image_difference_1

February 11, 2019

11 Feb 2019

1 Difference between two Nikon NEF images

In [1]:
```
# Packages
import numpy as np
import matplotlib.pyplot as plt
```

In [2]:
```
# Packages
import rawpy
import PIL

# Open RAW image
nef1 = rawpy.imread('Images/_DSC4576.NEF')
nef2 = rawpy.imread('Images/_DSC4577.NEF')

# Process RAW image
#img0 = raw0.postprocess(use_camera_wb=True)
#img1 = raw1.postprocess(use_camera_wb=True)
img1 = nef1.postprocess(no_auto_bright=True, use_auto_wb =False, gamma=None
img2 = nef2.postprocess(no_auto_bright=True, use_auto_wb =False, gamma=None

# Close RAW image
nef1.close()
nef2.close()

# Save processed image
PIL.Image.fromarray(img1).save('Output/img1.jpg', quality=90, optimize=True
PIL.Image.fromarray(img2).save('Output/img2.jpg', quality=90, optimize=True
```

In [3]:
```
# Characteristics of processed data
print(type(img1))
print(img1.dtype)
print(img1.shape)
print(img1.min(), img1.max())
```

```
<class 'numpy.ndarray'>
uint8
```

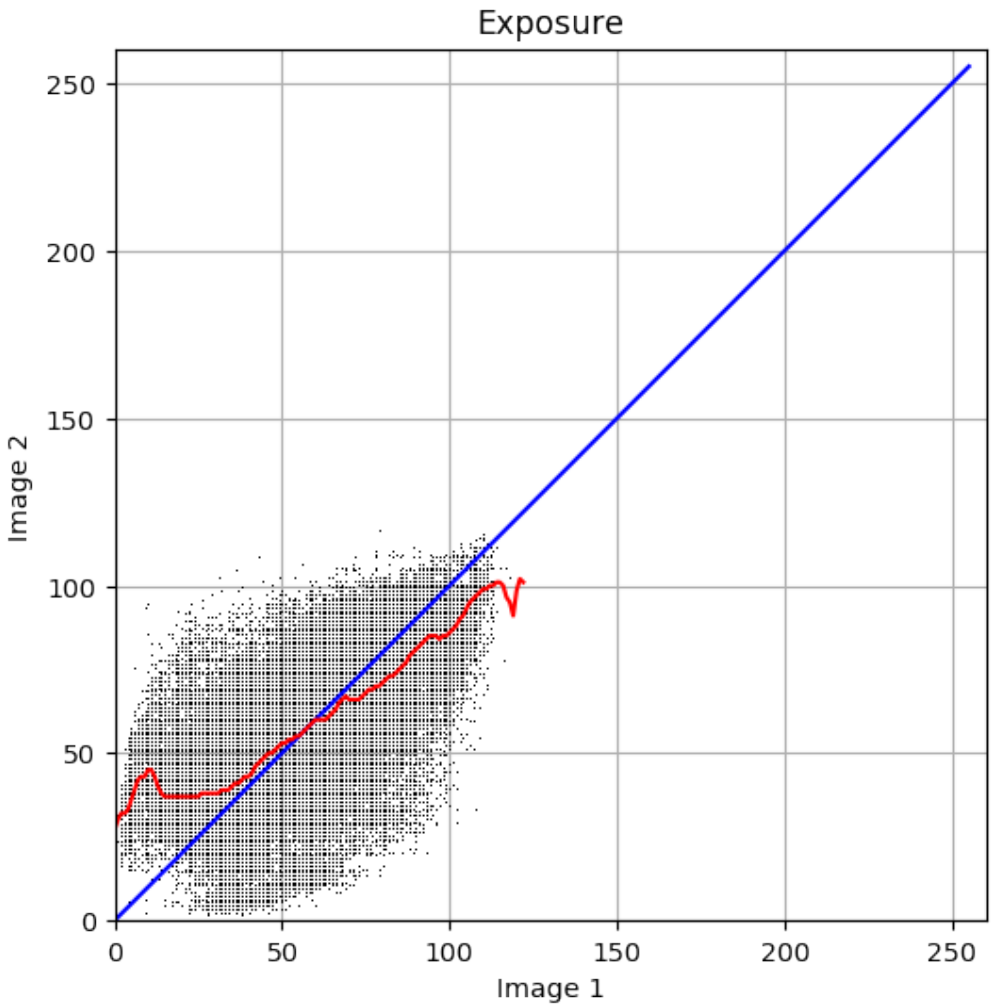
```
(2868, 4310, 3)
0 188
```

In [4]:
```
x1 = img1.flatten()
x2 = img2.flatten()

# Compute median
x2_median = np.zeros(256)
for i in np.arange(256):
    n = np.size(x1[x1 == i])
    if n > 10:
