DMA_DRIVER

January 21, 2025

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In [11]: from pynq import  DefaultHierarchy
         from pynq import allocate
         from math import log
         import numpy as np
         class FFT_Block_Driver(DefaultHierarchy):
             def __init__(self, description):
                 super().__init__(description)
                 self.configuration = 0
                 self.fft_size = 0

             def convert_to_data(self, fft_direction, size):
                 fft_direction = fft_direction.zfill(8)
                 byte2 = '0' * 8

                 x = int(log(size, 2))
                 fft_size = bin(x)[2:].zfill(8)

                 tdata = fft_direction + byte2 + fft_size
                 return int(tdata, 2)

             def configure(self, fft_direction, fft_size):
                 self.configuration = self.convert_to_data(fft_direction, fft_size)
                 temp = allocate(1, np.uint32)
                 temp[0] = self.configuration
                 self.config_dma.sendchannel.transfer(temp)
                 self.config_dma.sendchannel.wait()
                 del temp

             def stream_fft(self, input_buffer):
                 out_buffer = allocate(SAMPLES, np.csingle)
                 self.data_dma.sendchannel.transfer(input_buffer)
                 self.data_dma.recvchannel.transfer(out_buffer)
                 self.data_dma.sendchannel.wait()
                 self.data_dma.recvchannel.wait()
                 return out_buffer

             @staticmethod
             def checkhierarchy(description):
                 if 'data_dma' in description['ip'] and 'config_dma' in description['ip']:
                     print("Checking hierarchy")
                     return True
                 return False
```

