Biomedical Image Processing: Processing images in GrayScale

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SFU

Determining FOV: Intuition

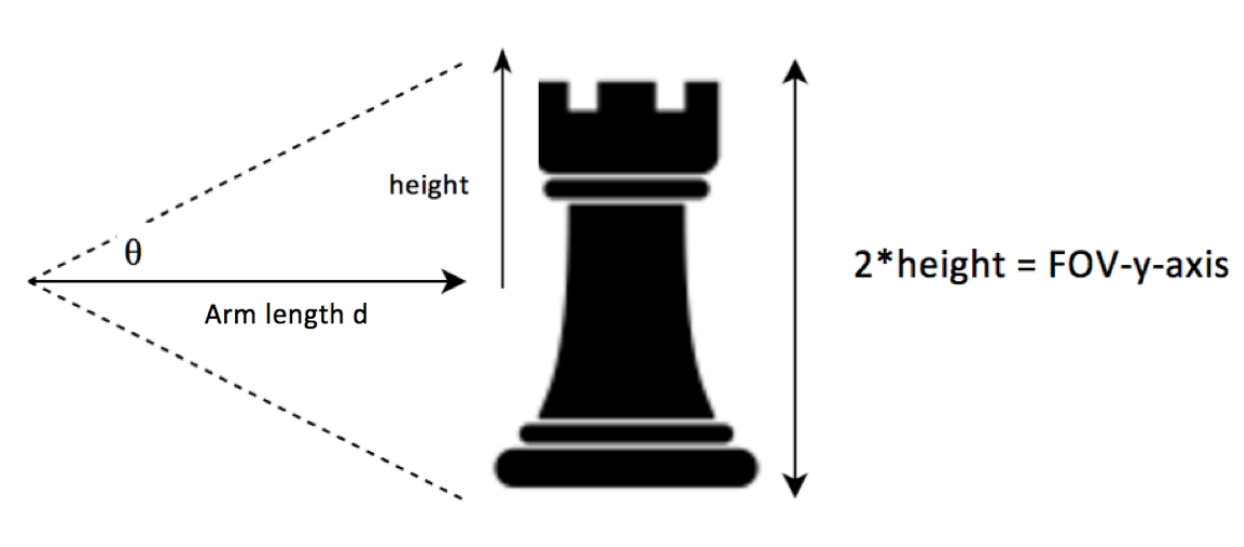

Figure 1: Selfie FOV illustration

Estimated Arm length d = 360 mm
Estimated θ for iPhone 5 front facing camera = 27° since the iPhone 5 lens has a 54° FOV as found on: https://www.boinx.com/chronicles/2013/3/22/field-of-view-fov-of-cameras-in-ios-devices/