        x2_median[i] = np.median(x2[x1 == i])
    else:
        x2_median[i] = np.nan
```

In [5]:
```
# Random sample
n = np.size(x1)
idx = np.random.randint(0, high=n, size=100000)
```

In [6]:
```
# Figure dimensions
fig_width = 6
fig_height = fig_width * img1.shape[0] / img1.shape[1]

# Display figure
fig, ax = plt.subplots(1, 1)

fig.set_size_inches(fig_width, fig_width)
fig.dpi = 102

line1, = ax.plot(x1[idx], x2[idx])
line1.set_linestyle('None')
line1.set_marker(',')
line1.set_markeredgecolor('black')
line1.set_markerfacecolor('black')
line1.set_markersize(2)

line2, = ax.plot([0, 255], [0, 255])
line2.set_linestyle('solid')
line2.set_color("blue")
line2.set_marker('None')

line3, = ax.plot(np.arange(256), x2_median)
line3.set_linestyle('solid')
line3.set_color("red")
line3.set_marker('None')

ax.set_xlabel('Image 1')
```

```
ax.set_ylabel('Image 2')
ax.set_title('Exposure')
ax.set_xlim([0, 260])
ax.set_ylim([0, 260])
ax.grid(b=True)
ax.set_aspect('equal')

plt.show()
```

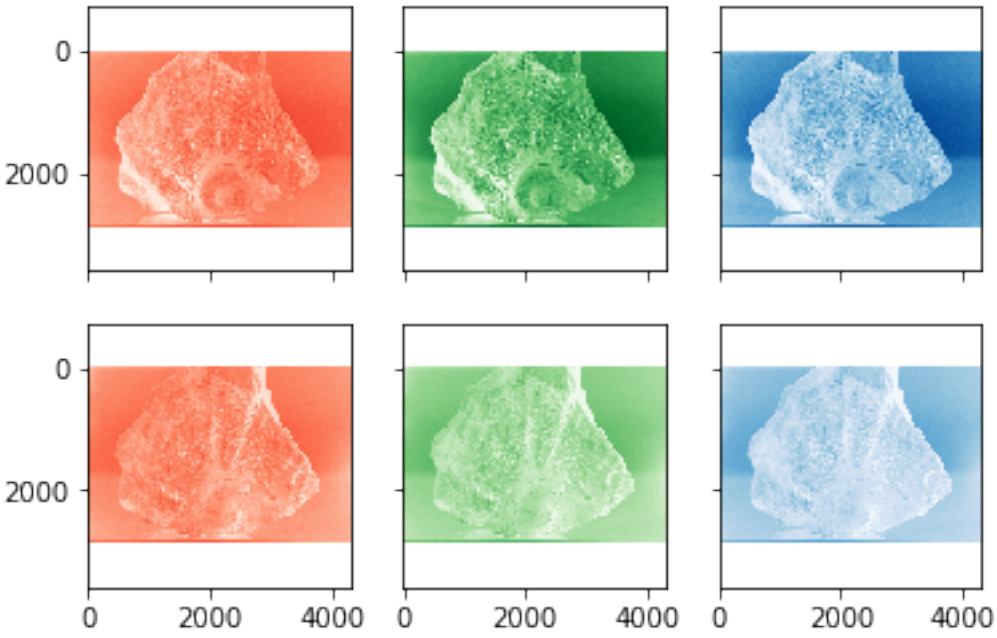


In [7]:
```
# Figure dimensions
fig_width = 6
fig_height = fig_width * img1.shape[0] / img1.shape[1]

# Display figure
fig, axs = plt.subplots(2, 1)
fig.set_size_inches(fig_width, 2 * fig_height)
```

