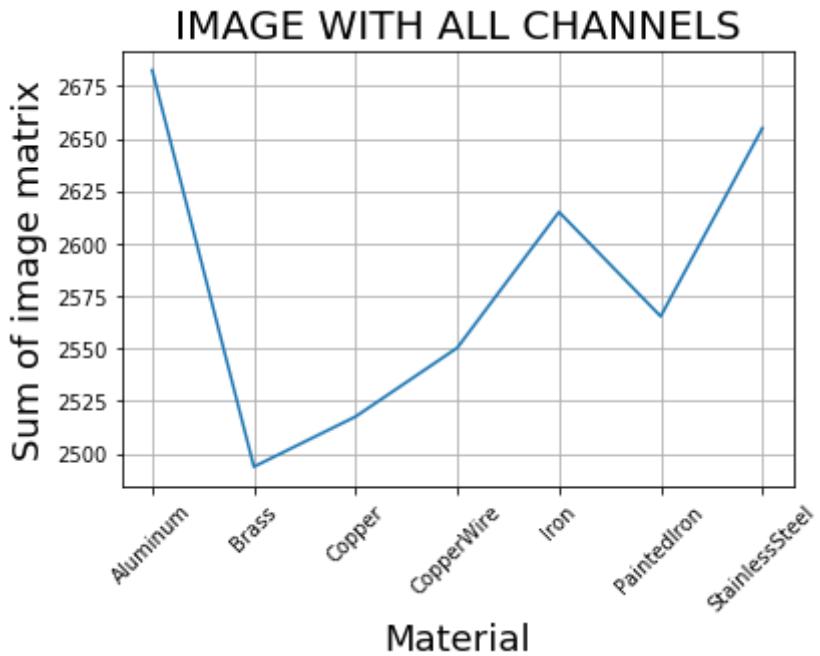
<Figure size 432x288 with 0 Axes>

Percentage of R,G,B



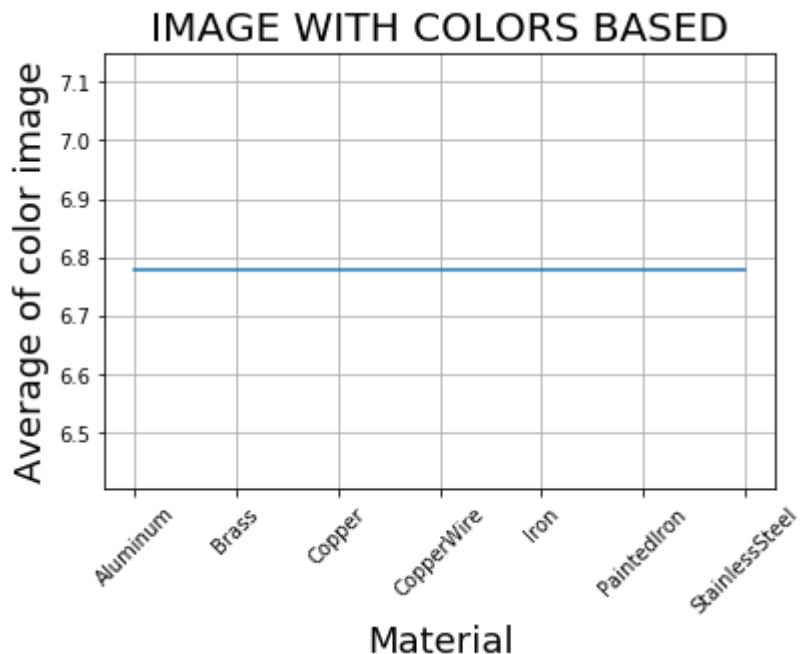
In [56]:

```
# Plot channel based
plt.plot(df_plot1.All_Bands)
plt.title('IMAGE WITH ALL CHANNELS', fontsize=20)
plt.xlabel('Material', fontsize=18)
plt.ylabel('Sum of image matrix', fontsize=18)
plt.xticks(rotation=45)
plt.grid(True)
plt.savefig(folder+'_Sum_all_channels.png', bbox_inches='tight', pad_inches=0.0)
plt.show()
```



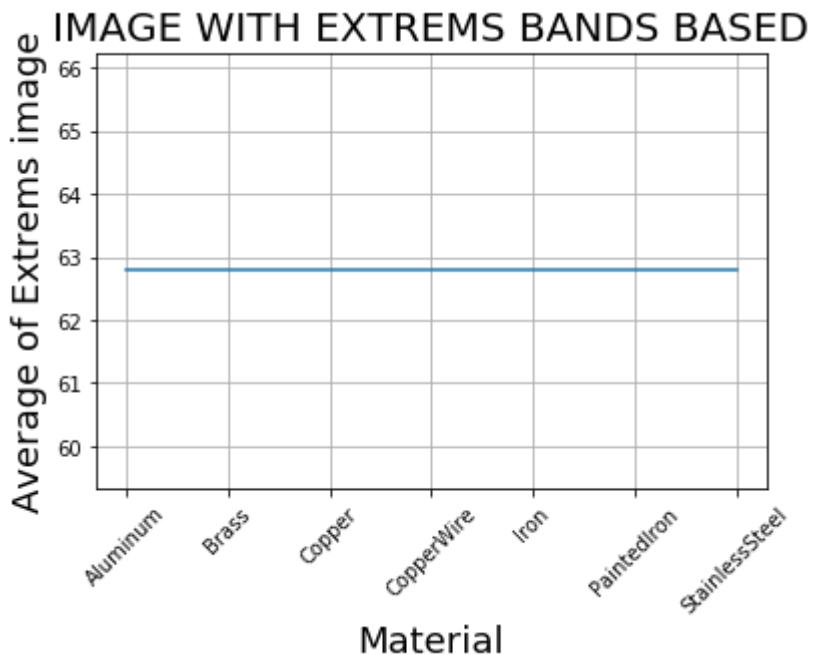
In [57]:

```
# Plot based on color
plt.plot(df_plot1.Color_dec/1000)
plt.title('IMAGE WITH COLORS BASED', fontsize=20)
plt.xlabel('Material', fontsize=18)
plt.ylabel('Average of color image', fontsize=18)
plt.xticks(rotation=45)
plt.grid(True)
plt.show()
```



In [58]:

```
# Plot based on Extrems of the Bands
plt.plot(df_plot1.Med_Extrems/10)
plt.title('IMAGE WITH EXTREMS BANDS BASED', fontsize=20)
plt.xlabel('Material', fontsize=18)
plt.ylabel('Average of Extrems image', fontsize=18)
plt.xticks(rotation=45)
plt.grid(True)
plt.savefig(folder+'_color_based.png', bbox_inches='tight', pad_inches=0.0)
plt.show()
```



Create Histograms

<https://www.cambridgeincolour.com/pt-br/tutoriais/histograms1.htm> (<https://www.cambridgeincolour.com/pt-br/tutoriais/histograms1.htm>)

<https://www.cambridgeincolour.com/pt-br/tutoriais/image-noise.htm> (<https://www.cambridgeincolour.com/pt-br/tutoriais/image-noise.htm>)

<http://www2.ic.uff.br/~aconci/aula-2-2015-AI.pdf> (<http://www2.ic.uff.br/~aconci/aula-2-2015-AI.pdf>)

<https://www.ic.unicamp.br/~ra144681/misc/files/ApostilaProcDelImagesPartel.pdf>
(<https://www.ic.unicamp.br/~ra144681/misc/files/ApostilaProcDelImagesPartel.pdf>)

histograma, também conhecido como distribuição de frequências ou diagrama das frequências, é a representação gráfica, em colunas (retângulos), de um conjunto de dados previamente tabulado e dividido em classes uniformes.

Histogramas:

O histograma de uma imagem cinza é uma função discreta $h(l)$ (vetor) que produz o número de ocorrências de cada nível de cinza na imagem. O histograma normalizado $h(l)/|D_l|$ representa a distribuição de probabilidade dos valores dos pixels.

Imagens claras possuem histogramas com altas concentrações de pixels de alto brilho. Imagens escuras possuem histogramas com altas concentrações de pixels de baixo brilho. O contraste maior está associado a um grau maior de dispersão do histograma.

No caso de imagens multiespectrais, cada banda é requantizada em um certo número de intervalos, de forma que o espaço de características Z_k é dividido em hipercubos (bins do histograma). A contagem de cores em cada bin é usada no cálculo do histograma. Assim, para cada bin, precisamos analisar os níveis de cinza das 3 bandas da imagem colorida (RGB).

Entendendo Histogramas:

O histograma mostra a frequência dos valores de brilho da imagem, ou seja, a quantidade de luz presente na imagem.

In [59]:

```
list_of_images
```

Out[59]:

```
['Aluminum_1.tif',
 'Aluminum_2.tif',
 'Aluminum_3.tif',
 'Aluminum_4.tif',
 'Aluminum_5.tif',
 'Aluminum_6.tif',
 'Brass_1.tif',
 'Brass_2.tif',
 'Brass_3.tif',
 'Brass_4.tif',
 'Brass_5.tif',
 'Brass_6.tif',
 'CopperWire_1.tif',
 'CopperWire_2.tif',
 'CopperWire_3.tif',
 'CopperWire_4.tif',
 'CopperWire_5.tif',
 'CopperWire_6.tif',
 'CopperWire_7.tif',
 'CopperWire_8.tif',
 'Copper_1.tif',
 'Copper_2.tif',
 'Copper_3.tif',
 'Copper_4.tif',
 'Iron_1.tif',
 'Iron_2.tif',
 'Iron_3.tif',
 'Iron_4.tif',
 'PaintedIron_1.tif',
 'PaintedIron_2.tif',
 'PaintedIron_3.tif',
 'PaintedIron_4.tif',
 'PaintedIron_5.tif',
 'PaintedIron_6.tif',
 'PaintedIron_7.tif',
 'StainlessSteel_1.tif',
 'StainlessSteel_2.tif',
 'StainlessSteel_3.tif',
 'StainlessSteel_4.tif',
 'StainlessSteel_5.tif',
 'StainlessSteel_6.tif',
 'StainlessSteel_7.tif',
 'StainlessSteel_8.tif',
 'StainlessSteel_9.tif']
```

In [60]:

```
# Delete values from list - Bad image names
def remove_values_from_list(list_values, mask):
    list_new = list()
    for list_value in list_values:
        if(mask not in list_value):
            print(list_value)
            list_new.append(list_value)
    return list_new
```

In [61]:

```
# Remove from List names with 'MASK'
new_list = remove_values_from_list(list_of_images, 'MASK')
```

```
Aluminum_1.tif
Aluminum_2.tif
Aluminum_3.tif
Aluminum_4.tif
Aluminum_5.tif
Aluminum_6.tif
Brass_1.tif
Brass_2.tif
Brass_3.tif
Brass_4.tif
Brass_5.tif
Brass_6.tif
CopperWire_1.tif
CopperWire_2.tif
CopperWire_3.tif
CopperWire_4.tif
CopperWire_5.tif
CopperWire_6.tif
CopperWire_7.tif
CopperWire_8.tif
Copper_1.tif
Copper_2.tif
Copper_3.tif
Copper_4.tif
Iron_1.tif
Iron_2.tif
Iron_3.tif
Iron_4.tif
PaintedIron_1.tif
PaintedIron_2.tif
PaintedIron_3.tif
PaintedIron_4.tif
PaintedIron_5.tif
PaintedIron_6.tif
PaintedIron_7.tif
StainlessSteel_1.tif
StainlessSteel_2.tif
StainlessSteel_3.tif
StainlessSteel_4.tif
StainlessSteel_5.tif
StainlessSteel_6.tif
StainlessSteel_7.tif
StainlessSteel_8.tif
StainlessSteel_9.tif
```

In [62]:

```
# Remove from List names with 'Enh'
new_list = remove_values_from_list(new_list, 'Enh')

Aluminum_1.tif
Aluminum_2.tif
Aluminum_3.tif
Aluminum_4.tif
Aluminum_5.tif
Aluminum_6.tif
Brass_1.tif
Brass_2.tif
Brass_3.tif
Brass_4.tif
Brass_5.tif
Brass_6.tif
CopperWire_1.tif
CopperWire_2.tif
CopperWire_3.tif
CopperWire_4.tif
CopperWire_5.tif
CopperWire_6.tif
CopperWire_7.tif
CopperWire_8.tif
Copper_1.tif
Copper_2.tif
Copper_3.tif
Copper_4.tif
Iron_1.tif
Iron_2.tif
Iron_3.tif
Iron_4.tif
PaintedIron_1.tif
PaintedIron_2.tif
PaintedIron_3.tif
PaintedIron_4.tif
PaintedIron_5.tif
PaintedIron_6.tif
PaintedIron_7.tif
StainlessSteel_1.tif
StainlessSteel_2.tif
StainlessSteel_3.tif
StainlessSteel_4.tif
StainlessSteel_5.tif
StainlessSteel_6.tif
StainlessSteel_7.tif
StainlessSteel_8.tif
StainlessSteel_9.tif
```

In [63]:

```
list_of_images = new_list
```

In [64]:

```
path = mypath + '/' + folder + '/'
path
```

Out[64]:

```
'C:\\\\Users\\\\manuel.robalinho\\\\Google Drive\\\\UPT_Portugalense\\\\Trabalho final\\\\Classificacao_Sucata\\\\Jupyter_Notebook/imagedata06/'
```

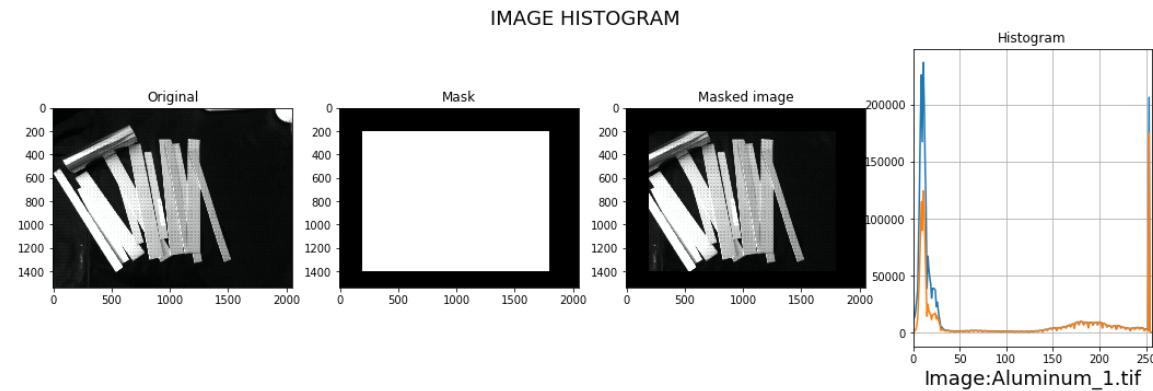
In [65]:

```
# HISTOGRAMS
# Print Histograms for all folder images
# list_of_images has all the name files

for x in list_of_images:
    print('Cv2 Histogram for File:', x)
    print_cv_hist(path, x)
```