```
In [12]: from pynq import Overlay
         ol= Overlay('recon_fft.bit')
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```
Checking hierarchy
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In [13]: ol?
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In [14]: fft=ol.fft_block
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In [15]: import numpy as np
         import matplotlib.pyplot as plt
         import random
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In [16]: SAMPLES =1024
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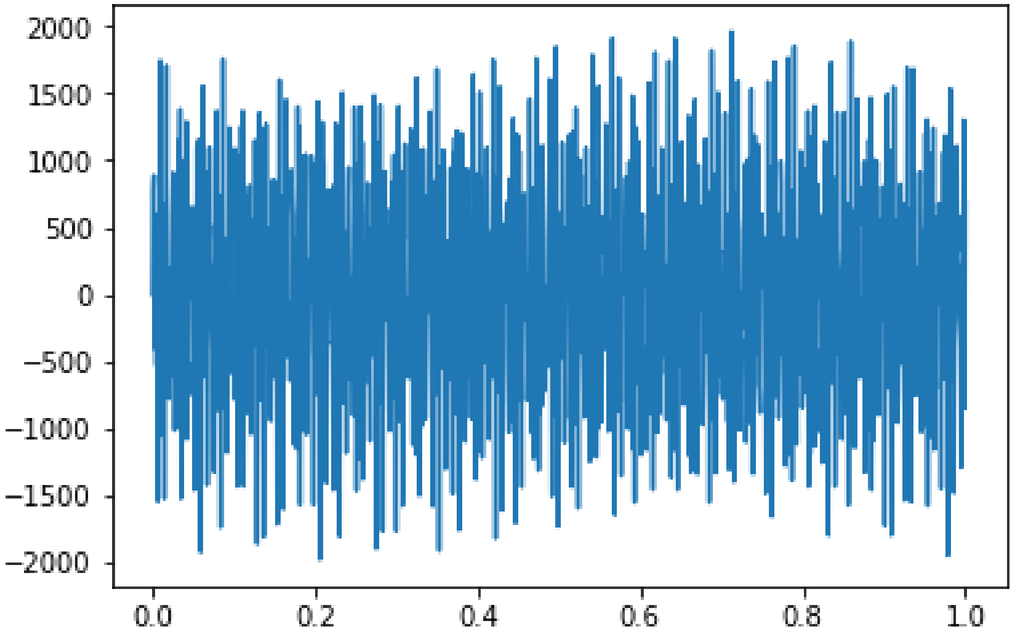
```
In [17]: time_interval = 1
         def create_data(SAMPLES,time_interval):
             A1= random.uniform(100,1000)
             A2= random.uniform(100,1000)
             A3 = random.uniform(100,1000)
             f1= random.uniform(100,150)
             f2= random.uniform(200,300)
             f3= random.uniform(500,600)
             w1= 2*np.pi*f1
             w2= 2*np.pi*f2
             w3= 2*np.pi*f3
             t= np.linspace(0,time_interval,SAMPLES)
             data= A1*np.sin(w1*t,dtype=np.csingle) + A2*np.sin(w2*t,dtype=np.csingle)+ A3*np.
             return data,t
```

```
In [18]: data,t= create_data(SAMPLES,time_interval)
         plt.plot(t,np.real(data))
```

```
Out[18]: [<matplotlib.lines.Line2D at 0xaf12afd0>]
```



```
In [19]: %%time
         output = np.fft.fft(data)

CPU times: user 2.63 ms, sys: 211 ţs, total: 2.84 ms
Wall time: 1.59 ms
```

```
In [20]: input_buffer= allocate(SAMPLES,np.csingle)

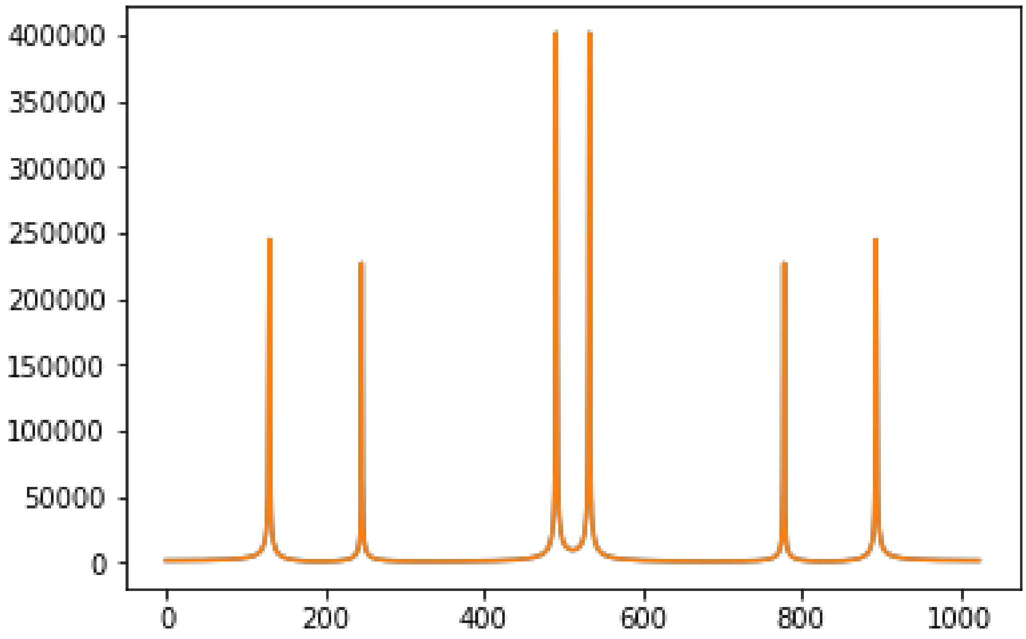
In [21]: np.copyto(input_buffer,data)

In [22]: fft.configure('1',SAMPLES)

In [23]: output_hw = fft.stream_fft(input_buffer)

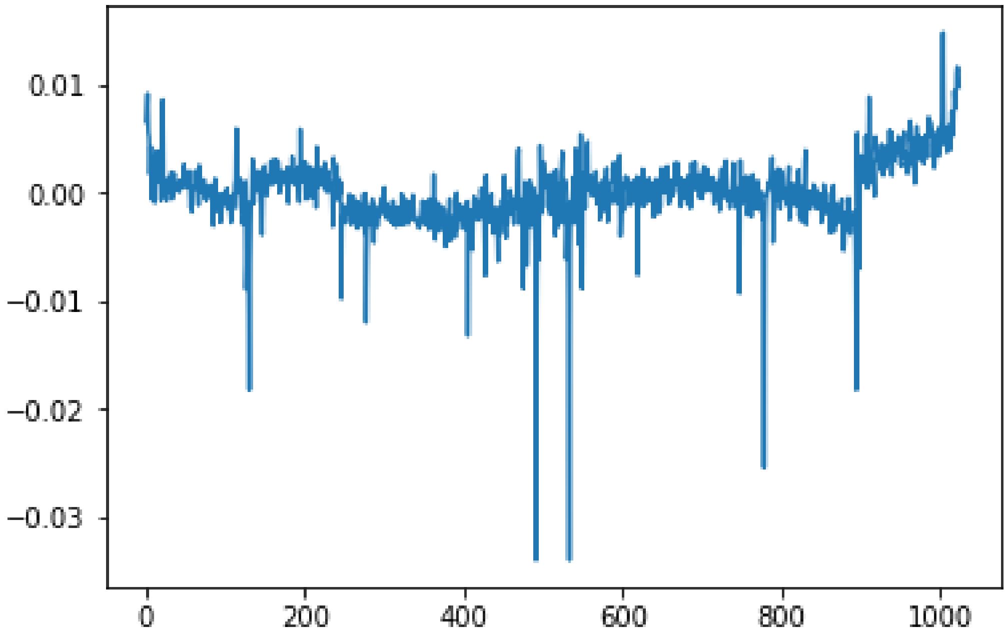
In [24]: plt.plot(np.abs(output))
         plt.plot(np.abs(output_hw))

Out[24]: [<matplotlib.lines.Line2D at 0xaf088870>]
```



```
In [25]: plt.plot(np.abs(output)-np.abs(output_hw))

Out[25]: [<matplotlib.lines.Line2D at 0xaefd78b0>]
```


0.01
0.00
−0.01
−0.02
−0.03
0
200
400
600
800
1000