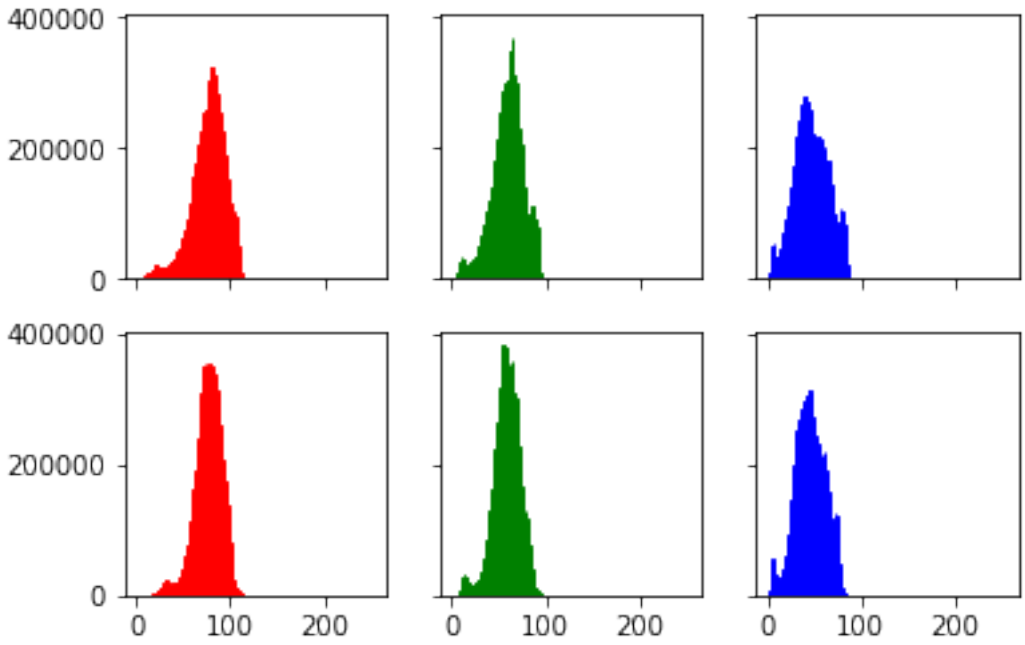
```
fig.dpi = 102
_ = axs[0].imshow(img1)
_ = axs[1].imshow(img2)
fig.tight_layout()
for ax in axs:
    ax.axis('off')
plt.show()
```

In [8]:
```
# Display figure: RGB layers
fig, ax = plt.subplots(2, 3, sharex=True, sharey=True)
_ = ax[0, 0].imshow(img1[:, :, 0], cmap='Reds')
```

