acquiring ADC data

October 28, 2024

[17]:
```
import qubic.toolchain as tc
import qubic.rpc_client as rc
import qubitconfig.qchip as qc
from distproc.hwconfig import FPGAConfig, load_channel_configs
import chipcalibration.config as cfg
import numpy as np
import matplotlib.pyplot as plt
import qubic.state_disc as sd
from chipcalibration import vna as vn
import qubic.job_manager as jm
```

0.1 Load Configs and Define Circuit

define FPGA config; this has timing information for the scheduler. For now it is fine to use the following hardcoded config

[18]:
```
fpga_config = FPGAConfig()
channel_configs = load_channel_configs('channel_config_hw.json')
qchip = qc.QChip('qubitcfg.json')
# qchip.cfg_dict
```

0.1.1 Define a circuit to generate pulses on Q3

For Q3, the frequency is 400MHz as defined in qubic.json. Also, Q3.qdrv is connected to DAC_228_1, and Q3.rdlo -> ADC_227_0

[19]:
```
circuit_q3 = [
    # play a pi pulse on Q3
    {'name': 'pulse', 'phase': 0, 'freq': 400e6, 'amp': 0.90, 'twidth': 64e-9,
     'env': {'env_func': 'cos_edge_square', 'paradict': {'ramp_fraction': 0.
↪25}},
     'dest': 'Q3.qdrv'},

    {'name': 'delay', 't': 100.0715e-9},

    {'name': 'pulse', 'phase': 0, 'freq': 400e6, 'amp': 0.50, 'twidth': 64e-9,
     'env': {'env_func': 'cos_edge_square', 'paradict': {'ramp_fraction': 0.
↪25}},
```

```
     'dest': 'Q3.qdrv'},

    {'name': 'delay', 't': 100.0715e-9},

    {'name': 'pulse', 'phase': 0, 'freq': 400e6, 'amp': 0.90, 'twidth': 64e-9,
     'env': {'env_func': 'cos_edge_square', 'paradict': {'ramp_fraction': 0.
 ↪25}},
     'dest': 'Q3.qdrv'},

    {'name': 'delay', 't': 100.0715e-9},

    # play a pi/2 pulse on Q6
    {'name': 'pulse', 'phase': 0, 'freq': 5.7e9, 'amp': 0.50, 'twidth': 32e-9,
    'env': {'env_func': 'cos_edge_square', 'paradict': {'ramp_fraction': 0.25}},
    'dest': 'Q6.qdrv'}

]
```

[20]:
```
compiled_q3_prog = tc.run_compile_stage(circuit_q3, fpga_config, qchip)
compiled_q3_prog.program
raw_asm_q3 = tc.run_assemble_stage(compiled_q3_prog, channel_configs)
```