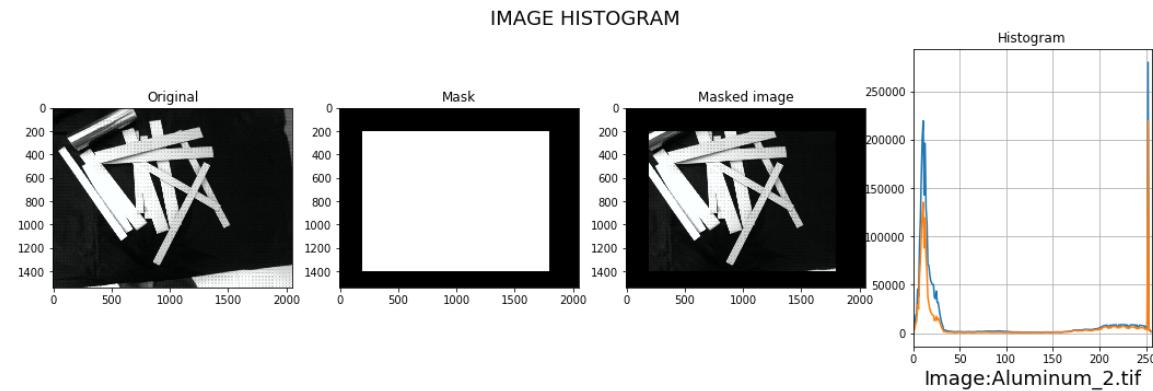
Cv2 Histogram for File: Aluminum_1.tif

Cv2 Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Aluminum_1.tif



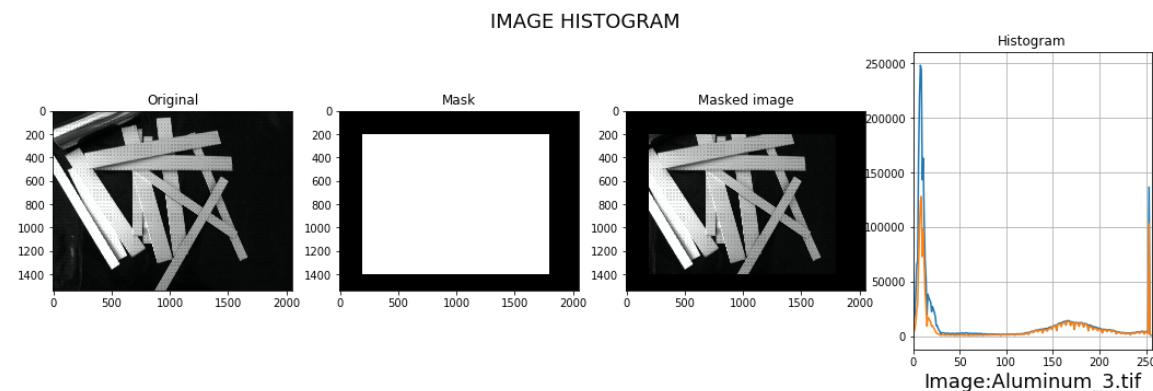
Cv2 Histogram for File: Aluminum_2.tif

Cv2 Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Aluminum_2.tif



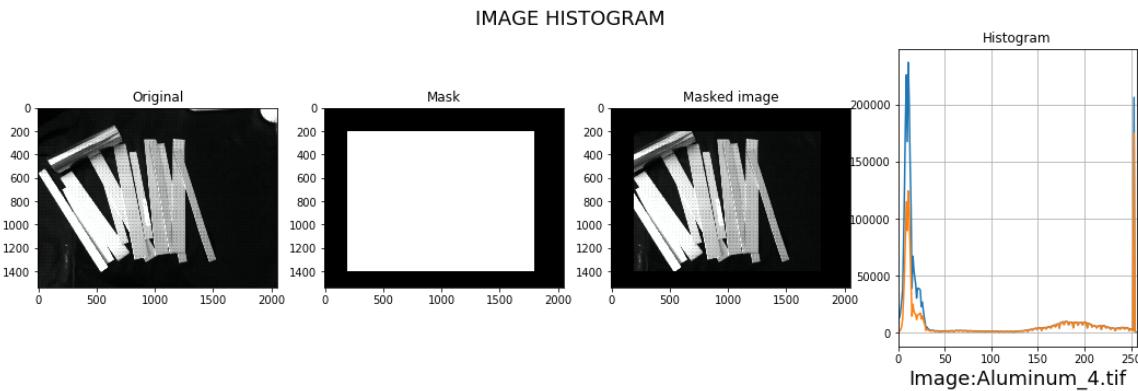
Cv2 Histogram for File: Aluminum_3.tif

Cv2 Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Aluminum_3.tif



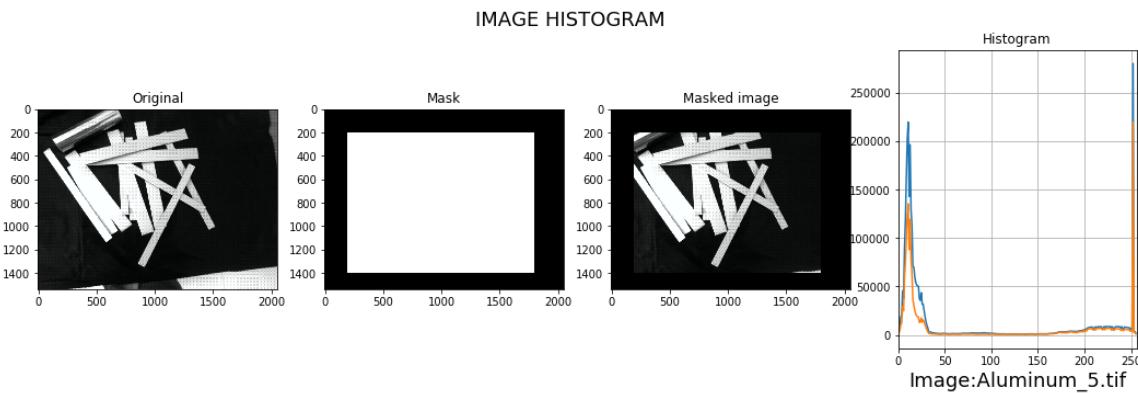
Cv2 Histogram for File: Aluminum_4.tif

Cv2 Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Aluminum_4.tif



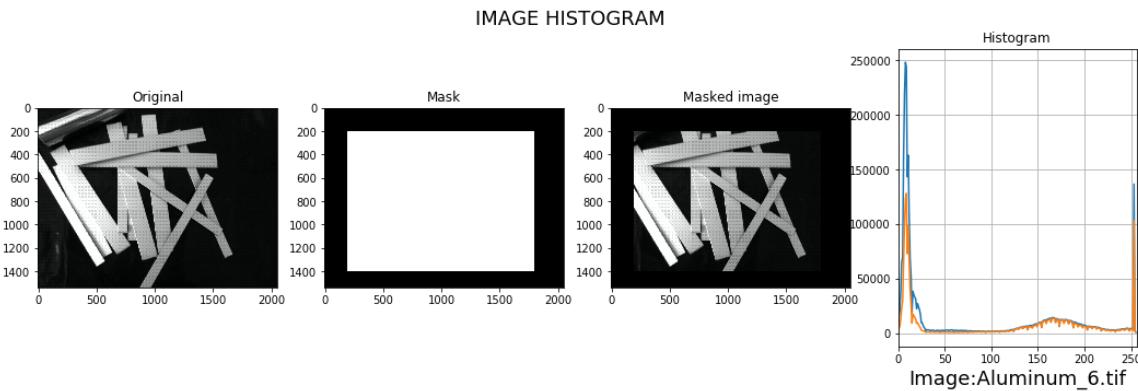
Cv2 Histogram for File: Aluminum_5.tif

Cv2 Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Aluminum_5.tif



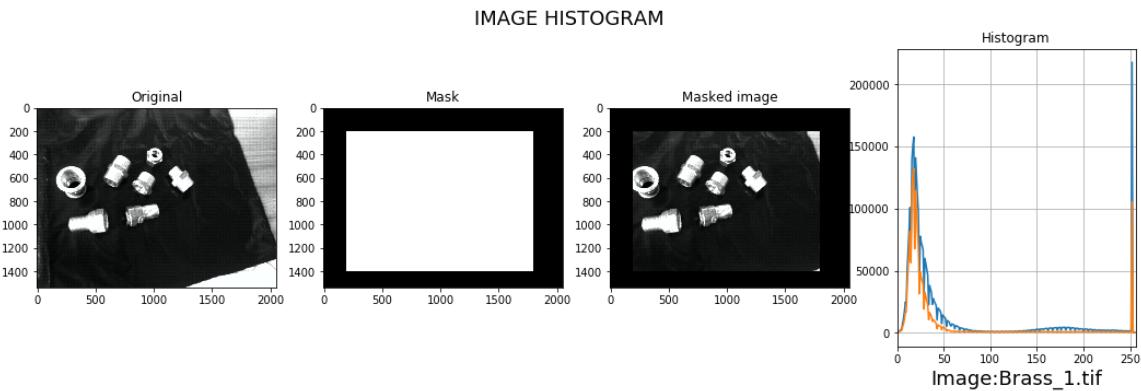
Cv2 Histogram for File: Aluminum_6.tif

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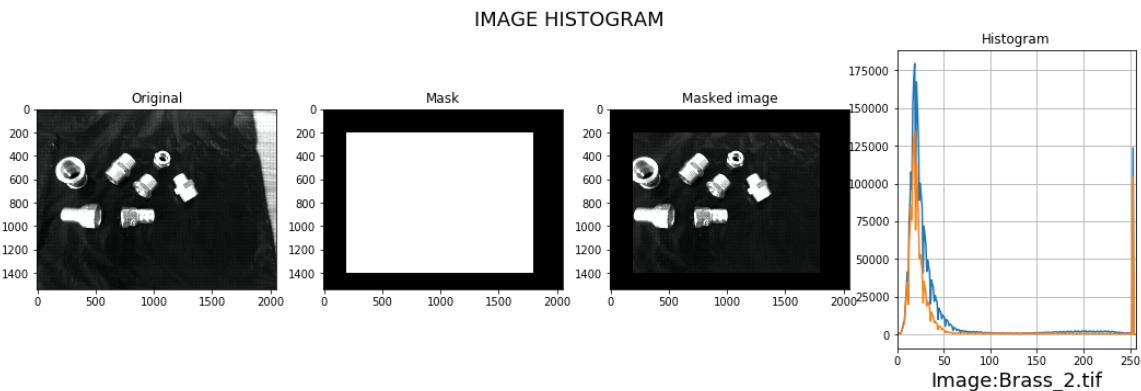
Cv2 Histogram for File: Brass_1.tif

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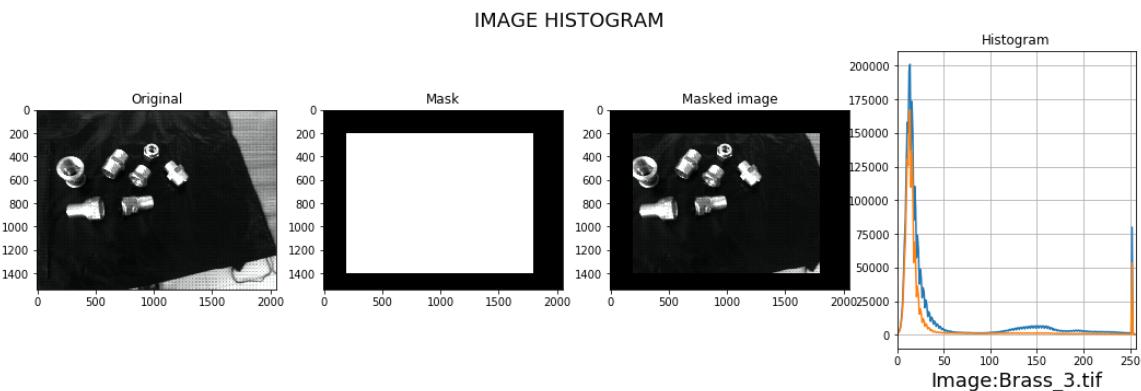
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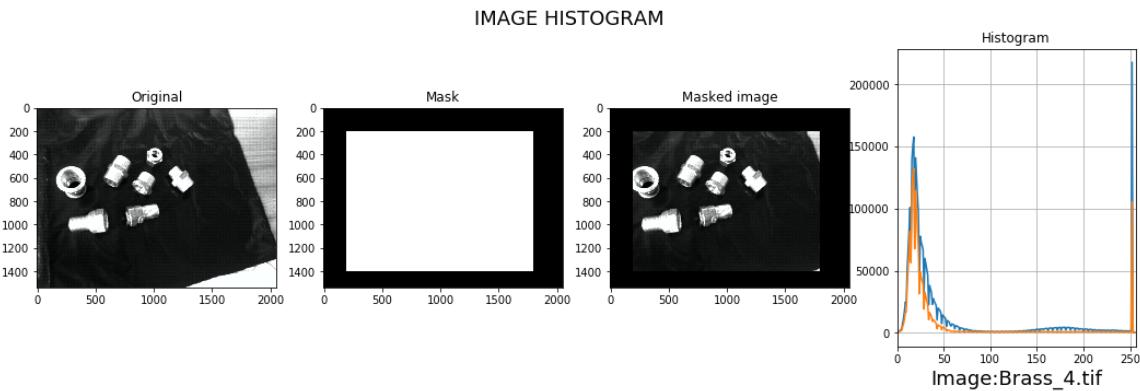
Cv2 Histogram for File: Brass_3.tif

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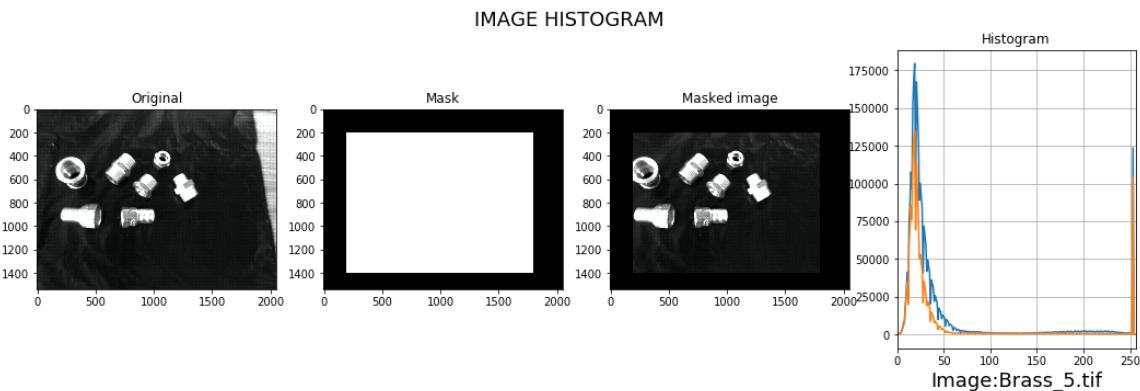
Cv2 Histogram for File: Brass_4.tif

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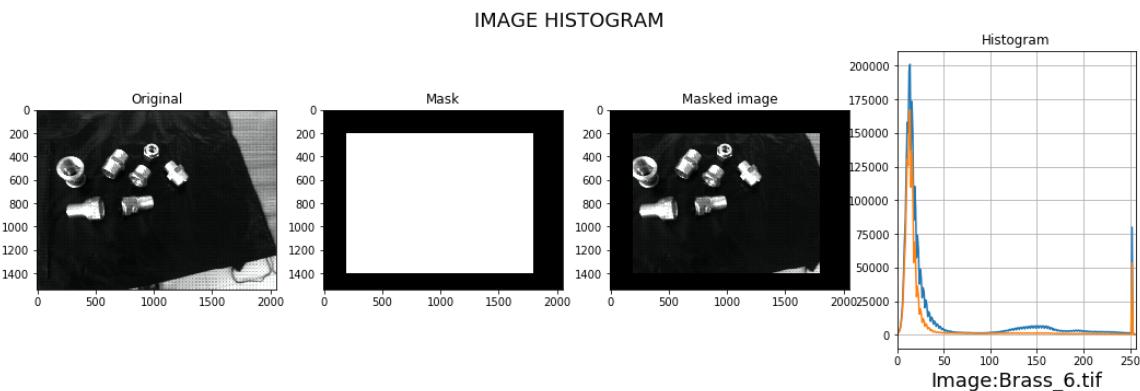
Cv2 Histogram for File: Brass_5.tif

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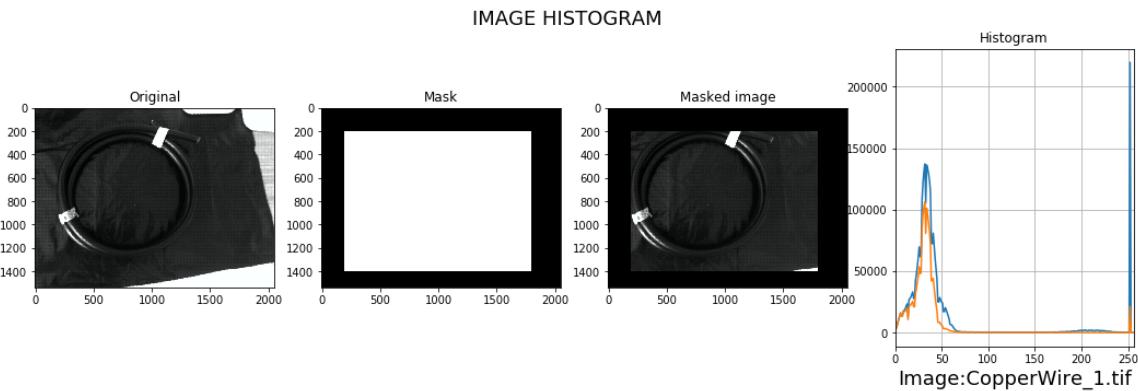
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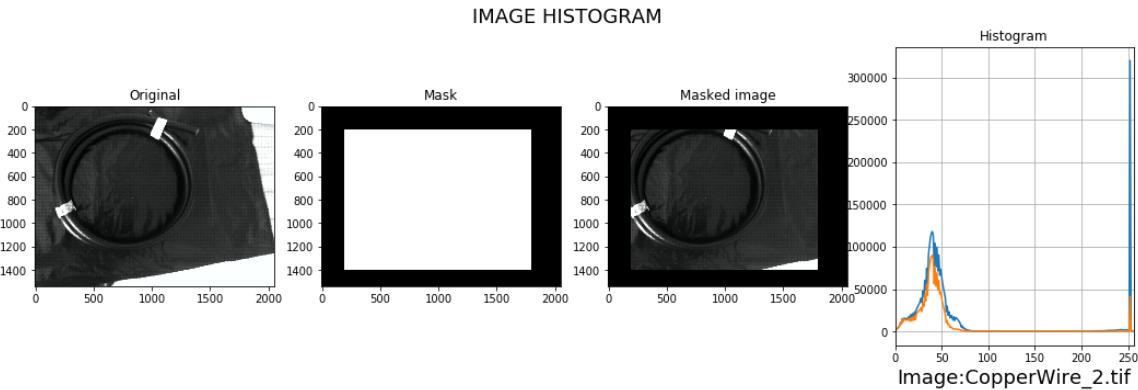
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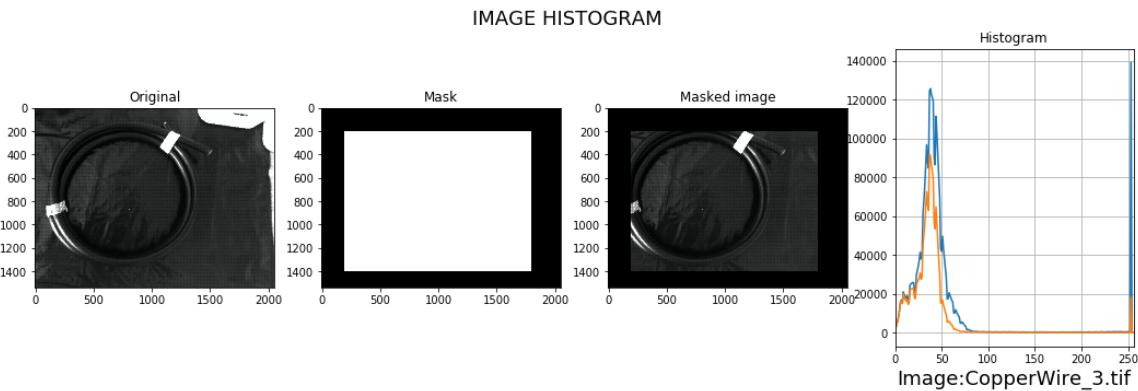
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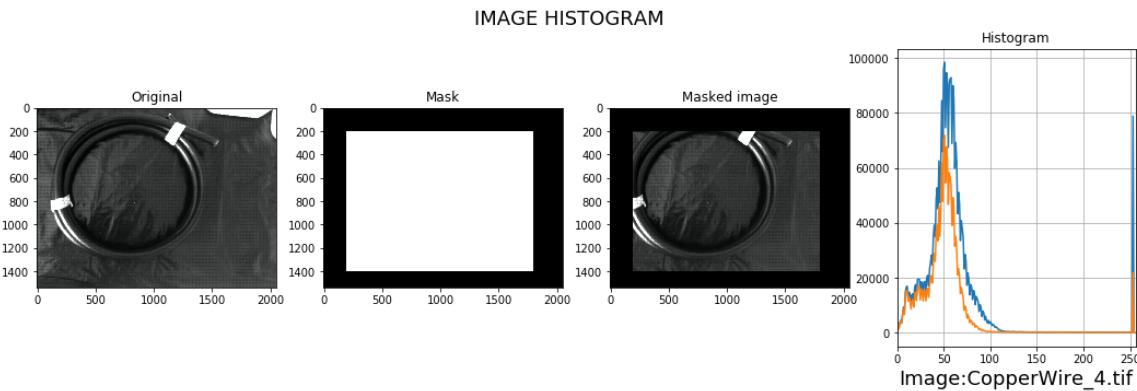
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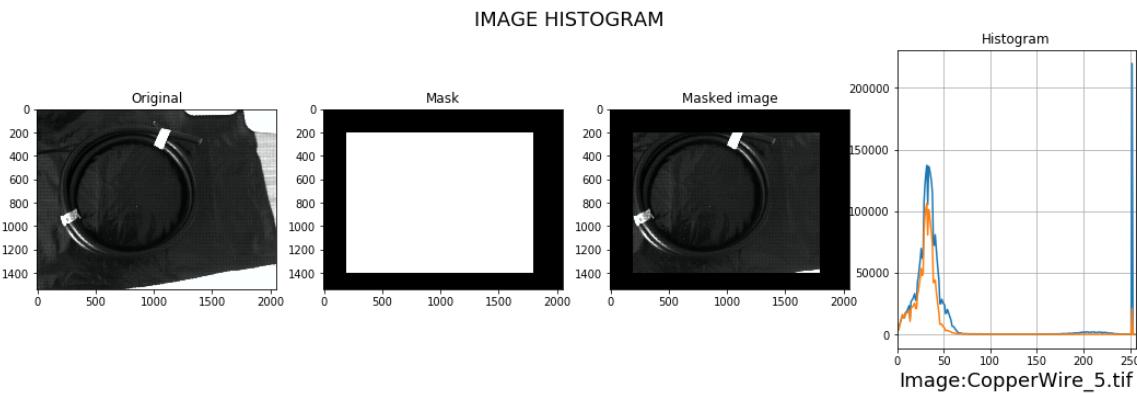
Cv2 Histogram for File: CopperWire_4.tif

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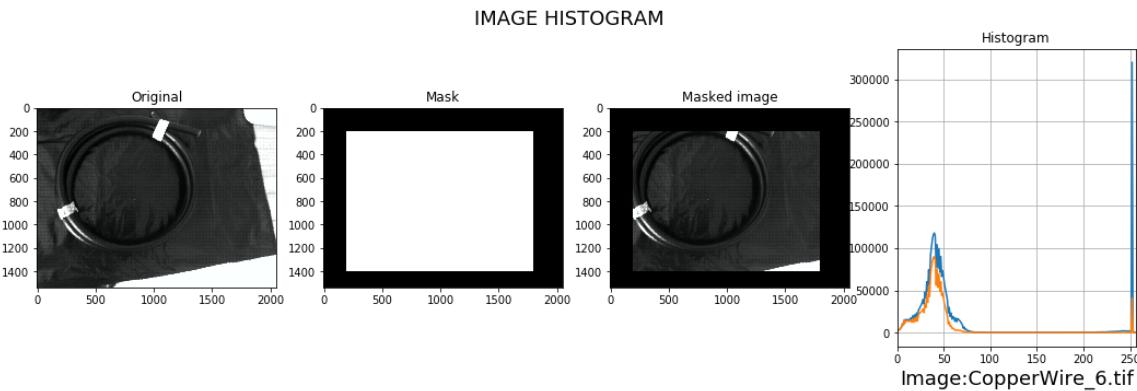
Cv2 Histogram for File: CopperWire_5.tif