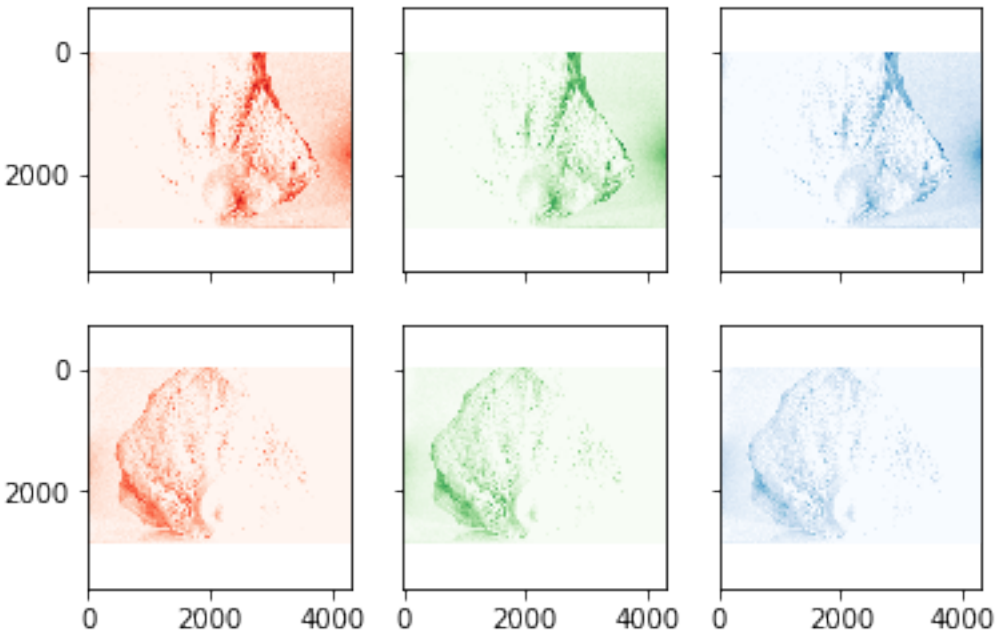
```
_ = ax[0, 1].imshow(img1[:, :, 1], cmap='Greens')
_ = ax[0, 2].imshow(img1[:, :, 2], cmap='Blues')
_ = ax[1, 0].imshow(img2[:, :, 0], cmap='Reds')
_ = ax[1, 1].imshow(img2[:, :, 1], cmap='Greens')
_ = ax[1, 2].imshow(img2[:, :, 2], cmap='Blues')

plt.show()
```