[21]:
```
runner = rc.CircuitRunnerClient(ip='localhost', port=9095)
```

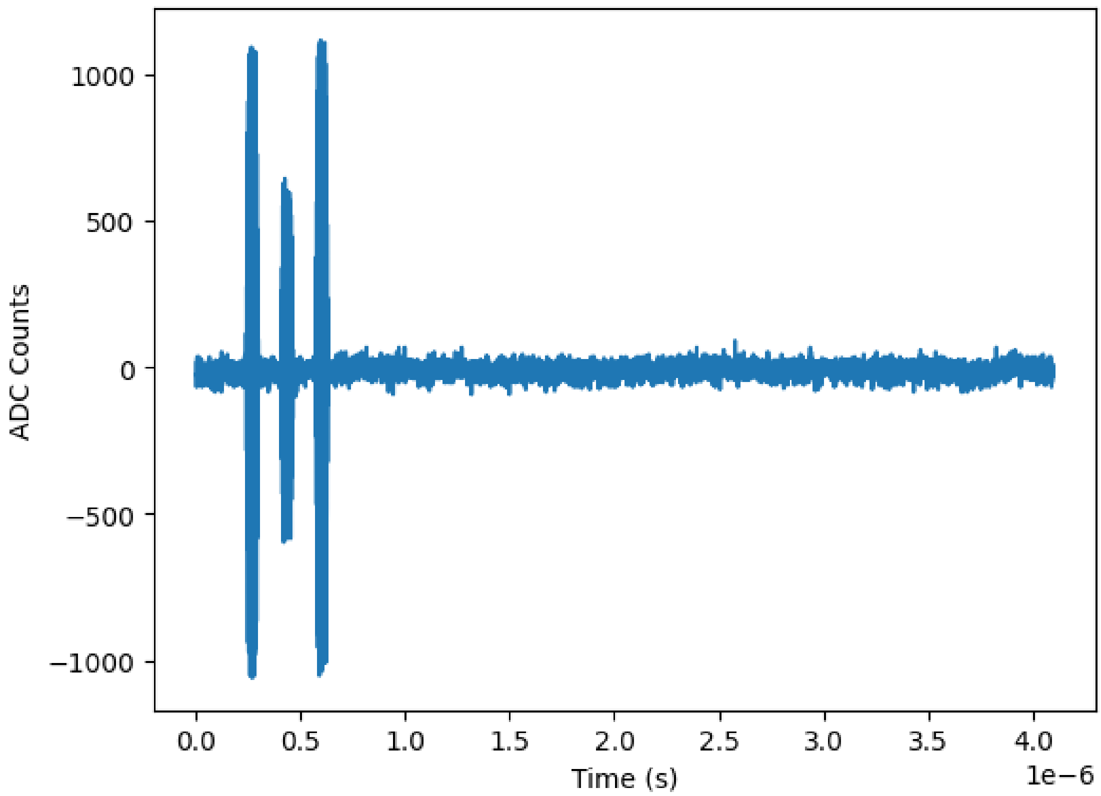
Submit the circuit to the server, and collect 1 shot. The runner will run the currently loaded program (or a batch of circuits) and acquire the results from acq buf or acc buf.

[22]:
```
acq_data_q3 = runner.load_and_run_acq(raw_asm_q3, n_total_shots=1,␣
 ↪acq_chans={'0':0,'1':1}, trig_delay=0e-9)
```

[23]:
```
# # plt.figure()

plt.xlabel('Time (s)')
plt.ylabel('ADC Counts')
plt.plot(np.arange(0,acq_data_q3['1'].shape[1]*0.5e-9,0.5e-9)[10:], np.
 ↪average(acq_data_q3['1'],axis=0)[10:])
```

[23]:
```
[<matplotlib.lines.Line2D at 0x769456fefef0>]
```



[24]:
```
# %matplotlib notebook
# # plt.figure()
# plt.xlabel('Time (s)')
# plt.ylabel('ADC Counts')
# plt.plot(np.arange(0,acq_data['1'].shape[1]*0.5e-9,0.5e-9)[10:], np.
 ↪average(acq_data['1'],axis=0)[10:])

# Data setup
time = np.arange(0, acq_data_q3['1'].shape[1] * 0.5e-9, 0.5e-9)[10:]
adc_counts = np.average(acq_data_q3['1'], axis=0)[10:]

import plotly.graph_objects as go

# Interactive Plotly plot
fig = go.Figure(data=go.Scatter(x=time, y=adc_counts, mode='lines'))
fig.update_layout(
    title="Interactive Plot with Plotly",
    xaxis_title="Time (s)", yaxis_title="ADC Counts on Q3"
    )

# Show interactive plot with zoom and scale controls
```

```
fig.show()
```

0.1.2 Generate puleses on Q1, which is 4.6GHz

For Q1, the frequency is 4675138775.442301 (4.6 GHz), and the output of the DAC channel for Q1, which is **Q1.qdrv** on core_ind 4, elem_ind 0, **DAC_228_3**, must be connected to **Q1 rdlo**, which is core 4, elem_id 2, connected to **ADC_227_2**.