Determining FOV: Calculations

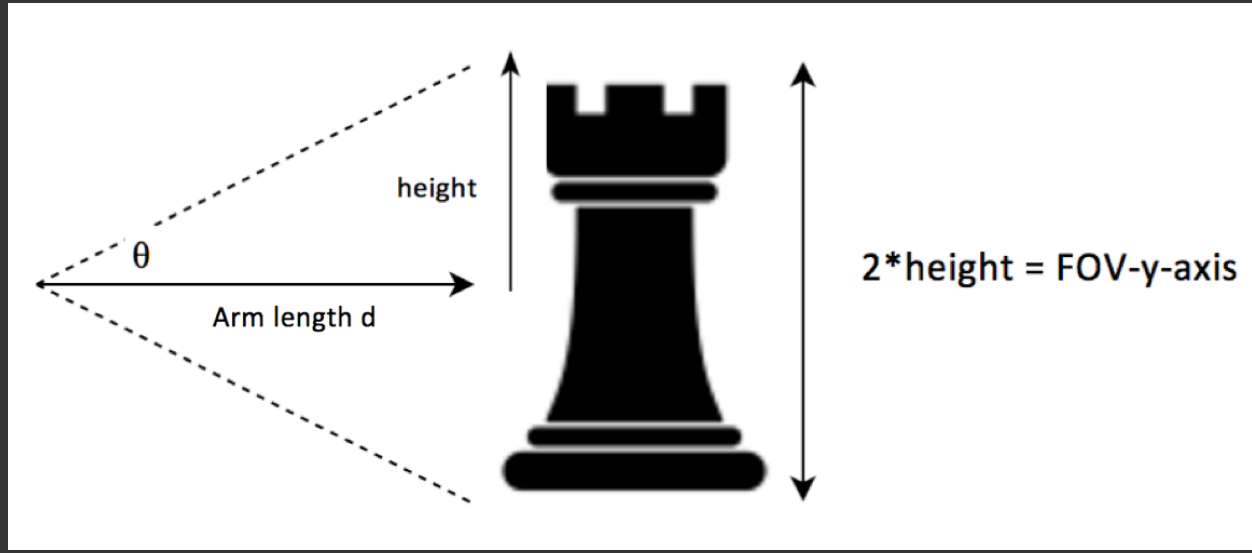

Figure 1: Selfie FOV illustration

Height = (Arm length d)* tanθ
= 360 * tan(27)

FOV-y-axis = 2*Height
= 2* 360 * tan(27)
= 366.85 mm

Thus, the Field of View in the vertical direction is 366.85 mm.

Determining Resolution: Intuition

- After importing the mugshot into MATLAB we know the image is 1280x960 samples
  - Total y-axis samples = $N_y = 1280$
  - Total x-axis samples = $N_x = 960$

- From part 1 we know our FOV-y-axis is 366.85mm therefore we can calculate the FOV-x-axis in mm by comparing the ratios in the x/y axis

- From there we can solve for Δx and Δy which represent the resolution in mm as depicted in lecture 2 page 2 : $\Delta x = \frac{FOV_x}{N_x}$ || $\Delta y = \frac{FOVy}{Ny}$

Determining Resolution: Calculations

$$\frac{y-axis\ resolution\ in\ mm}{x-axis\ resolutioin\ in\ mm} = \frac{366.85\ mm}{x-axis\ resolution\ in\ mm} = \frac{1280}{960}$$

Therefore, x-axis resolution in mm = $\frac{960}{1280}$*366.85 mm = 275.14 mm

$N_y = 1280 \quad N_x = 960$

$FOV_x = 275.14$ mm
$FOV_y = 366.85$ mm

Substituting $\Delta x = \frac{FOV_x}{N_x}$ || $\Delta y = \frac{FOVy}{Ny}$

$\Delta y = \frac{366.85}{1280} = 0.29$ mm
$\Delta x = \frac{275.14}{960} = 0.29$ mm

Therefore we have a resolution of 0.29 mm in both the x and y sample axis.

Number of samples in x-y dimensions

From MATLAB, we can see that there are 1280 y-samples and 960 x-samples.

```
>> info = imfinfo('mugshot1.jpg')

info =

  struct with fields:

           Filename: '/Users/luapvu/Desktop/ENSC 474/Assignments/Assi…'
        FileModDate: '08-Jan-2017 15:20:52'
           FileSize: 217890
             Format: 'jpg'
      FormatVersion: ''
              Width: 1280
             Height: 960
           BitDepth: 24
          ColorType: 'truecolor'
    FormatSignature: ''
    NumberOfSamples: 3
```

Figure 2: iminfo results of mugshot

Number of bits used per sample

Intuition:
Each sample contains an R-G-B component. Since each component is represented by 8 bits in MATLAB, each sample will have an 8 bit Red, 8 Bit Green and 8 Bit Blue component.

Calculation:

8-bit Red + 8-bit Green + 8-bit Blue = 24 bit RGB representation per sample

Therefore, each sample is represented by 24 bits.

Total bits required to store the image

Intuition:
There are 1280*960 samples of 24bits. There are 8 bits in 1 byte.

Calculations:

$$\frac{(1280*960\ samples)*\left(24\frac{bits}{sample}\right)}{\left(8\frac{bits}{byte}\right)} = 3{,}686{,}400 \text{ bytes}$$

Actual image size on disk

From the image properties, we can see that the JPEG image has been compressed to 217, 890 bytes.

Figure 3: Mugshot image properties on MAC

Compression ratio

Calculation:

Number of bits on disk = 217, 890 bytes
Required total number of bits = 3,686,400 bytes

Compression ratio = $\frac{217{,}890\ bytes}{3{,}686{,}400\ bytes}$ = 0.0591 = approximately 16:1 compression ratio. We can see that JPEG has significantly compressed the photo.

Assignment Results

To replicate these results please run Assignment1_main.m which is the main script.

Figure 4: From left to right, we have a mugshot in gray scale, smile shot in gray scale and the resulting difference image when the two images are subtracted with each other