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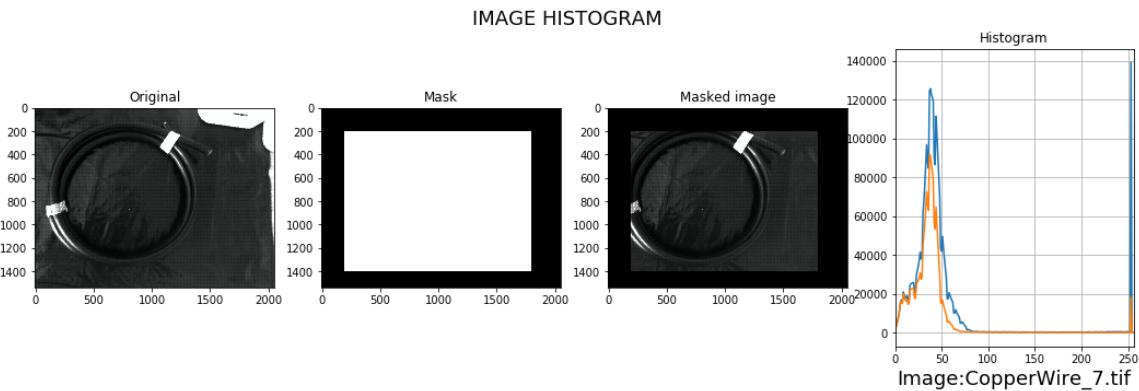
Cv2 Histogram for File: CopperWire_6.tif

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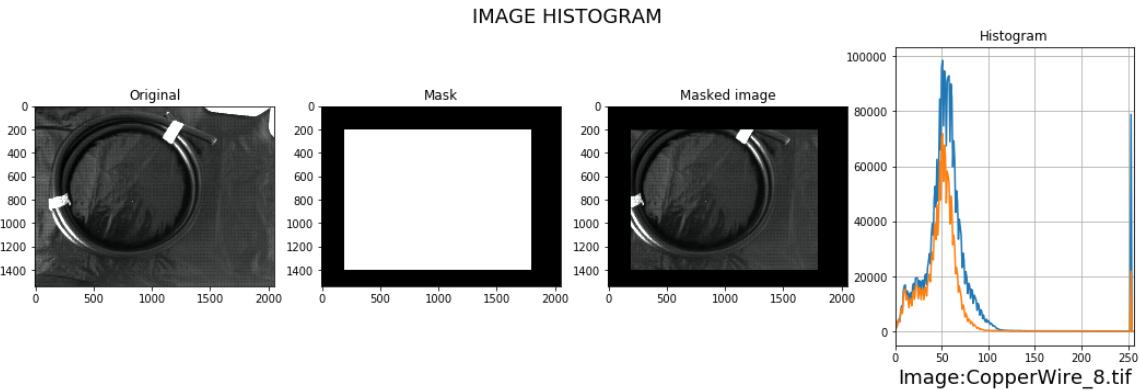
Cv2 Histogram for File: CopperWire_7.tif

Cv2 Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/CopperWire_7.tif



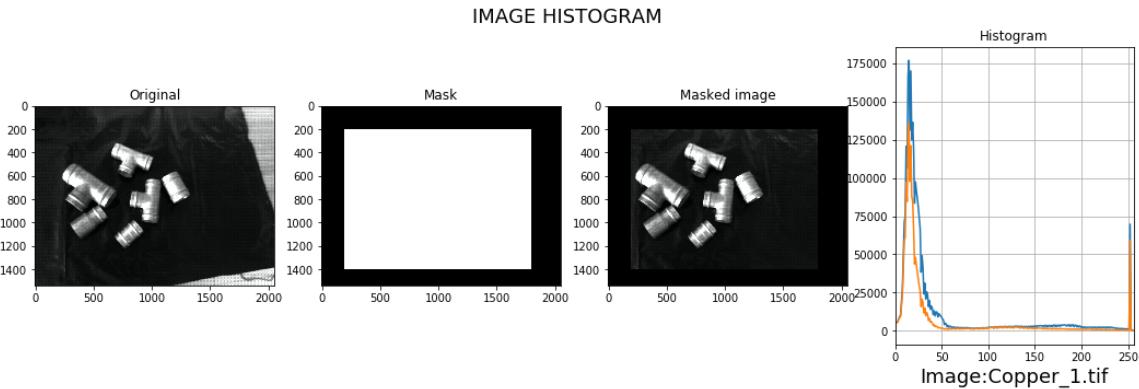
Cv2 Histogram for File: CopperWire_8.tif

Cv2 Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/CopperWire_8.tif



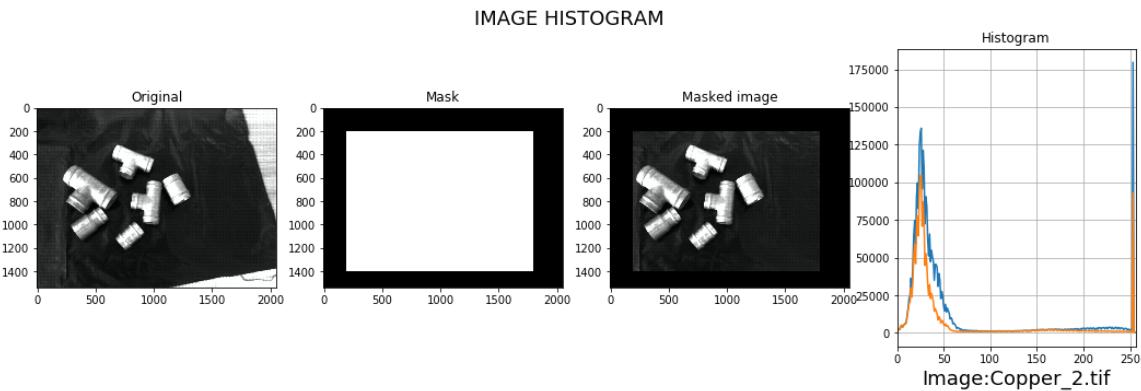
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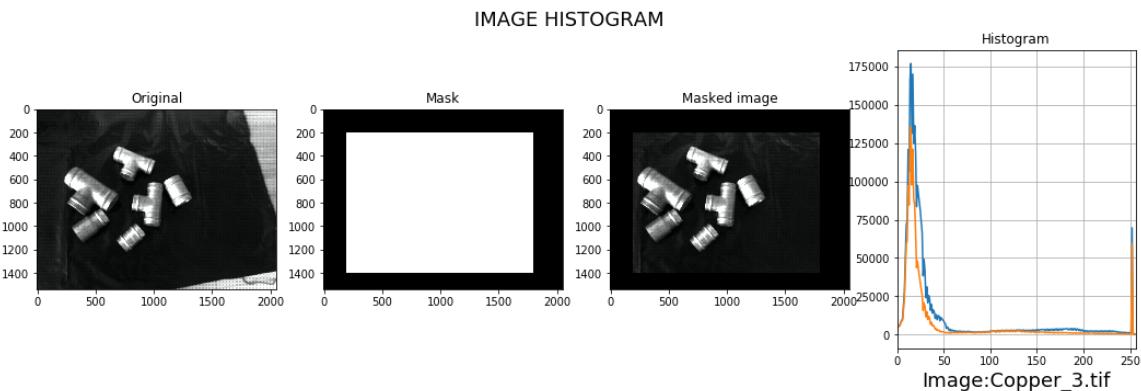
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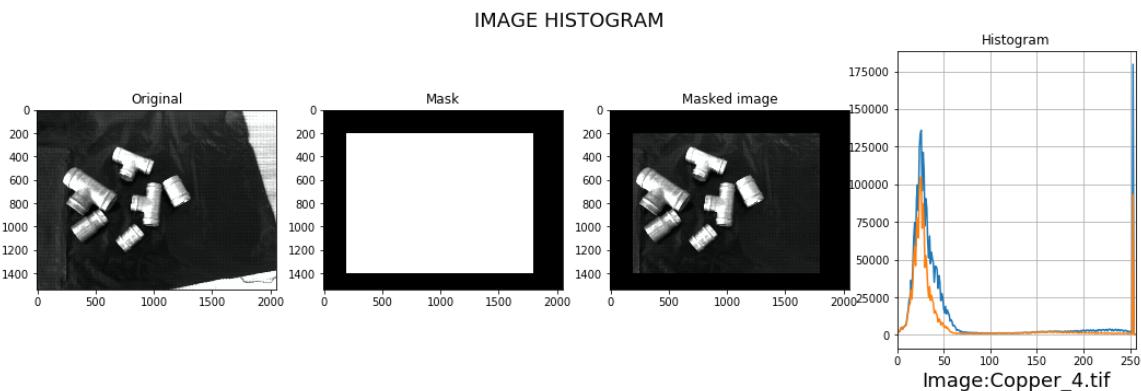
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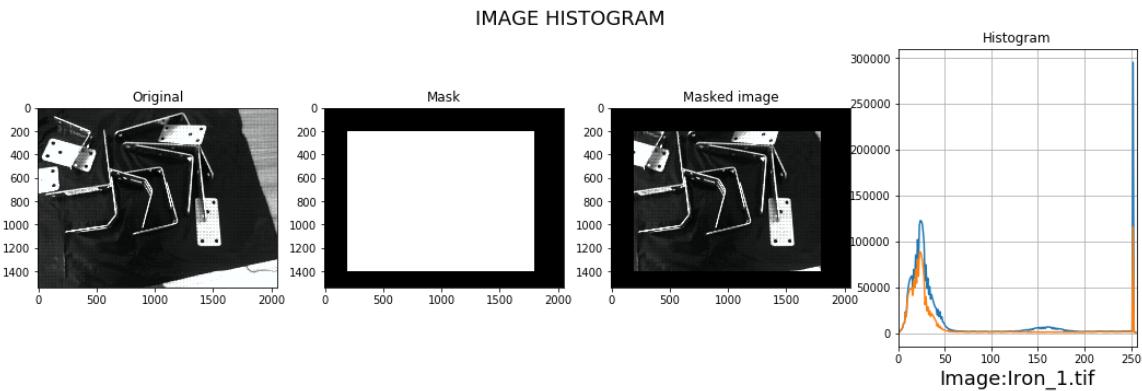
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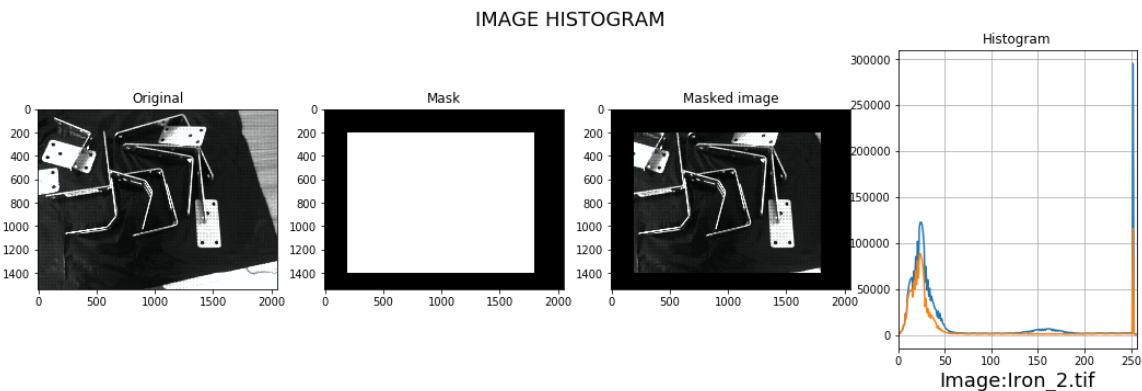
Cv2 Histogram for File: Iron_1.tif

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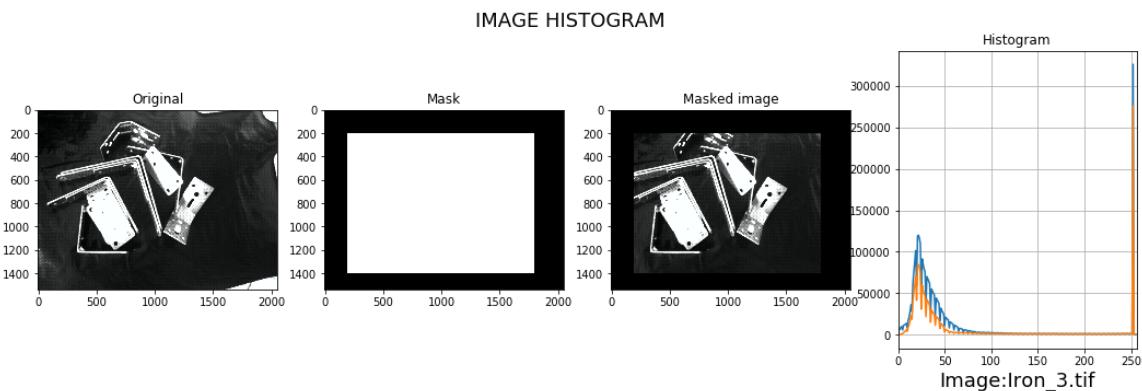
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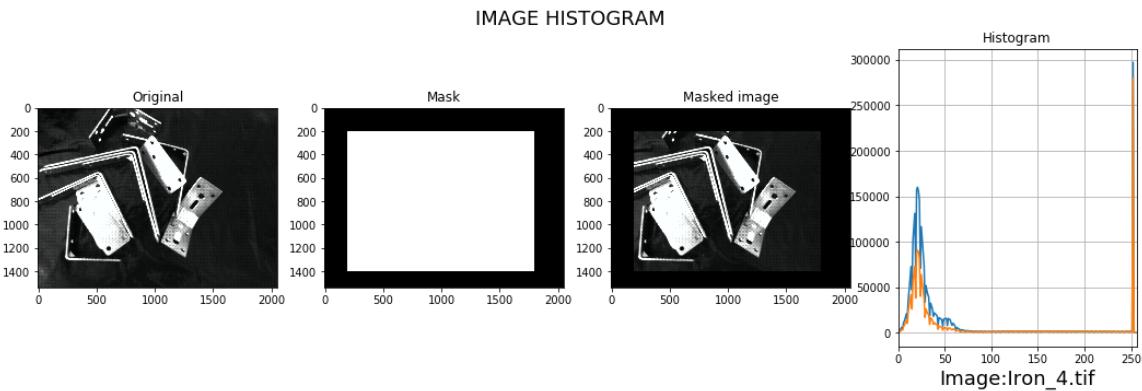
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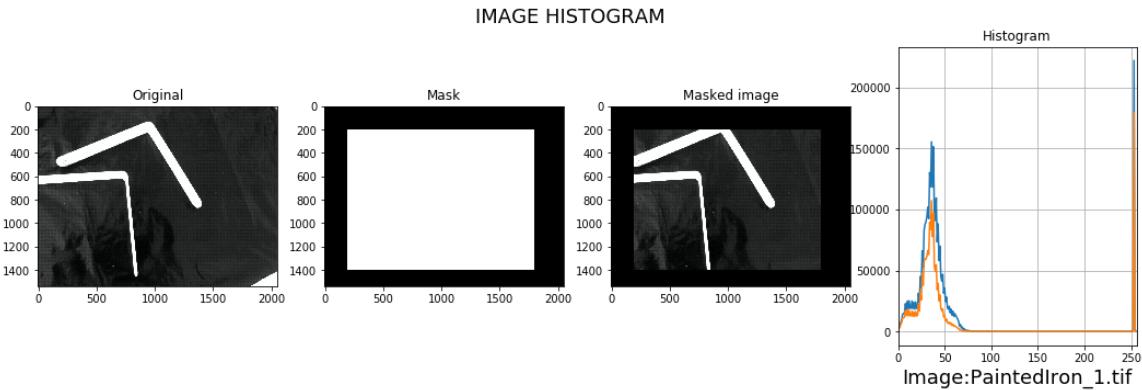
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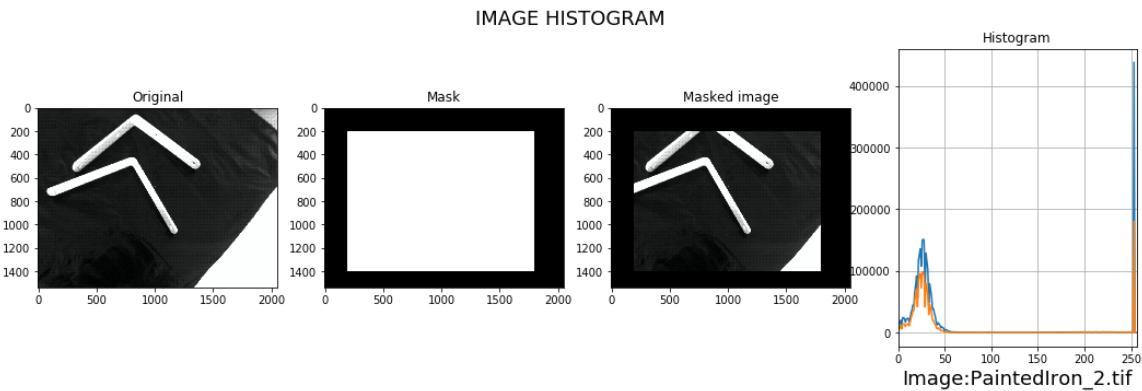
Cv2 Histogram for File: PaintedIron_1.tif