[25]:
```
X90_Q1 = {'name': 'pulse',                        # generic pulse
          'phase': 0,                             # phase starts at 0
          'freq': 5000e6,                     # carrier frequence in Hz
          'amp': 0.48150320341813146,             # amplitude applied to envelope
          'twidth': 2.4e-08,                      # duration in seconds
          'env': {                                # the pulse envelope
              'env_func': 'cos_edge_square',      # function describing the␣
 ↪envelope
              'paradict': {                       # parameters input to env_func
                  'ramp_fraction': 0.25           # fraction of the square to be
              }                                   #  smoothed by the cosine
          },
          'dest': 'Q1.qdrv'                       # channel to play the pulse on,␣
 ↪here
                                                  #  the drive of qubit 1
}

circuit_q1 = [
    # Passive reset (this assumes the qubit T1 is roughy 100us.
    {'name': 'delay', 't': 500.e-6},
    # Our X90 pulse on Q1, defined above.
    X90_Q1,
    # Another X90, to achieve an X180, ie. a bit flip.
    X90_Q1,
    # An additional delay of 20ns
    {'name': 'delay', 't': 100.e-9},
    # A measurement of Q1, defined qubitcfg.json, just like the above
    # X90 was.
    {'name': 'read', 'qubit': 'Q1'},
]
```

[26]:
```
compiled_q1_prog = tc.run_compile_stage(circuit_q1, fpga_config, qchip)
compiled_q1_prog.program
```

[26]:
```
{('Q1.qdrv', 'Q1.rdrv', 'Q1.rdlo'): [{'op': 'phase_reset'},
  {'op': 'pulse',
   'freq': 5000000000.0,
   'phase': 0,
   'amp': 0.48150320341813146,
```

```
  'env': {'env_func': 'cos_edge_square',
   'paradict': {'ramp_fraction': 0.25, 'twidth': 2.4e-08}},
  'start_time': 250005,
  'dest': 'Q1.qdrv'},
 {'op': 'pulse',
  'freq': 5000000000.0,
  'phase': 0,
  'amp': 0.48150320341813146,
  'env': {'env_func': 'cos_edge_square',
   'paradict': {'ramp_fraction': 0.25, 'twidth': 2.4e-08}},
  'start_time': 250017,
  'dest': 'Q1.qdrv'},
 {'op': 'pulse',
  'freq': 6558671869.775688,
  'phase': 0.0,
  'amp': 0.018964980535141,
  'env': {'env_func': 'cos_edge_square',
   'paradict': {'ramp_fraction': 0.25, 'twidth': 2e-06}},
  'start_time': 250079,
  'dest': 'Q1.rdrv',
  'tag': 'Q1read'},
 {'op': 'pulse',
  'freq': 6558671869.775688,
  'phase': 0,
  'amp': 1.0,
  'env': {'env_func': 'square',
   'paradict': {'phase': 0.0, 'amplitude': 1.0, 'twidth': 2e-06}},
  'start_time': 250379,
  'dest': 'Q1.rdlo',
  'tag': 'Q1read'},
 {'op': 'done_stb'}]]
```

[27]:
```
raw_asm_q1 = tc.run_assemble_stage(compiled_q1_prog, channel_configs)
```

[28]:
```
# acq_data_q1 = runner.load_and_run_acq(raw_asm_q1, n_total_shots=1,␣
↪trig_delay=131.0715e-6)
acq_data_q1 = runner.load_and_run_acq(raw_asm_q1, n_total_shots=1,␣
↪acq_chans={'0':0,'1':1}, trig_delay=0e-9)
```

[29]:
```
# use 0.2e-9 since the frequency is, time scale is 2 / 5000e6 = 0.4e-10
time = np.arange(0, acq_data_q1['1'].shape[1] * 0.4e-10, 0.4e-10)[10:]
adc_counts = np.average(acq_data_q1['1'], axis=0)[10:]

import plotly.graph_objects as go

# Interactive Plotly plot
fig = go.Figure(data=go.Scatter(x=time, y=adc_counts, mode='lines'))
```

```python
fig.update_layout(
    title="Interactive Plot with Plotly",
    xaxis_title="Time (s)", yaxis_title="ADC Counts on Q1"
    )

# Show interactive plot with zoom and scale controls
fig.show()
```

[ ]:

```python

```