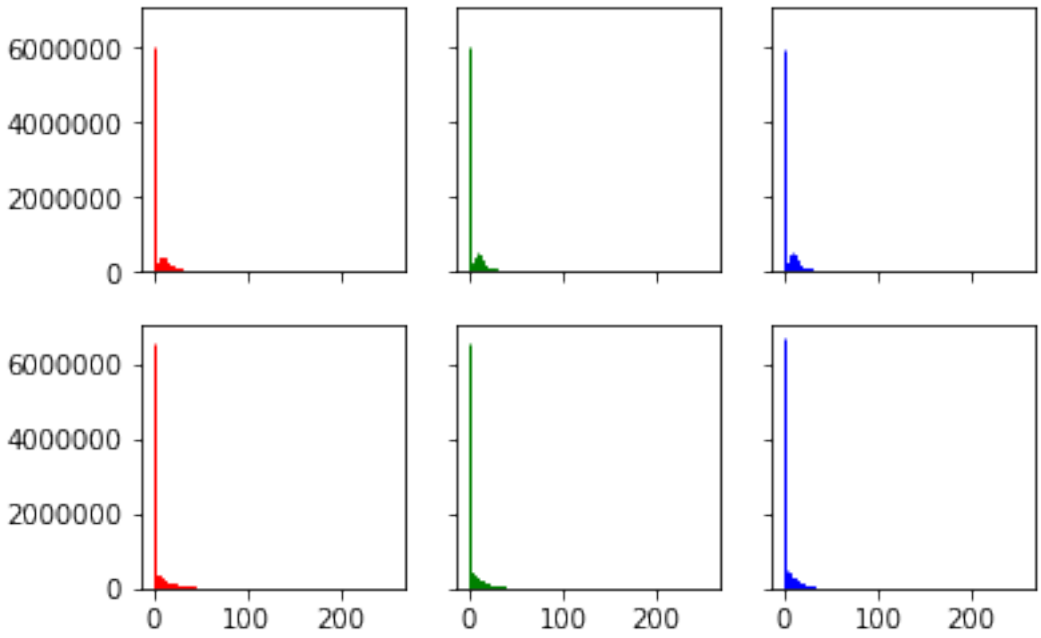
In [9]:
```
# Plot histogram
fig, ax = plt.subplots(2, 3, sharex=True, sharey=True)
_ = ax[0, 0].hist(img1[:, :, 0].ravel(), bins=256, range=(0, 255), fc='r',
_ = ax[0, 1].hist(img1[:, :, 1].ravel(), bins=256, range=(0, 255), fc='g',
_ = ax[0, 2].hist(img1[:, :, 2].ravel(), bins=256, range=(0, 255), fc='b',
_ = ax[1, 0].hist(img2[:, :, 0].ravel(), bins=256, range=(0, 255), fc='r',
_ = ax[1, 1].hist(img2[:, :, 1].ravel(), bins=256, range=(0, 255), fc='g',
_ = ax[1, 2].hist(img2[:, :, 2].ravel(), bins=256, range=(0, 255), fc='b',

# Display
plt.show()
```




```
In [10]: # Difference
         img12 = img1 - img2
         img12[img1 < img2] = 0

         img21 = img2 - img1
         img21[img2 < img1] = 0

In [11]: # RGB layers

         # Display figure:
         fig, ax = plt.subplots(2, 3, sharex=True, sharey=True)
         _ = ax[0, 0].imshow(img12[:, :, 0], cmap='Reds')
         _ = ax[0, 1].imshow(img12[:, :, 1], cmap='Greens')
         _ = ax[0, 2].imshow(img12[:, :, 2], cmap='Blues')
         _ = ax[1, 0].imshow(img21[:, :, 0], cmap='Reds')
         _ = ax[1, 1].imshow(img21[:, :, 1], cmap='Greens')
         _ = ax[1, 2].imshow(img21[:, :, 2], cmap='Blues')

         plt.show()
```




```
In [12]: # Plot histogram
         fig, ax = plt.subplots(2, 3, sharex=True, sharey=True)
         _ = ax[0, 0].hist(img12[:, :, 0].ravel(), bins=256, range=(0, 255), fc='r'
         _ = ax[0, 1].hist(img12[:, :, 1].ravel(), bins=256, range=(0, 255), fc='g'
         _ = ax[0, 2].hist(img12[:, :, 2].ravel(), bins=256, range=(0, 255), fc='b'
         _ = ax[1, 0].hist(img21[:, :, 0].ravel(), bins=256, range=(0, 255), fc='r'
         _ = ax[1, 1].hist(img21[:, :, 1].ravel(), bins=256, range=(0, 255), fc='g'
         _ = ax[1, 2].hist(img21[:, :, 2].ravel(), bins=256, range=(0, 255), fc='b'

         # Display
         plt.show()
```




```
In [13]: # Add difference images
         img3 = img12 + img21

In [14]: # Save processed image
         PIL.Image.fromarray(img3).save('Output/img3.jpg', quality=90, optimize=Tru

In [15]: # Figure dimensions
         fig_width = 6
         fig_height = fig_width * img3.shape[0] / img3.shape[1]

         # Display figure
         fig, axs = plt.subplots(2, 1)
         fig.set_size_inches(fig_width, 2.2 * fig_height)
         fig.dpi = 102
         _ = axs[0].imshow(img12)
         _ = axs[1].imshow(img21)
         fig.tight_layout
         axs[0].set_title("Difference: image 1 - image 2")
         axs[1].set_title("Difference: image 2 - image 1")
         for ax in axs:
             ax.axis('off')
         plt.show()
```

Difference: image 1 - image 2

Difference: image 2 - image 1

```
In [16]: # Figure dimensions
         fig_width = 6
         fig_height = fig_width * img3.shape[0] / img3.shape[1]

         # Display figure
```

```
fig, ax = plt.subplots(1, 1)
fig.set_size_inches(fig_width, fig_height)
fig.dpi = 102
_ = ax.imshow(img3)
ax.set_title("Difference (superimposed)")
ax.axis('off')
plt.show()
```