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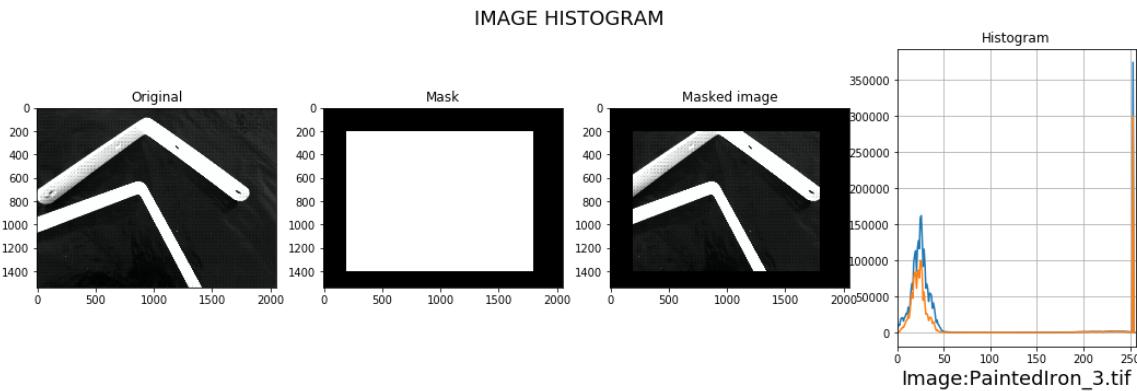
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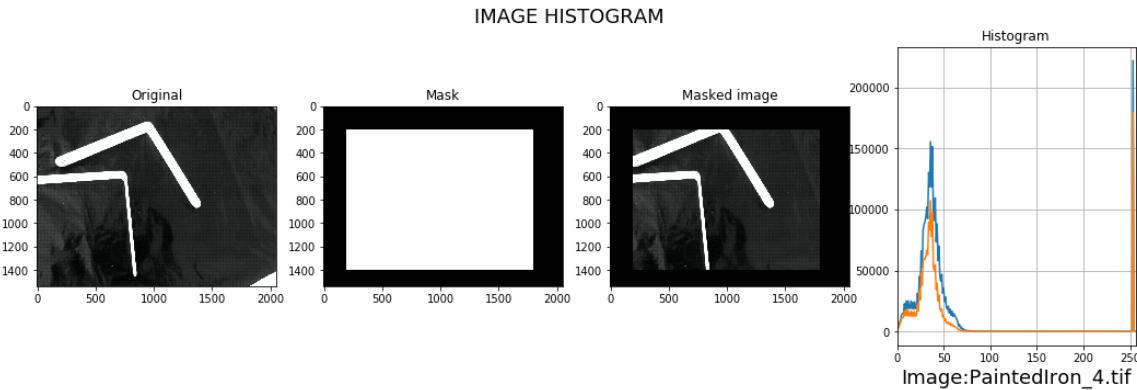
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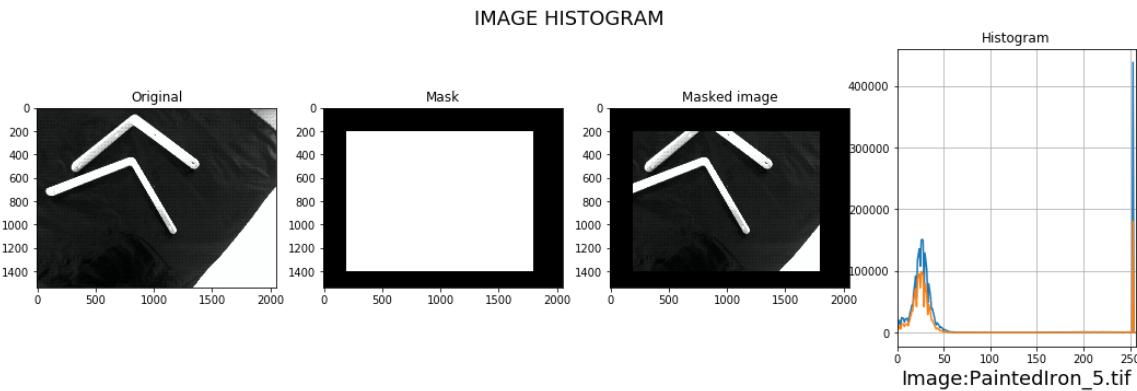
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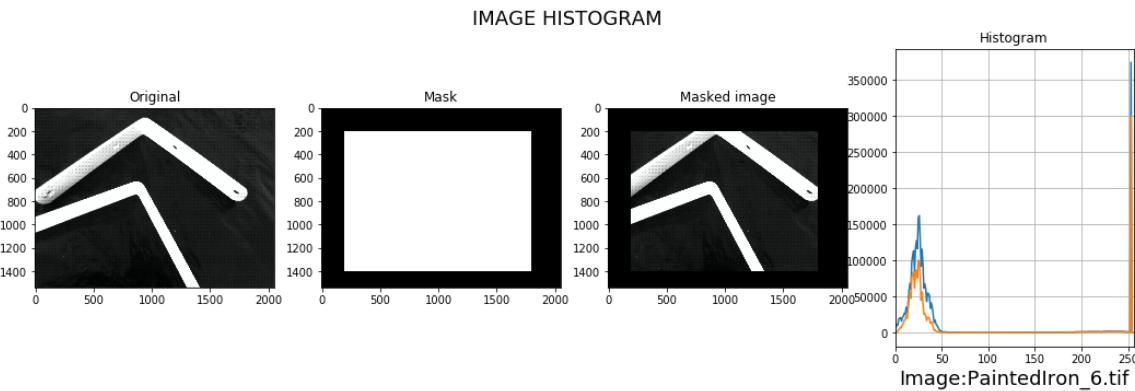
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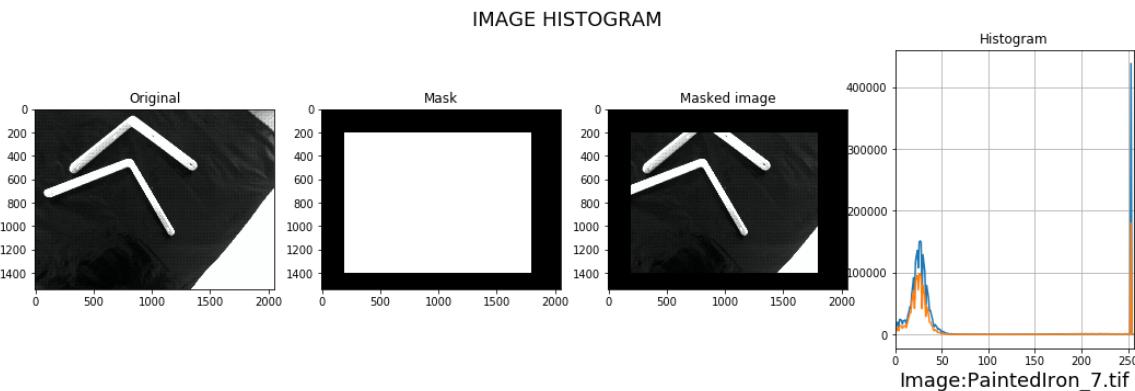
Cv2 Histogram for File: PaintedIron_6.tif

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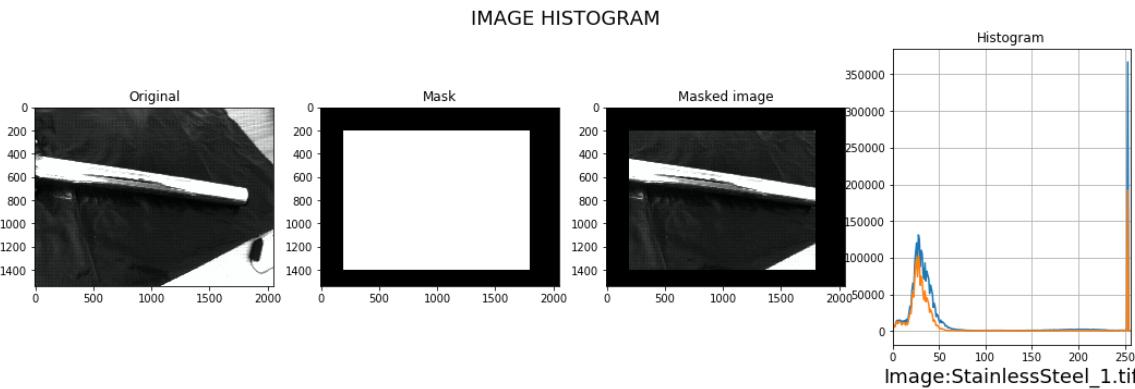
Cv2 Histogram for File: PaintedIron_7.tif

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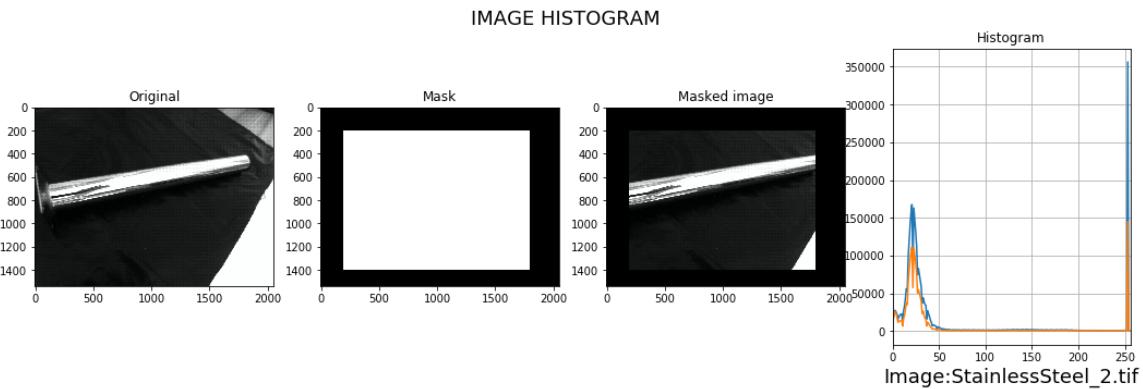
Cv2 Histogram for File: StainlessSteel_1.tif

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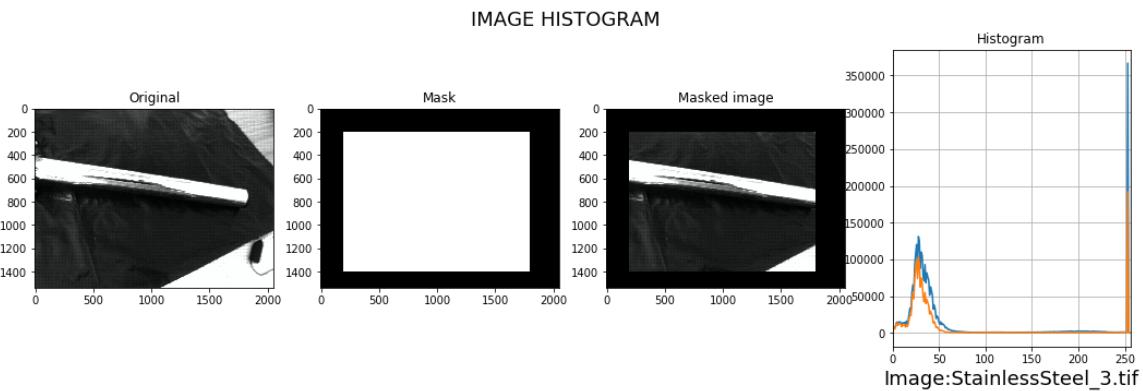
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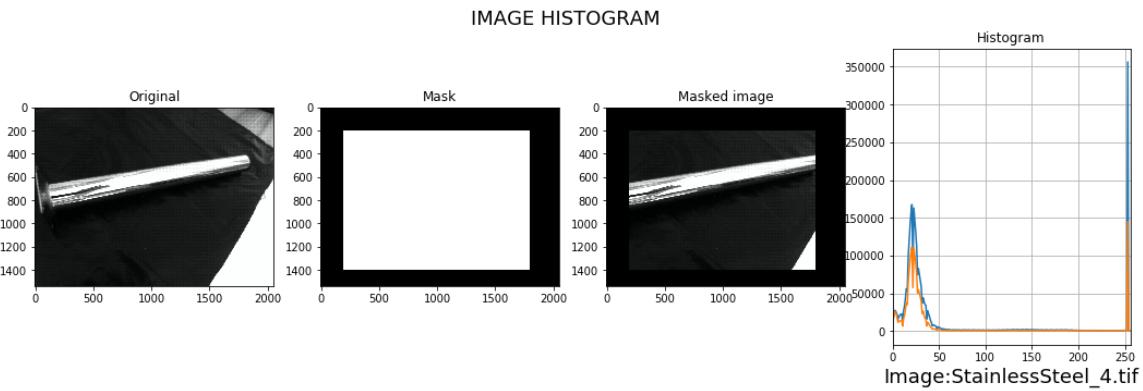
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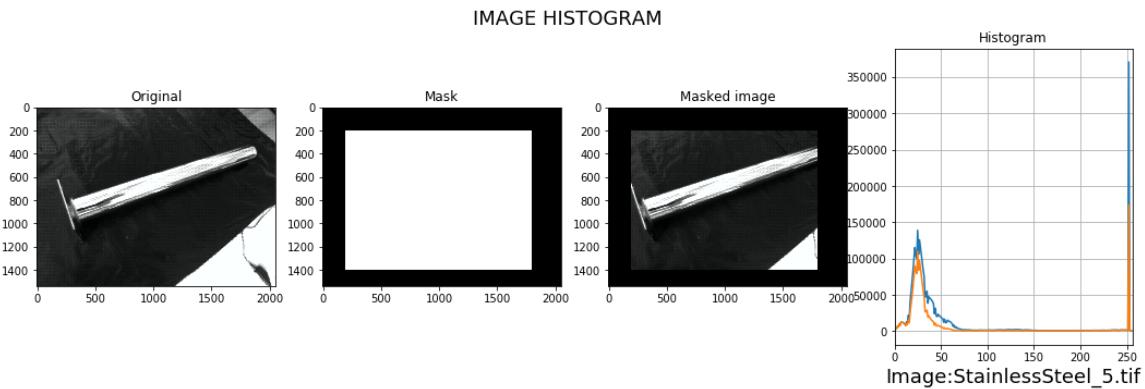
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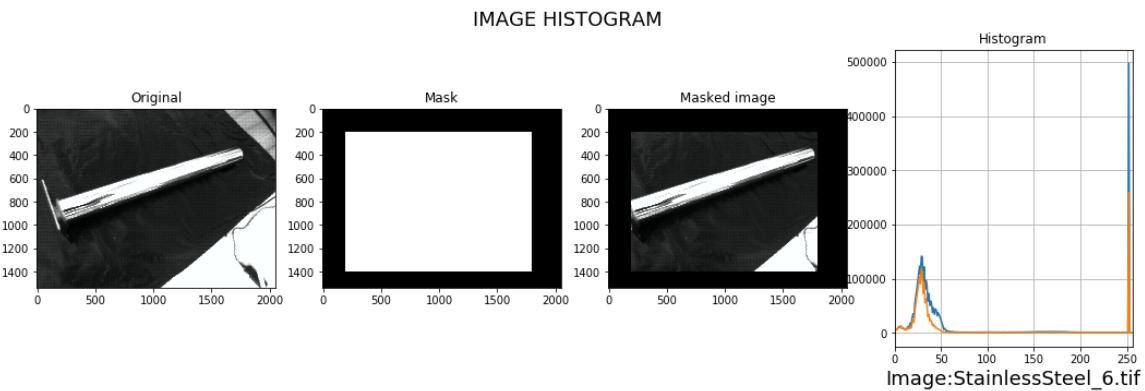
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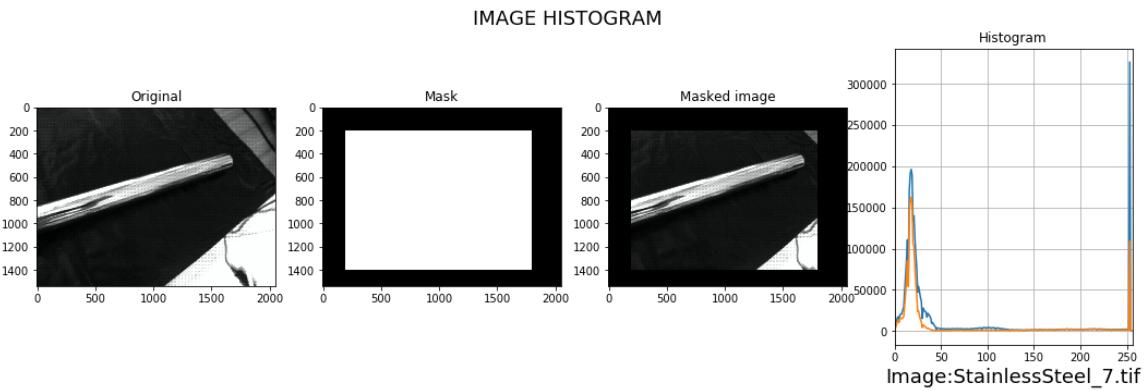
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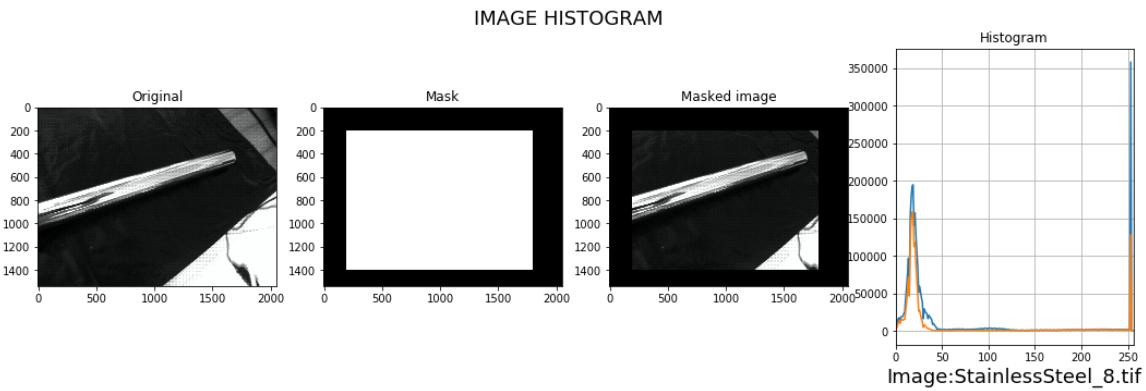
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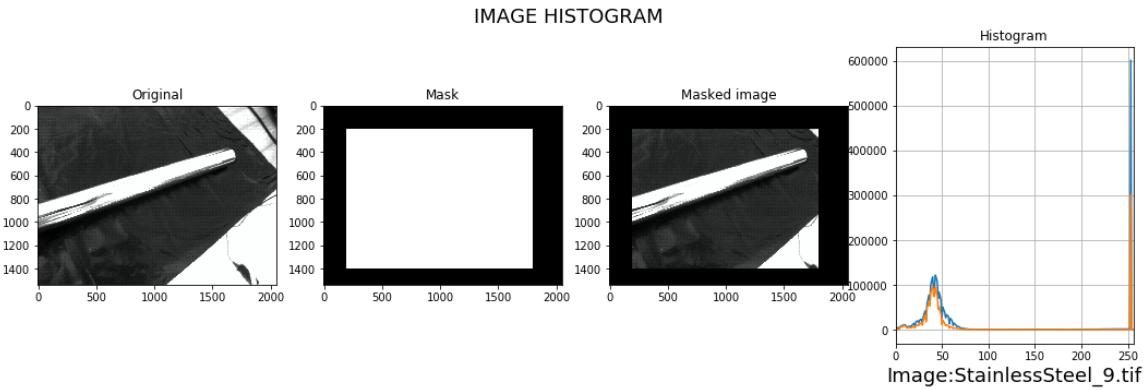
Cv2 Histogram for File: StainlessSteel_8.tif

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Cv2 Histogram for File: StainlessSteel_9.tif

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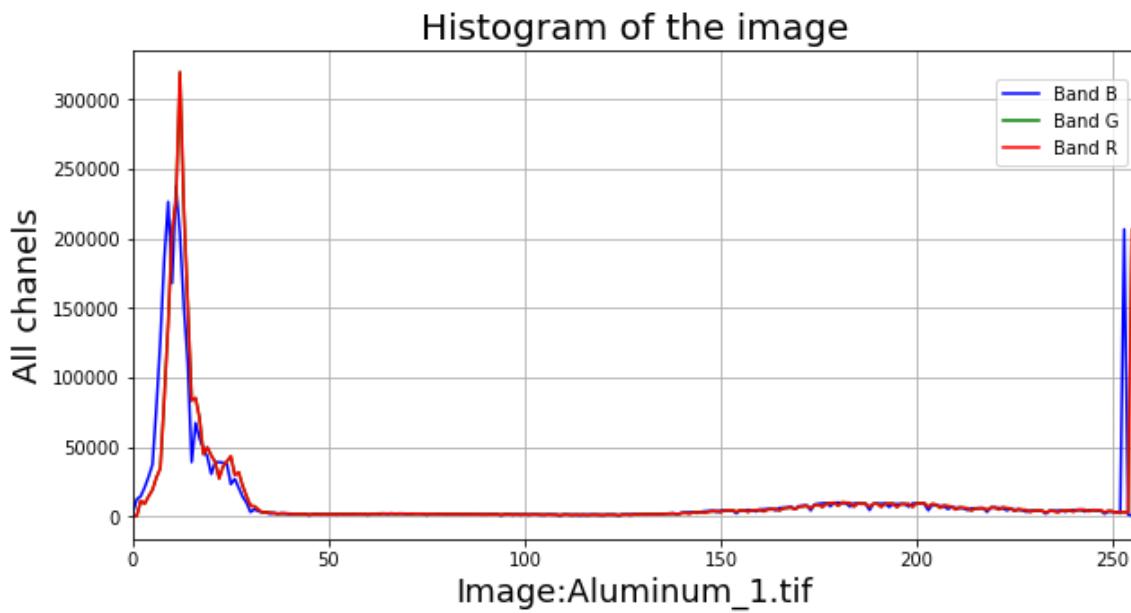


