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| --- | --- | --- | --- | --- |
| ###### | ###### | ###### | ###### | ###### |
| Not started | Paused | Working on | Almost finished | Done |

Note:

* In English writing, one paragraph is about one thing, concept.
* Can first determine what figures to include.
* Can start with technical details and not introduction.
* When listing table of content, can thing what figure can go with the titles.
* Introduction
  + Briefly talk about qubit control and readout. Can ref engineering guide & long’s thesis (heterodyne readout).
  + How transmon, fluxonium work (draw spectrum, compare t1, t2, no need matrix element).
  + Readout: focus on dispersive readout.
* Motivation
  + Price comparison: Tek AWG + Alazar v.s. ZCU216.
  + Also compare with other commercial e,g. quatum machine.
  + Also, other need analog upconversion/down, need calibrate.
  + Can direcly mux sg & readout.
  + Can use a big table to compare.
  + Fpga Programmable.
  + Digital mixer.
* Overview of thesis (brief of each chapter)
* Firmware -> (put sw & fw in on chaper, change title to “connection of fpga to python”)
  + overview
  + Vivado
    - export & re-create vivado block design
    - generate bitstream & load with pynq
  + Ip
  + bd
* Software
  + overview
  + Experiment program coding basics
    - Initialize(), Body(), config, declare\_readout(), acquire(), etc.
  + ~~Some important python classes~~
    - ~~Pynq: MMIO, Overlay, DefaultIP~~
    - ~~Qick’s python lib: QickSoc, QickConfig, QickProgram, AveragerProgram~~
* Hardware -> measurement setup and signal conditioning
  + Components, measurement setup
    - Xm655 add-on card, 10MHz Rubidium clock, Local oscillator - sgs100a, Amplifier, mixer, splitter, DC-block, attenuator.
  + Signal integrity debugging
    - Sampling & re-construction (alias, images)
    - Rf component’s non-linearity (harmonics, intermodulation)
  + Frequency standard synchronization
    - ZCU PLL settings & sync with 10MHz Rubidium clock
    - Random phase after direct output and down-convert with sgs100a.
  + DAC gain & ADC level to dBm conversion (calibration table)
* Experiment
  + ~~Sinica-5q measurement~~-> change to transmon & fluxonium, 5q is optional.\*-\*
    - Setup
    - TWPA oneshot readout
    - Multiplexed readout
    - Quantum process tomography
    - Comparison with r&s VNA on oneTone measurement
* Summary and outlook
  + Realtime feedback.
  + Faster averaging.