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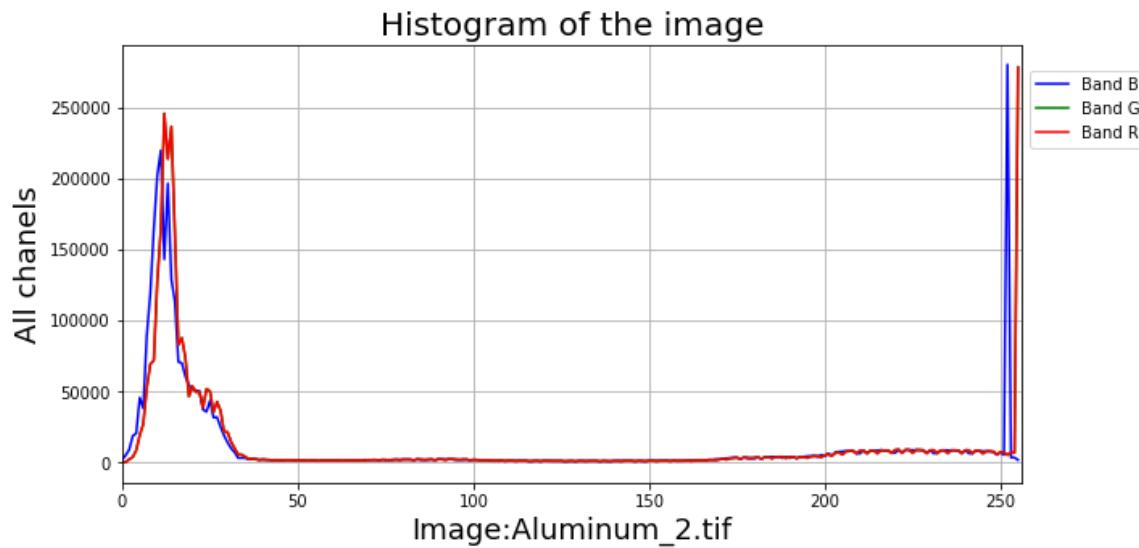
```
# HISTOGRAMS
# Print Histograms for all folder images
# list_of_images has all the name files

for x in list_of_images:
    print('Matplot Histogram for File:', x)
    print_matplot_hist(path, x)
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Matplot Histogram for File: Aluminum_1.tif
Matplot Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Aluminum_1.tif

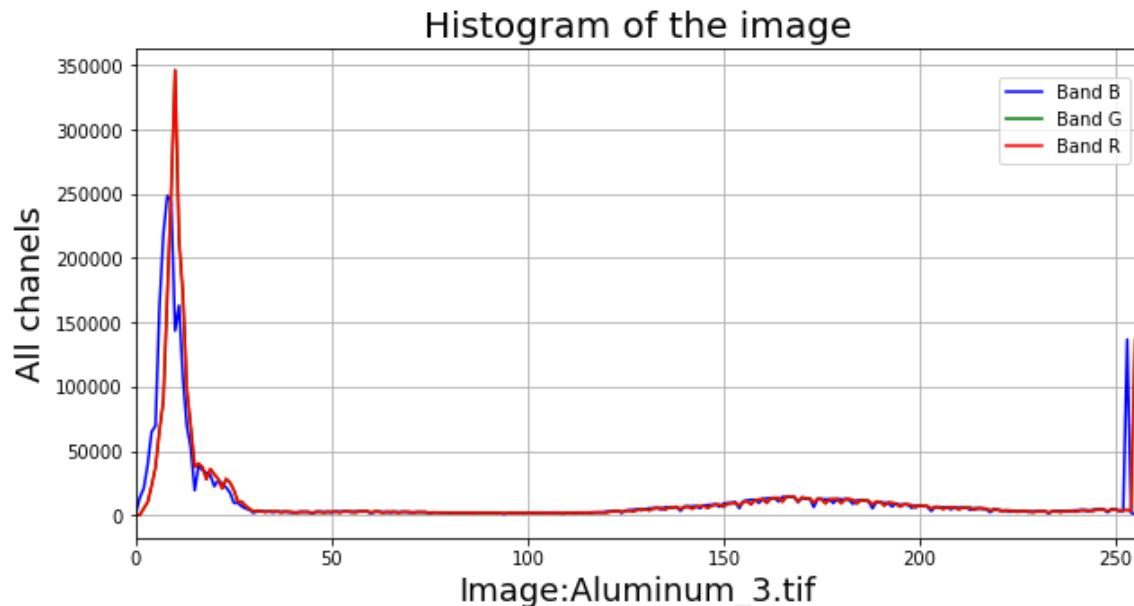


Matplot Histogram for File: Aluminum_2.tif
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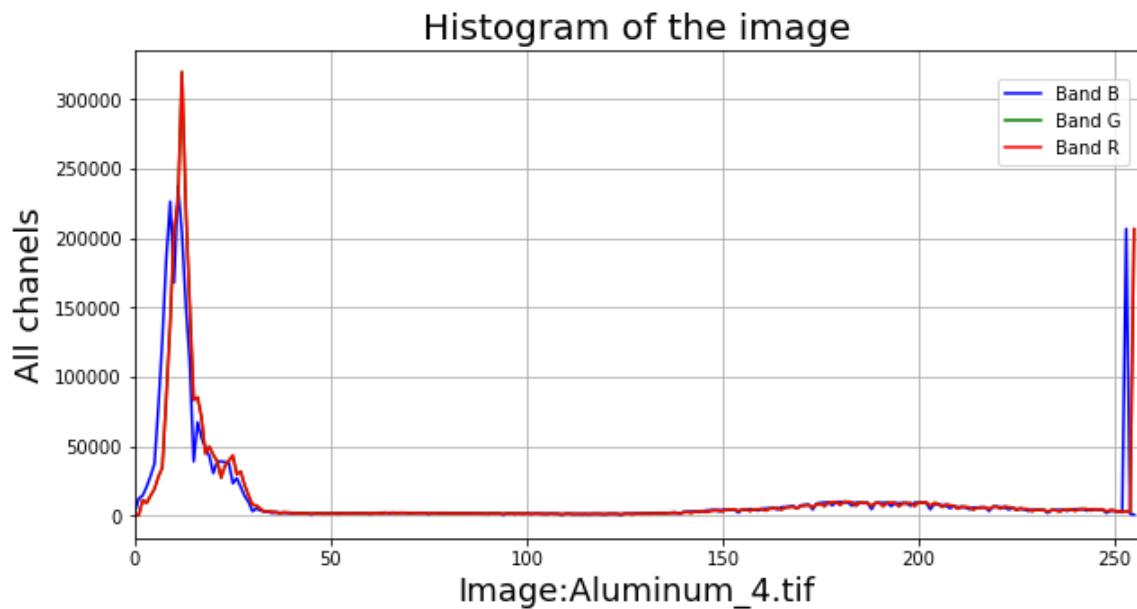
Matplot Histogram for File: Aluminum_3.tif

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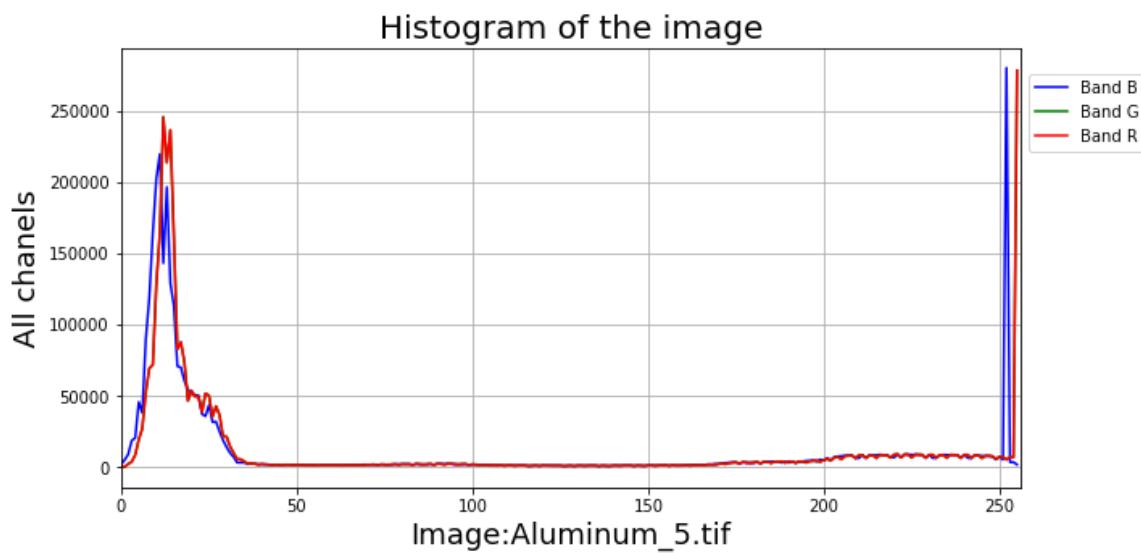
Matplot Histogram for File: Aluminum_4.tif

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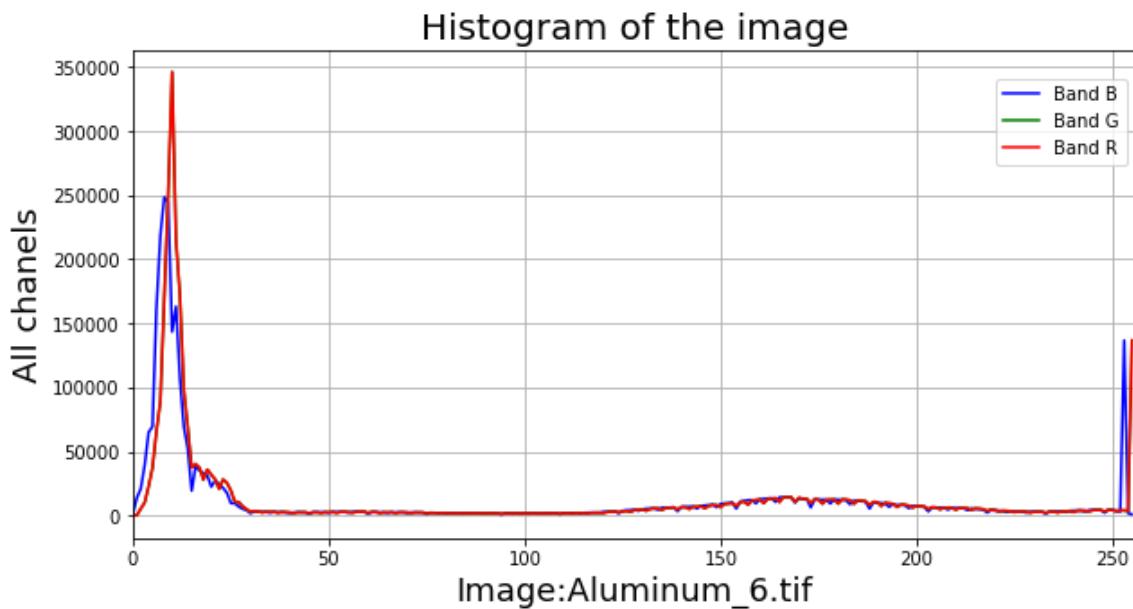
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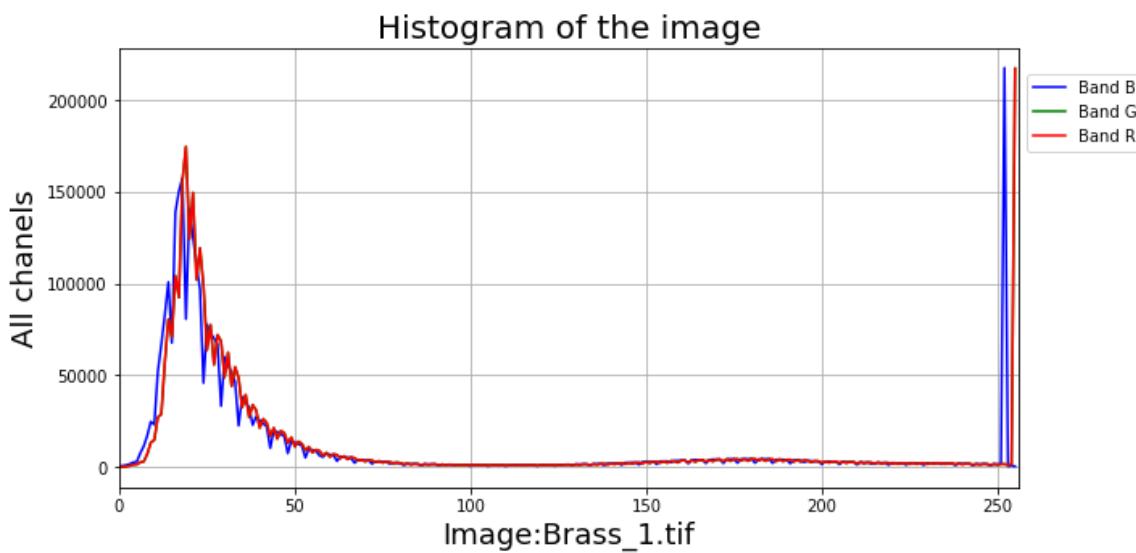
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Matplot Histogram for File: Brass_1.tif

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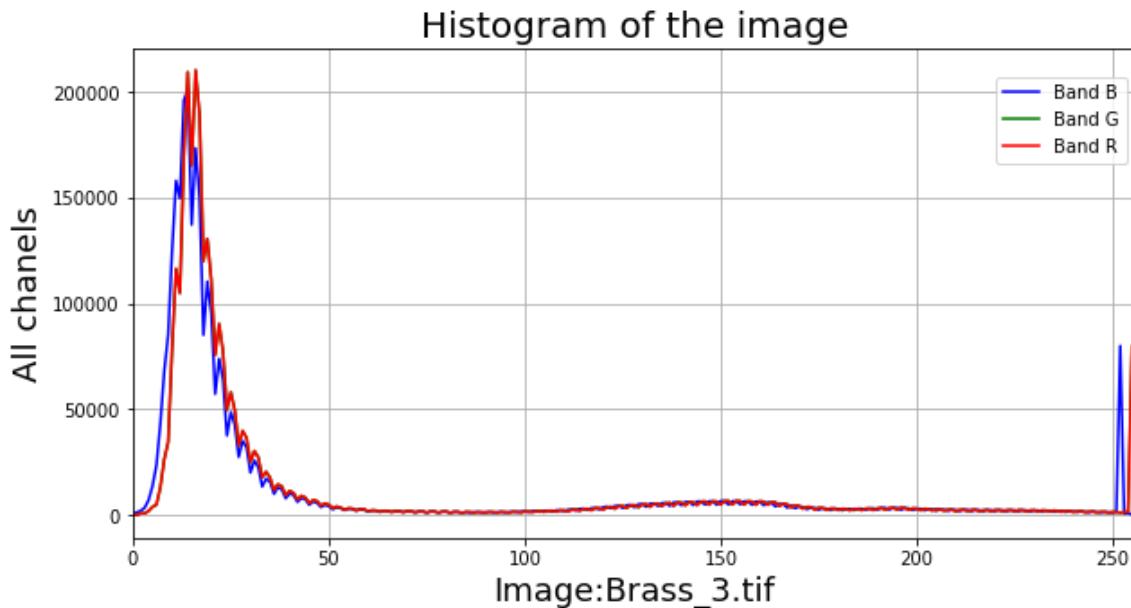
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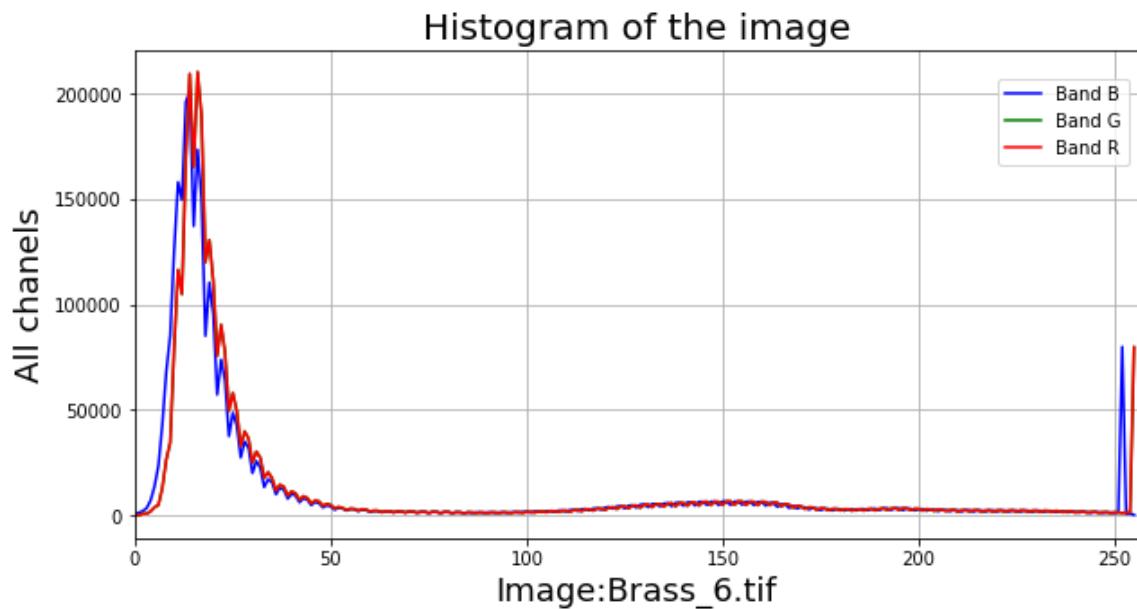
Matplot Histogram for File: Brass_5.tif

Matplot Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Brass_5.tif



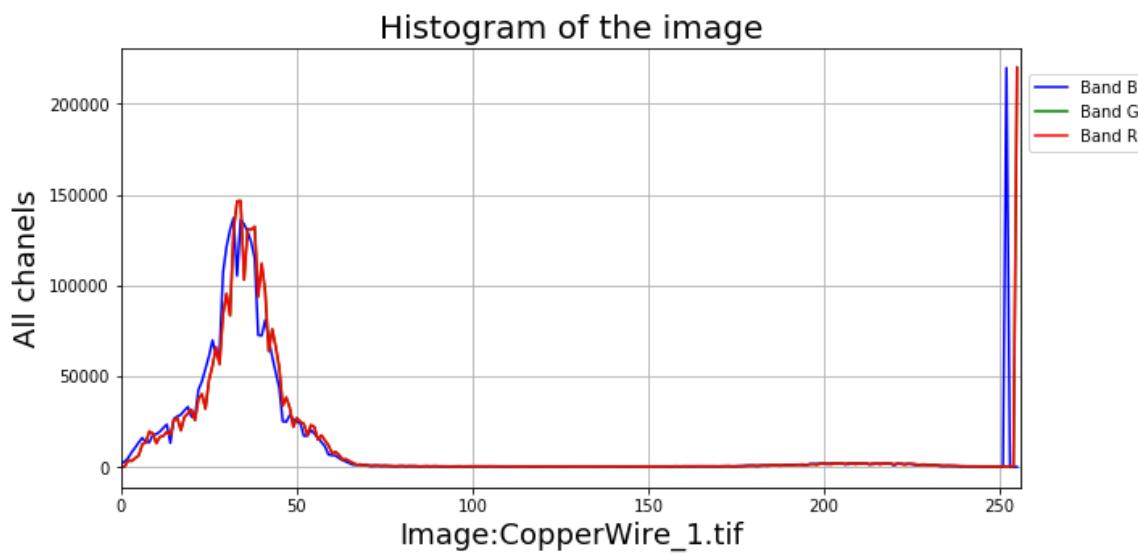
Matplot Histogram for File: Brass_6.tif

Matplot Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Brass_6.tif



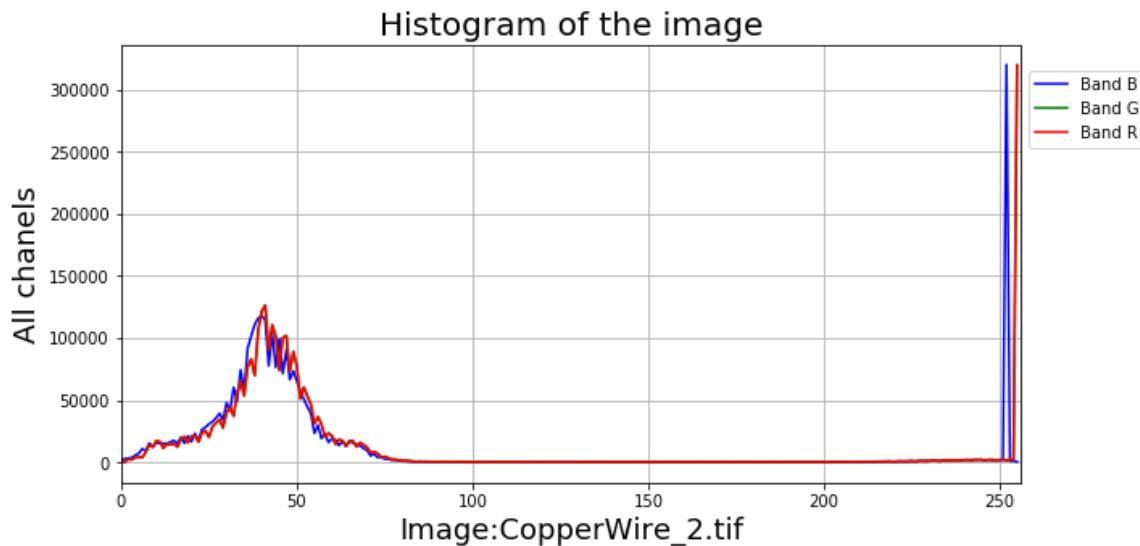
Matplot Histogram for File: CopperWire_1.tif

Matplot Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portuguese\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/CopperWire_1.tif



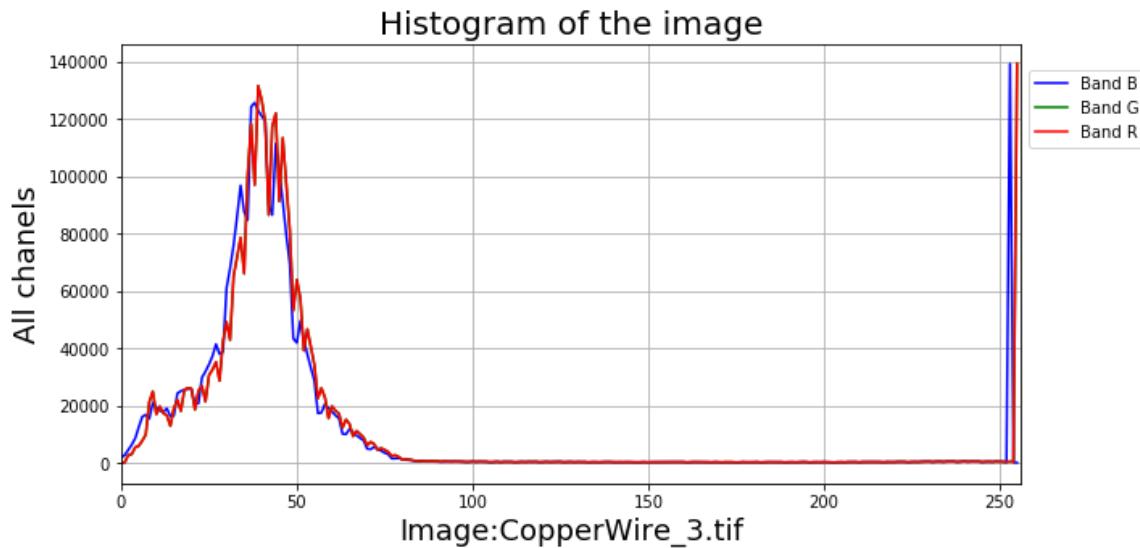
Matplot Histogram for File: CopperWire_2.tif

Matplot Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portuguese\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/CopperWire_2.tif



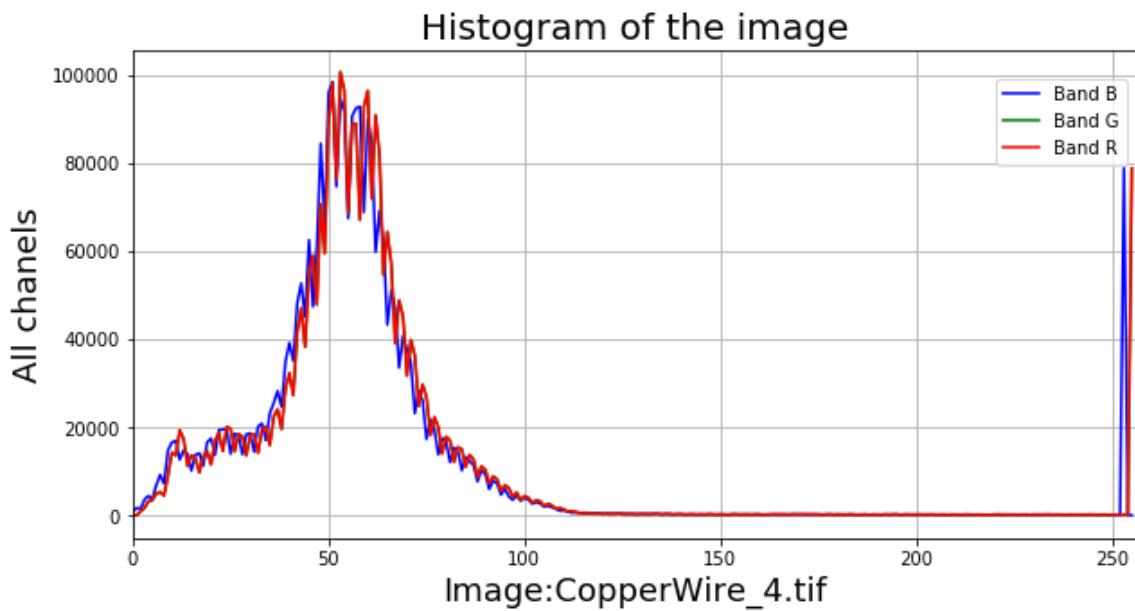
Matplot Histogram for File: CopperWire_3.tif

Matplot Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/CopperWire_3.tif



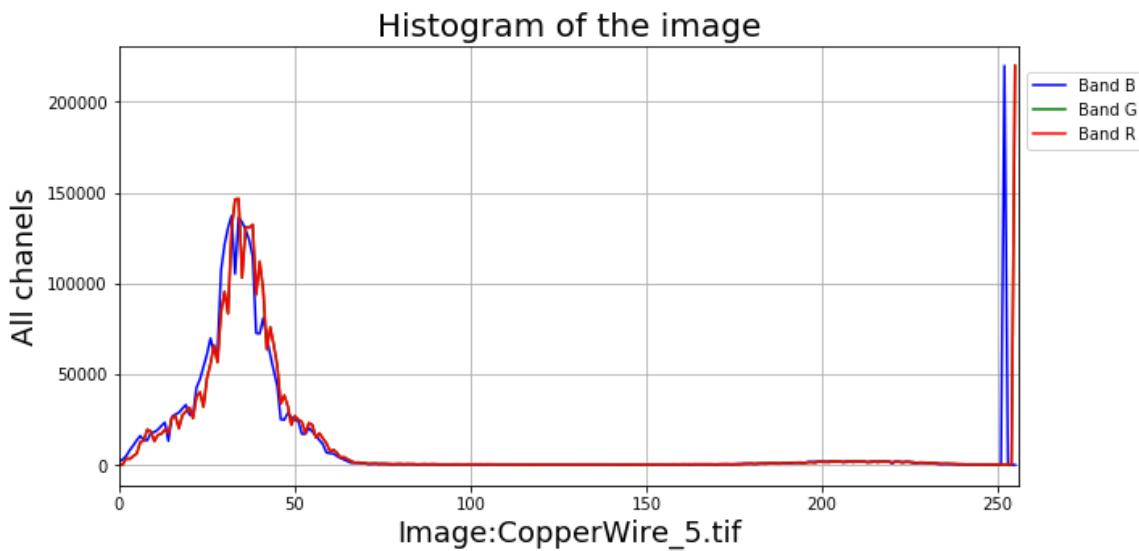
Matplot Histogram for File: CopperWire_4.tif

Matplot Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/CopperWire_4.tif



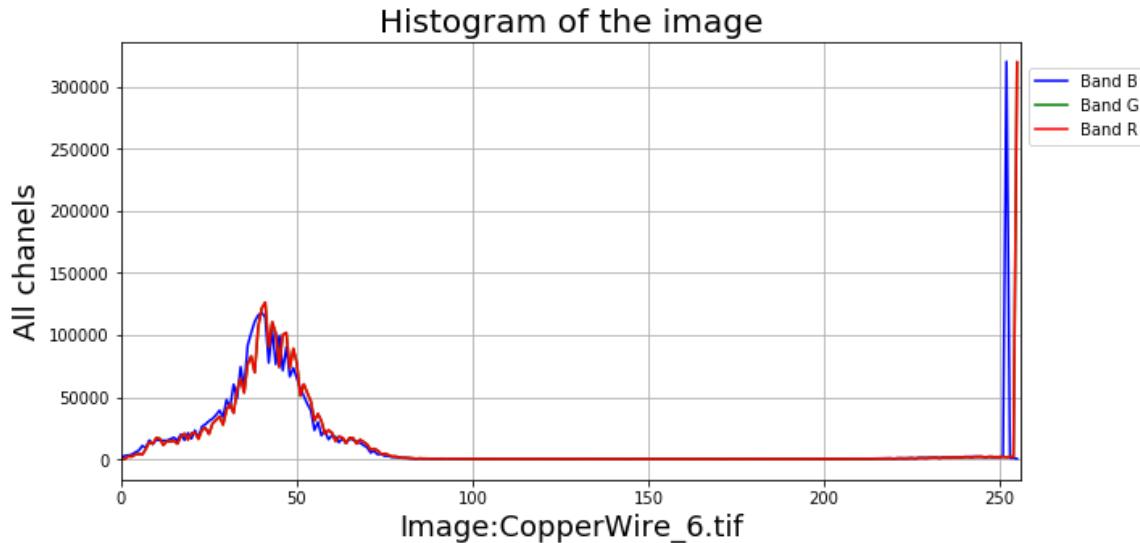
Matplot Histogram for File: CopperWire_5.tif

Matplot Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portuguese\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/CopperWire_5.tif



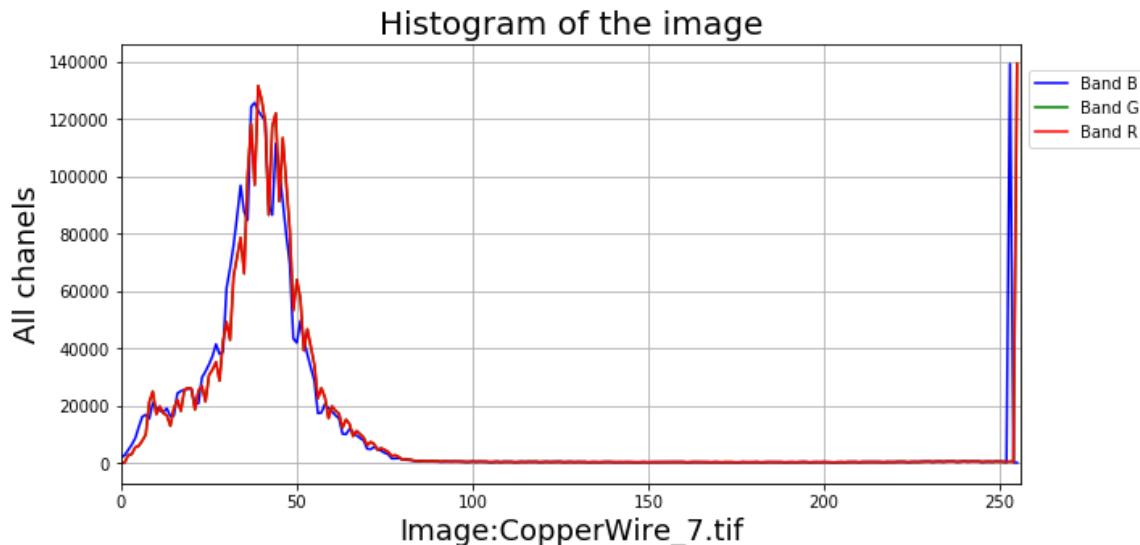
Matplot Histogram for File: CopperWire_6.tif

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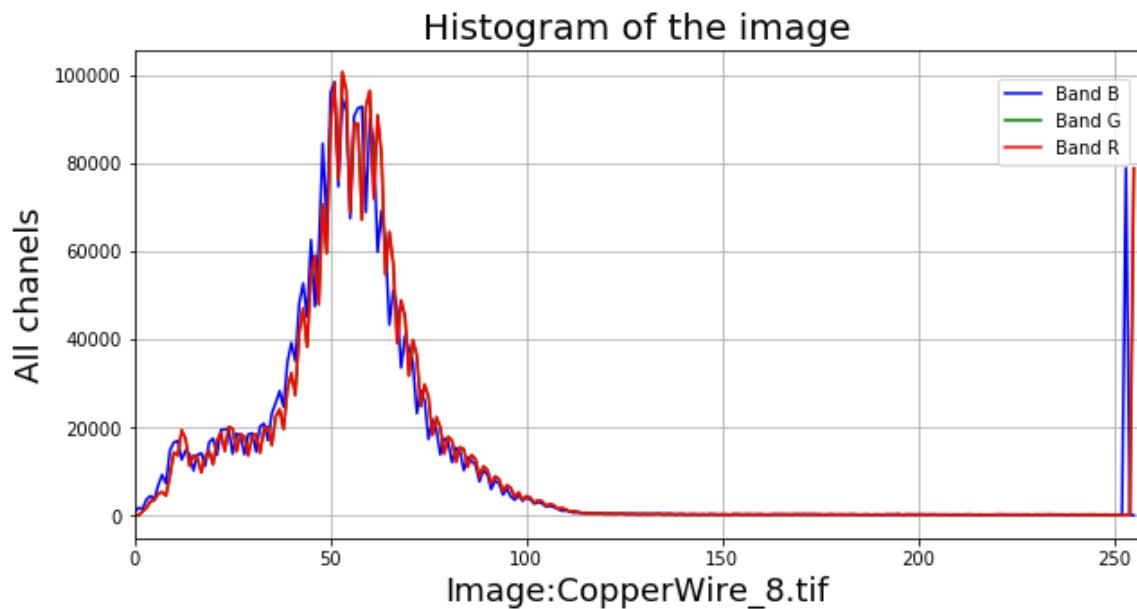
Matplot Histogram for File: CopperWire_7.tif

Matplot Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/CopperWire_7.tif



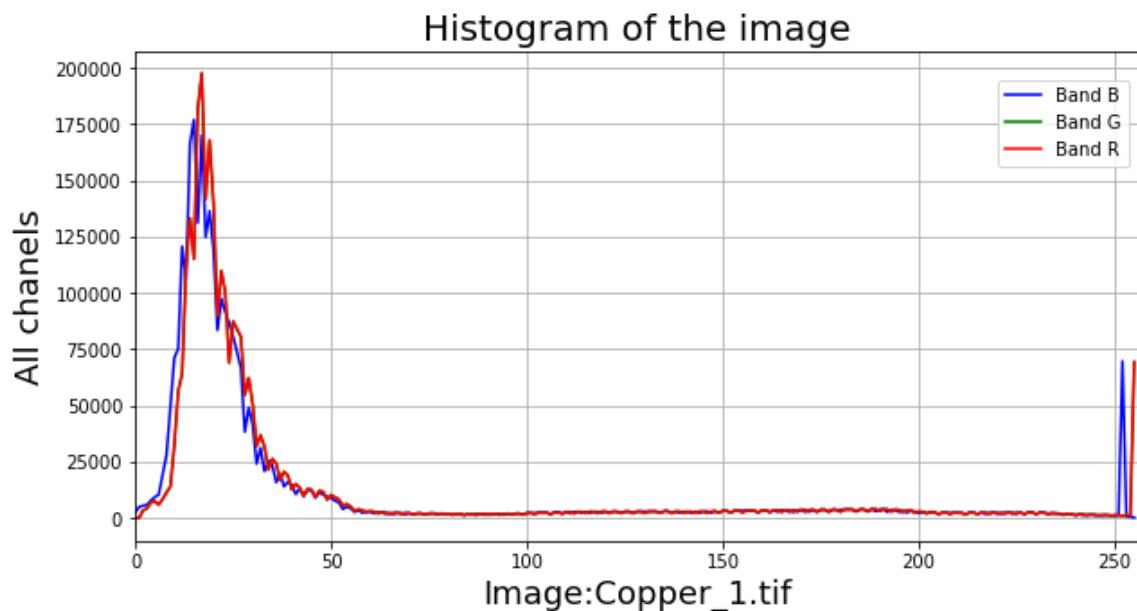
Matplot Histogram for File: CopperWire_8.tif

Matplot Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/CopperWire_8.tif



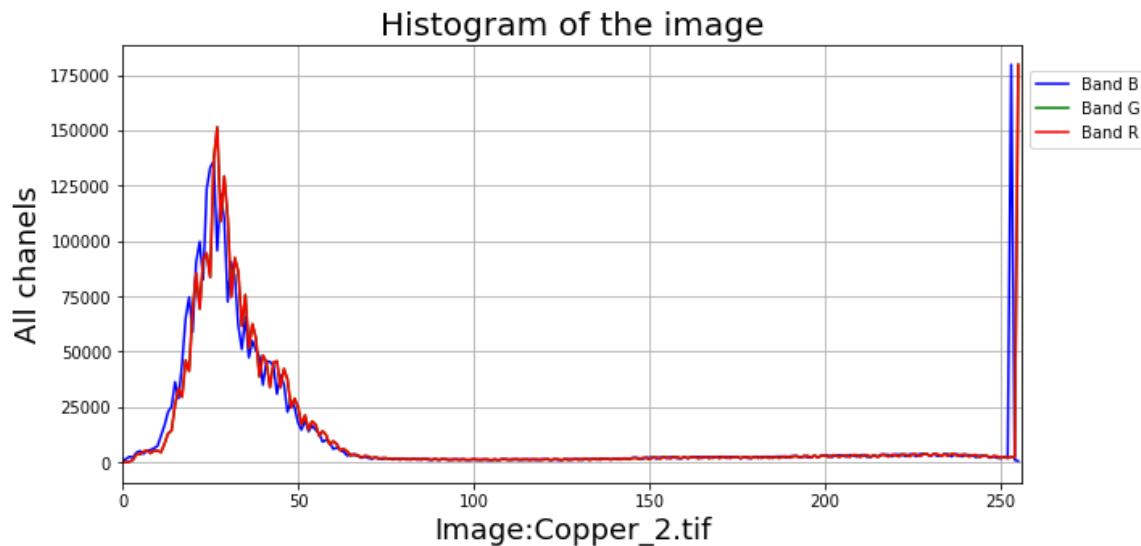
Matplot Histogram for File: Copper_1.tif

Matplot Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portuguese\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Copper_1.tif



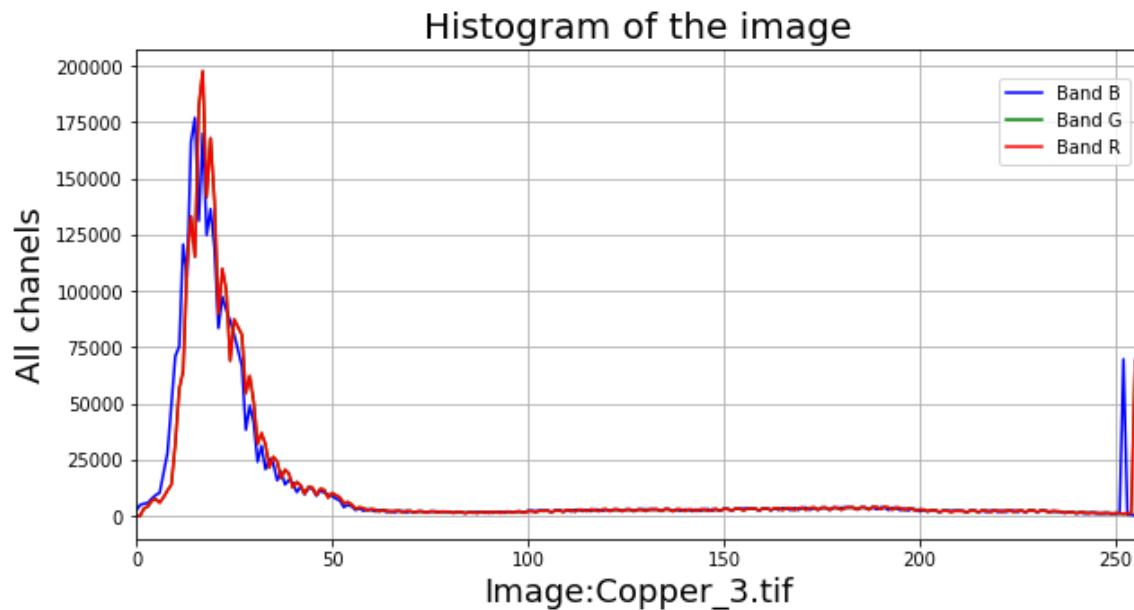
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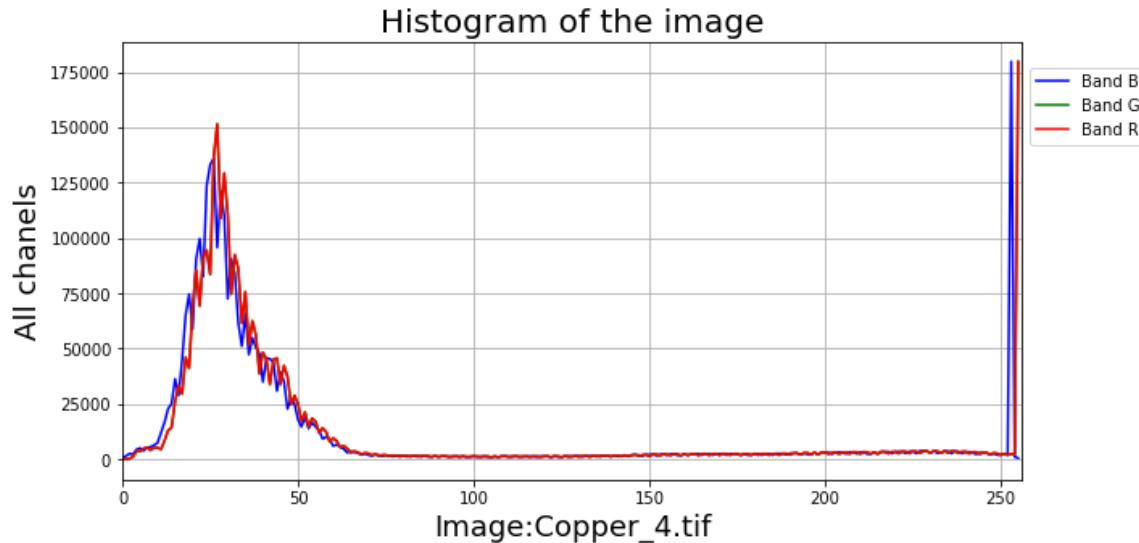
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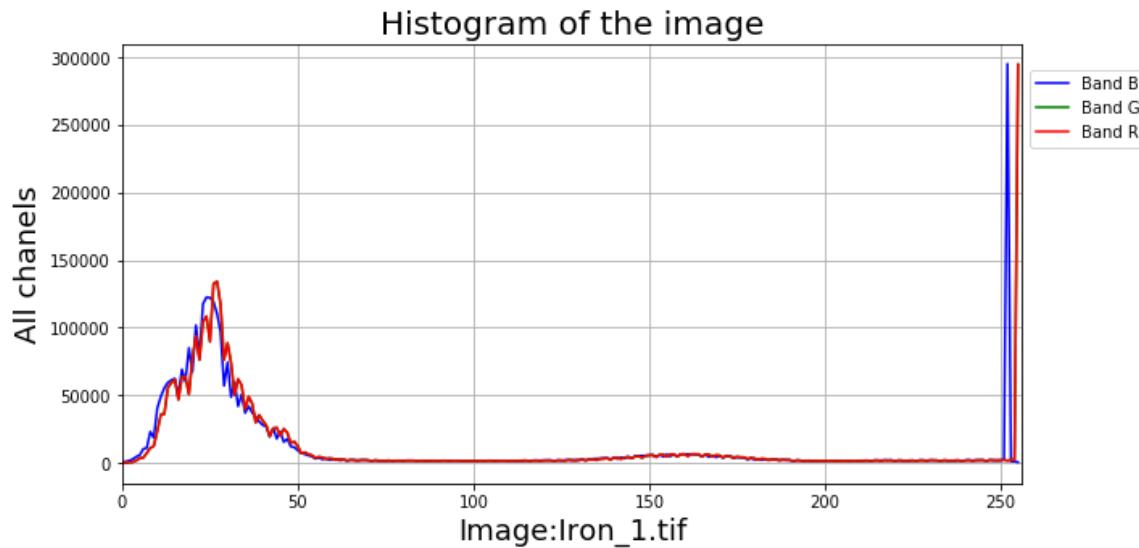
Matplot Histogram for File: Copper_4.tif

Matplot Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Copper_4.tif



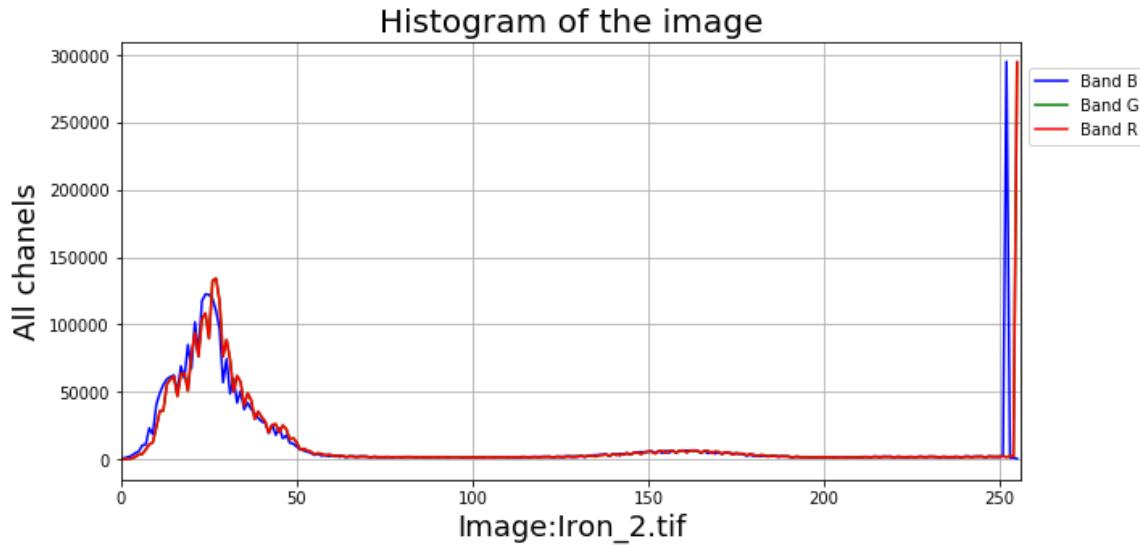
Matplot Histogram for File: Iron_1.tif

Matplot Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Iron_1.tif



Matplot Histogram for File: Iron_2.tif

Matplot Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Iron_2.tif



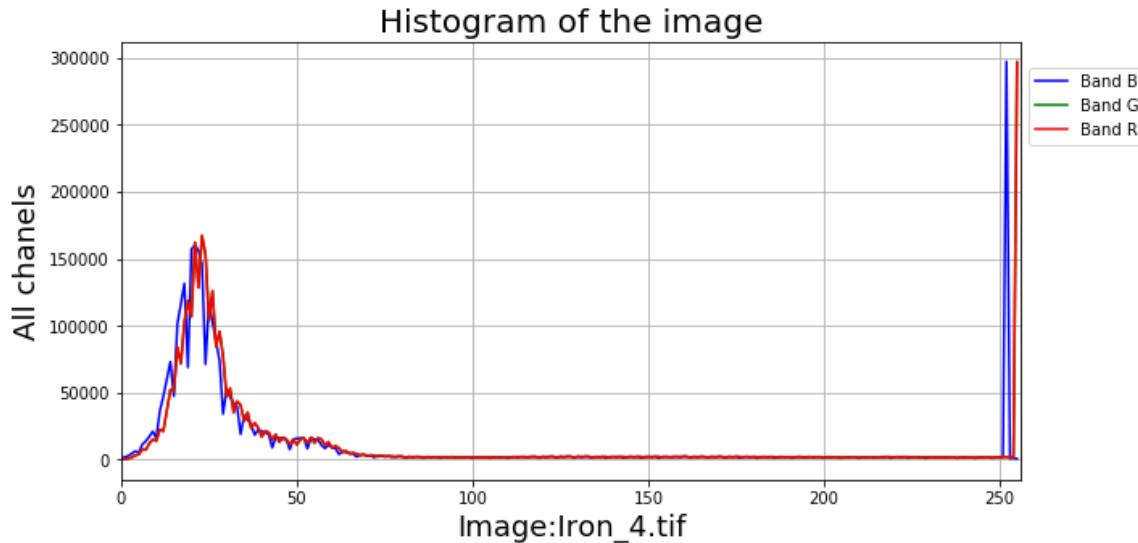
Matplot Histogram for File: Iron_3.tif

Matplot Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/Iron_3.tif



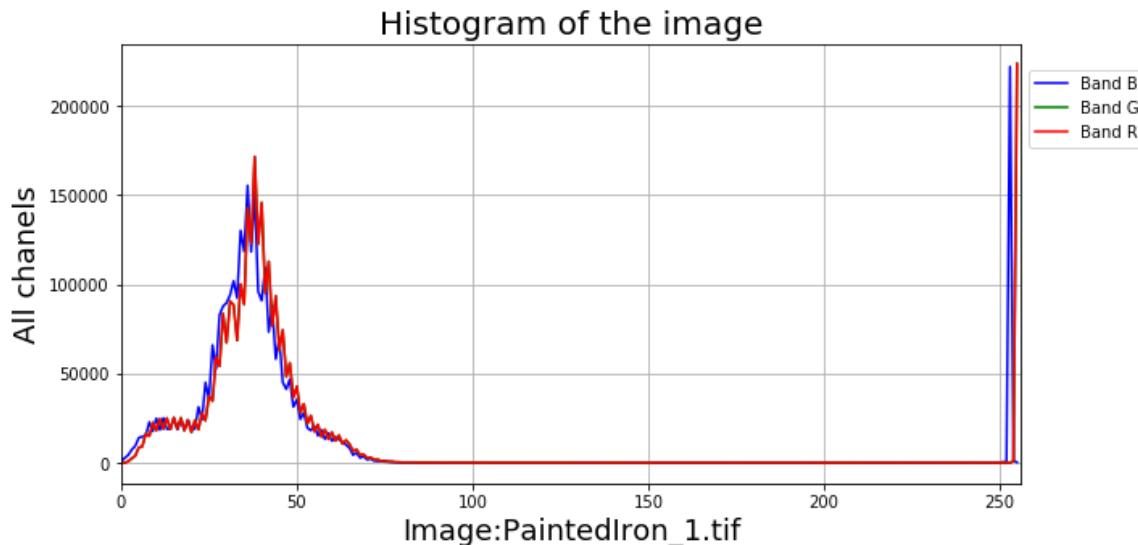
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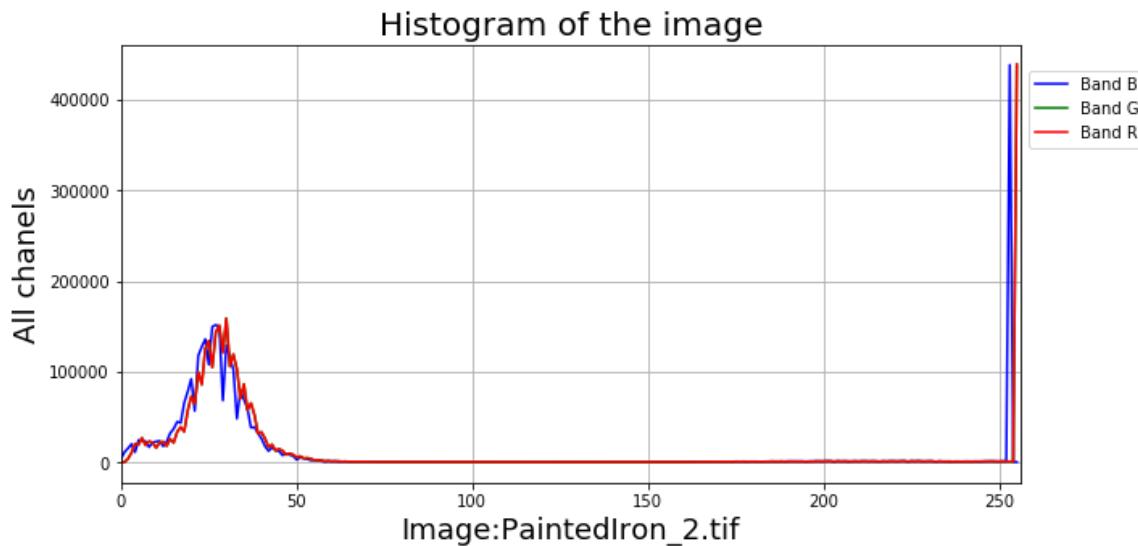
Matplot Histogram for File: PaintedIron_1.tif

Matplot Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/PaintedIron_1.tif



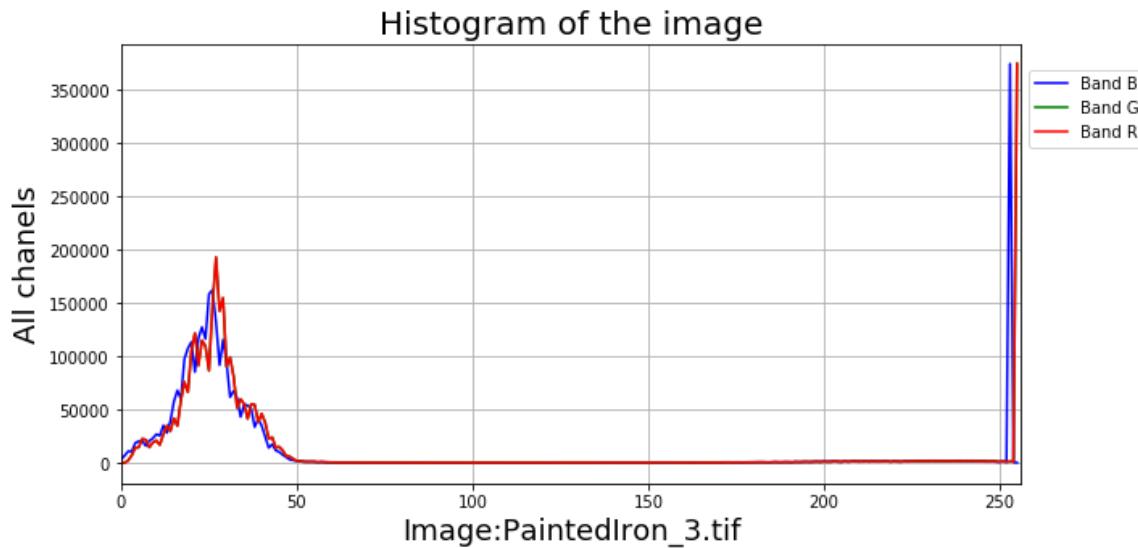
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Matplot Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/PaintedIron_2.tif



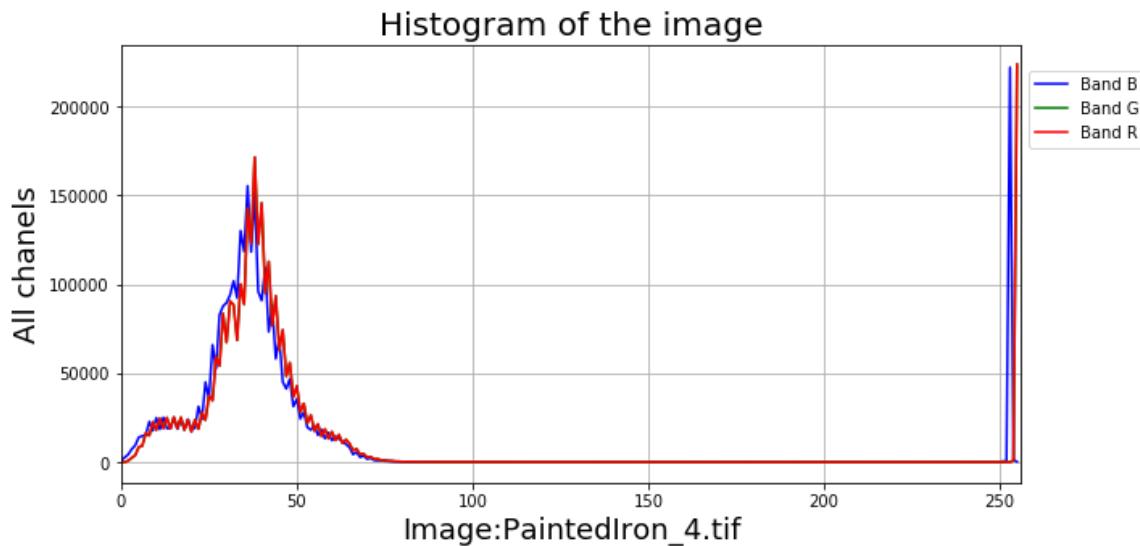
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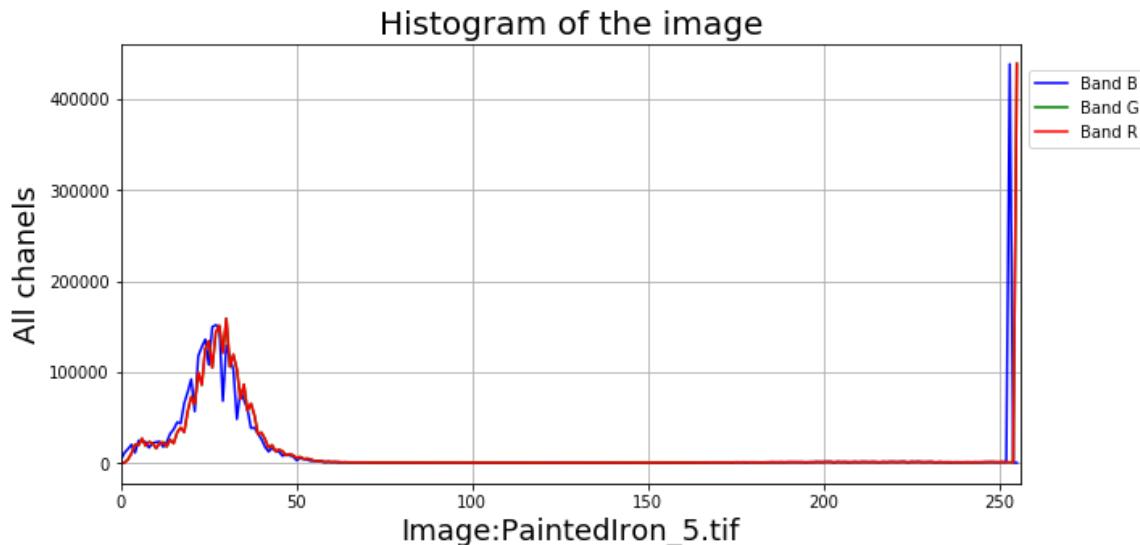
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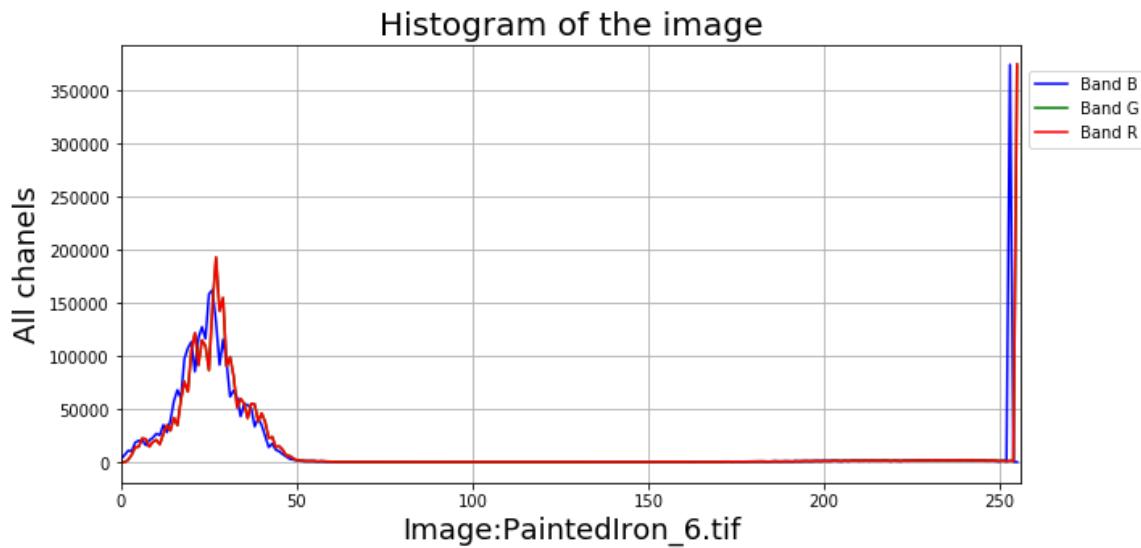
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Matplot Histogram for File: PaintedIron_6.tif

Matplot Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/PaintedIron_6.tif



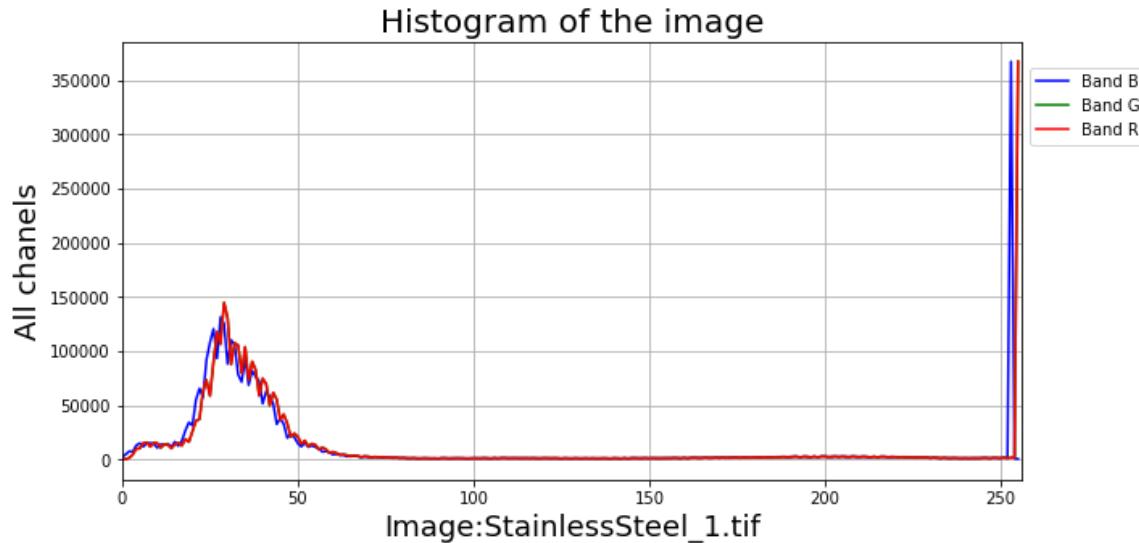
Matplot Histogram for File: PaintedIron_7.tif

Matplot Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/PaintedIron_7.tif



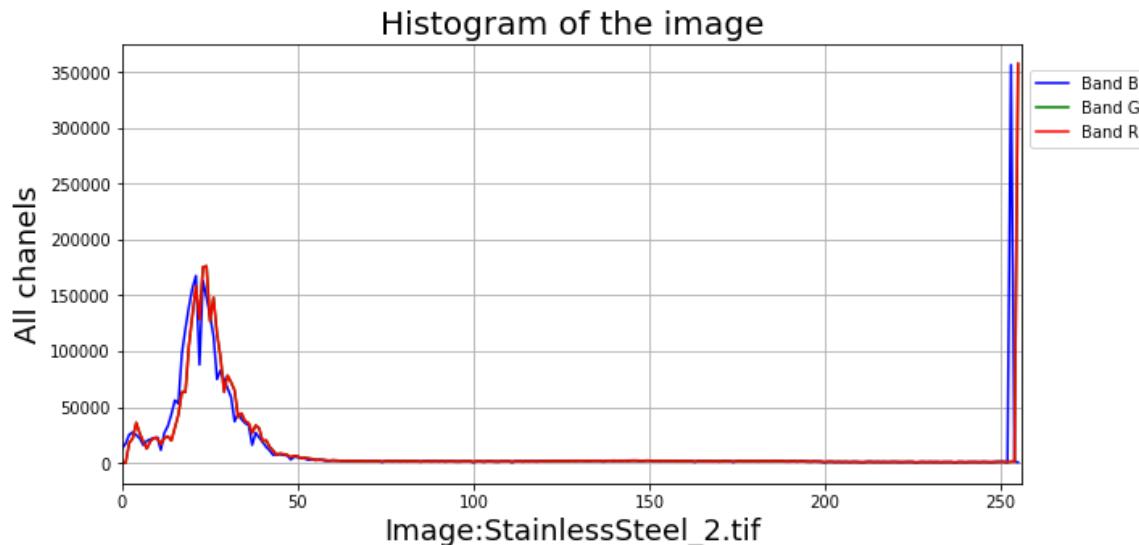
Matplot Histogram for File: StainlessSteel_1.tif

Matplot Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/StainlessSteel_1.tif



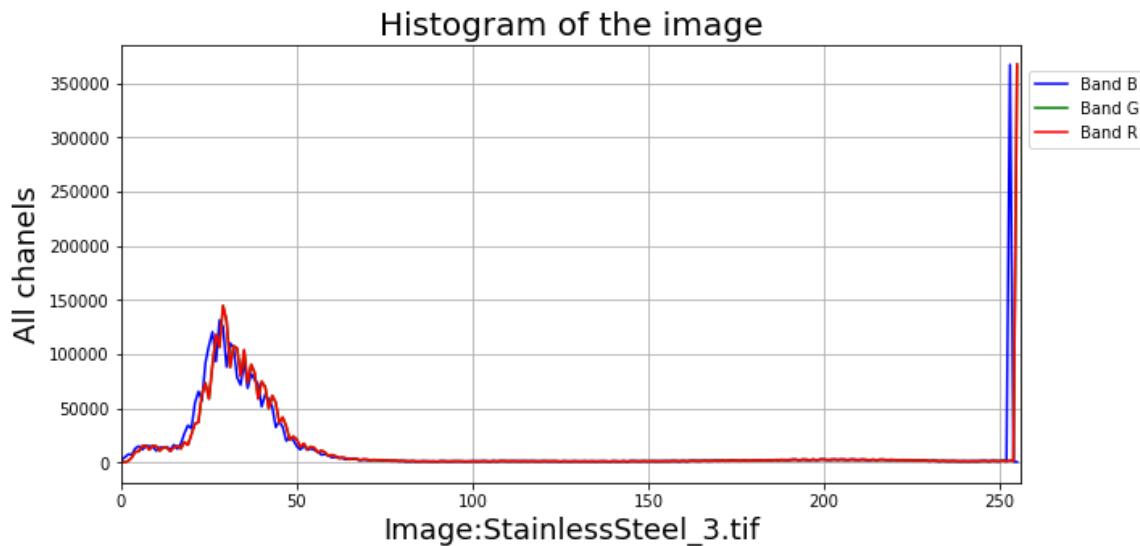
Matplot Histogram for File: StainlessSteel_2.tif

Matplot Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/StainlessSteel_2.tif



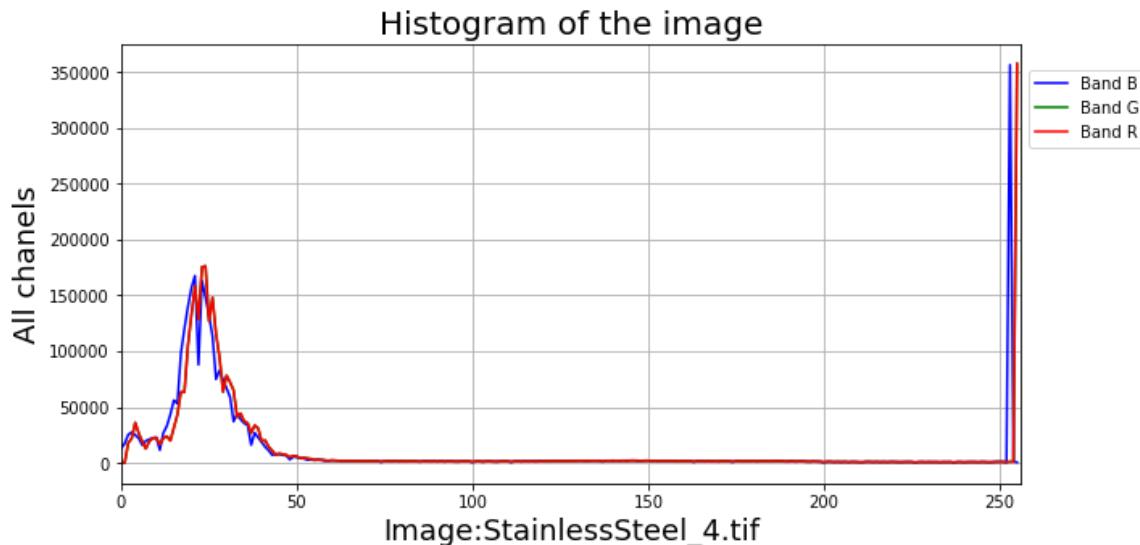
Matplot Histogram for File: StainlessSteel_3.tif

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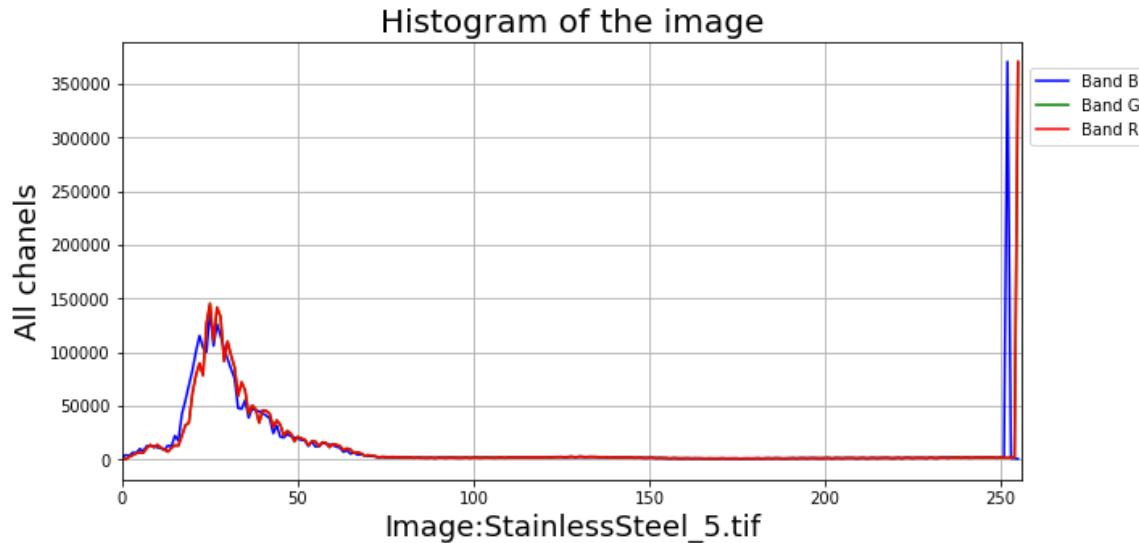
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Matplot Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/StainlessSteel_4.tif



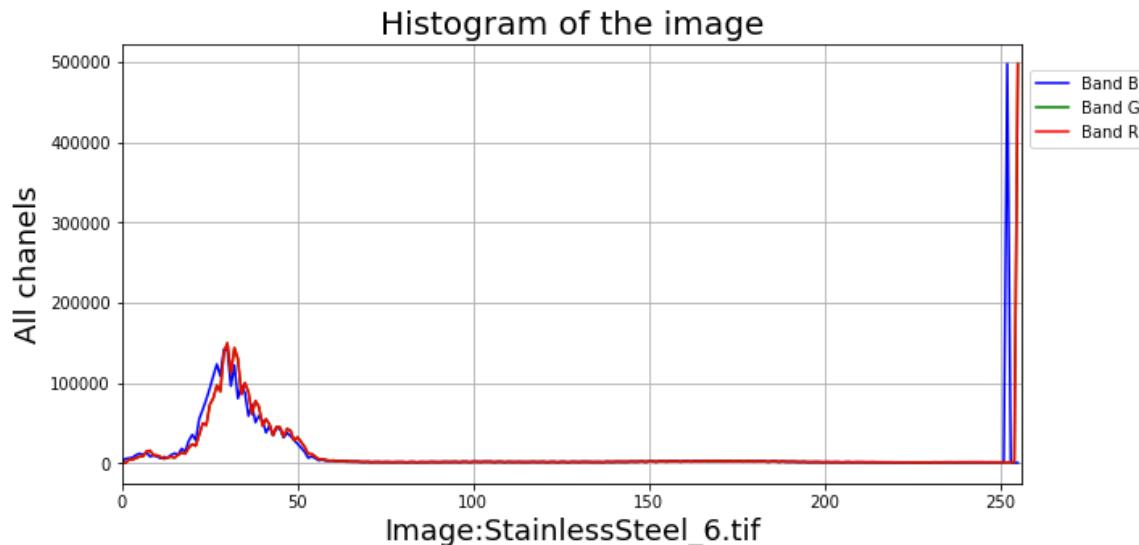
Matplot Histogram for File: StainlessSteel_5.tif

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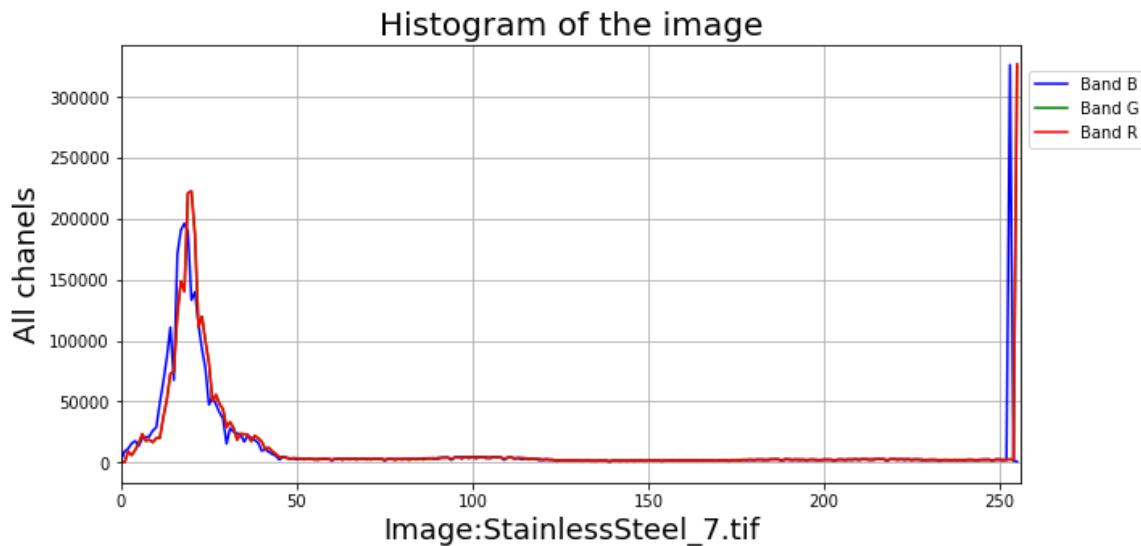
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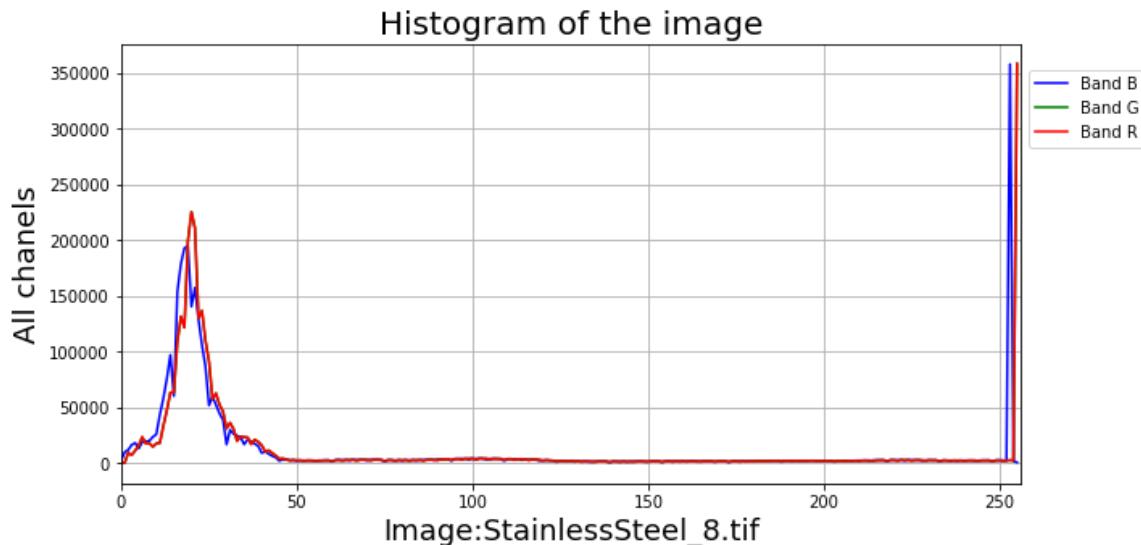
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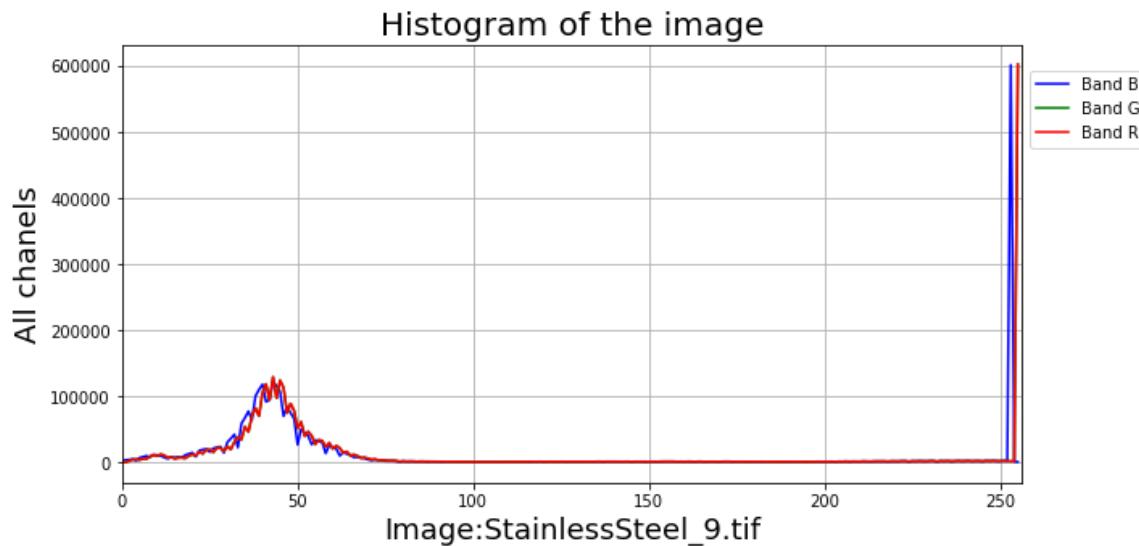
Matplot Histogram for File: StainlessSteel_8.tif

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Matplot Histogram for File: StainlessSteel_9.tif

Matplot Hist from file: C:\Users\manuel.robalinho\Google Drive\UPT_Portugalense\Trabalho final\Classificacao_Sucata\Jupyter_Notebook/imagedata06/StainlessSteel_9.tif



In [67]:

```
print('Finished')
```

Finished

In []: