About me

Name: Surjendu Manna
Nationality: Indian
Current Degree: Bachelor's in Technology in Electrical Engineering (Final Year)
Institution: RCC Institute of Information Technology, Kolkata, India
Previous Work: High-Voltage AC, Power Systems
Trained in:

Hardware Circuit Design
Simulation (LTSpice and MATLAB/Simulink) & PCB Design
Electrical Machine Design

Personal Interests & Hobbies

Chess
1300+ ELO (FIDE unrated)
Represented home institution in multiple national and state-level tournaments

Stock Market & Finance
Investing for 2+ years in ETFs and equity, actively learning financial analysis and market strategies

Anime
Fan of *Naruto*, *Pokémon*, *Dragon Ball series,* and more

Research Background in India

Previous Internship

IEEE Silchar Subsection, National Institute of Technology (NIT) Silchar
June 2024 – July 2024
Research Intern – Microgrid systems

Previous Training

Oil and Natural Gas Corporation (ONGC)
Dehradun, India
Dec 2024 – Feb 2024
Winter Trainee – Electrical Rigs

Conference and Publication

1. **Title**: *A Comprehensive Analysis of Solar Power in West Bengal*
Presented at NITK CREST 2025 National Conference
Status: In press; to be published in conference proceedings.

Study Period for KEKSSP 2025

Location: Linear Accelerator Building (LINAC Building), J-PARC

Group: RF Group

Supervisor: Ersin Cicek (KEK Accelerator Lab.)

Summer Student Night at J-PARC
(一号館 / Building No. 1)

1. Studying and understanding the LLRF control system in the accelerator applications (at J-PARC LINAC).

2. Gaining hands-on experience: RF measurements.

3. (If time permits) To perform simulations for an FPGA-based Digital Feedforward (DFF) and Digital Feedback (DFB) system using Red Pitaya.

→Simulations to be done on MATLAB Simulink to predict system discrepancies and behaviour
→Start with DFF control block to drive the RF source and feed the cavity.
→Proceed to DFB control block for error and pulse compensation
→ Implementing the Red Pitaya Board for other practical applications.

ONGOING

Understanding the LLRF Systems Incorporated in J-PARC LINAC

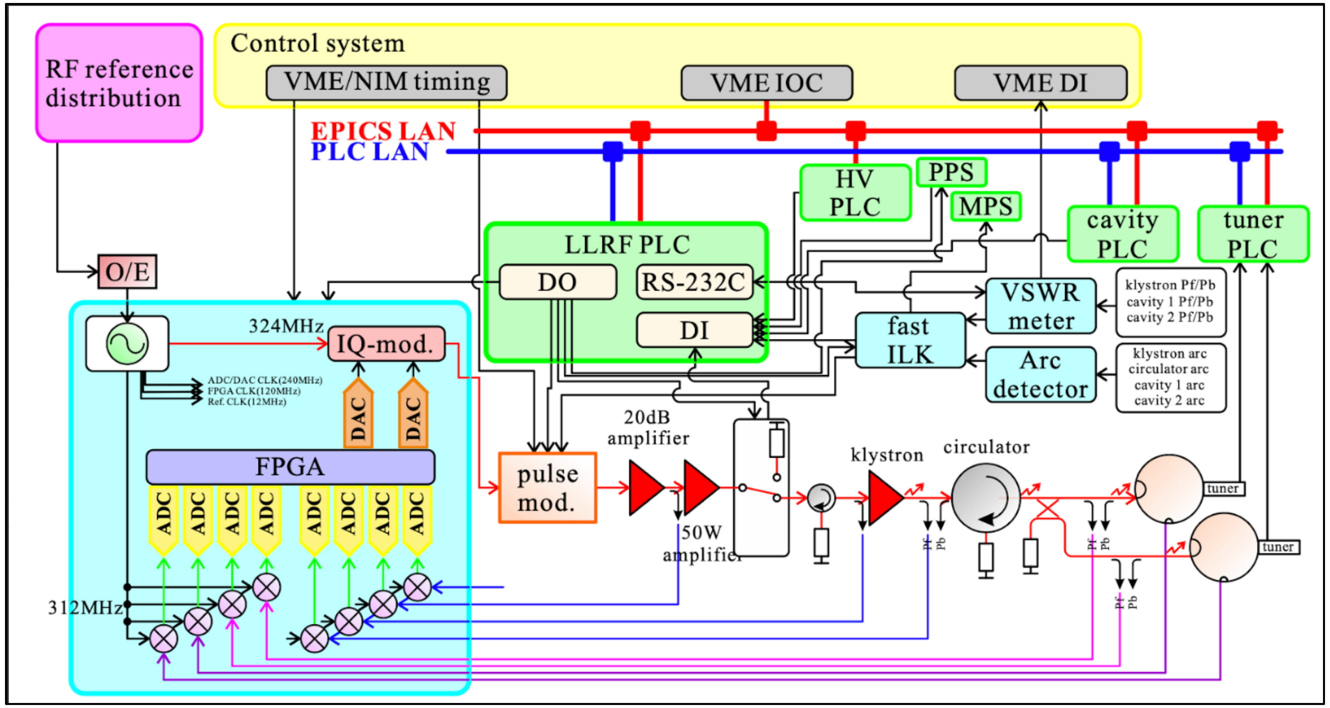


Fig.1: J-PARC LINAC LLRF System Typical @324MHz

K. Futatsukawa et al., "Demonstration of beam loading compensation system for discrete beam with comb-like structure in proton linear accelerator", Nucl. Instrum. Methods Phys. Res. A, 1047 (2023) 167778. DOI: https://doi.org/10.1016/j.nima.2022.167778

To obtain high beam quality and stable operation, a low-level RF (LLRF) control system:

1. Stability of accelerating RF field inside the cavity.

→**Digital Feedback Feedforward system** (DFB&DFF)
→Resonance frequency control (mechanical tuner, piezo, or cooling water temperature control
→Environmental temperature/humidity control
→Waveguide, etc.

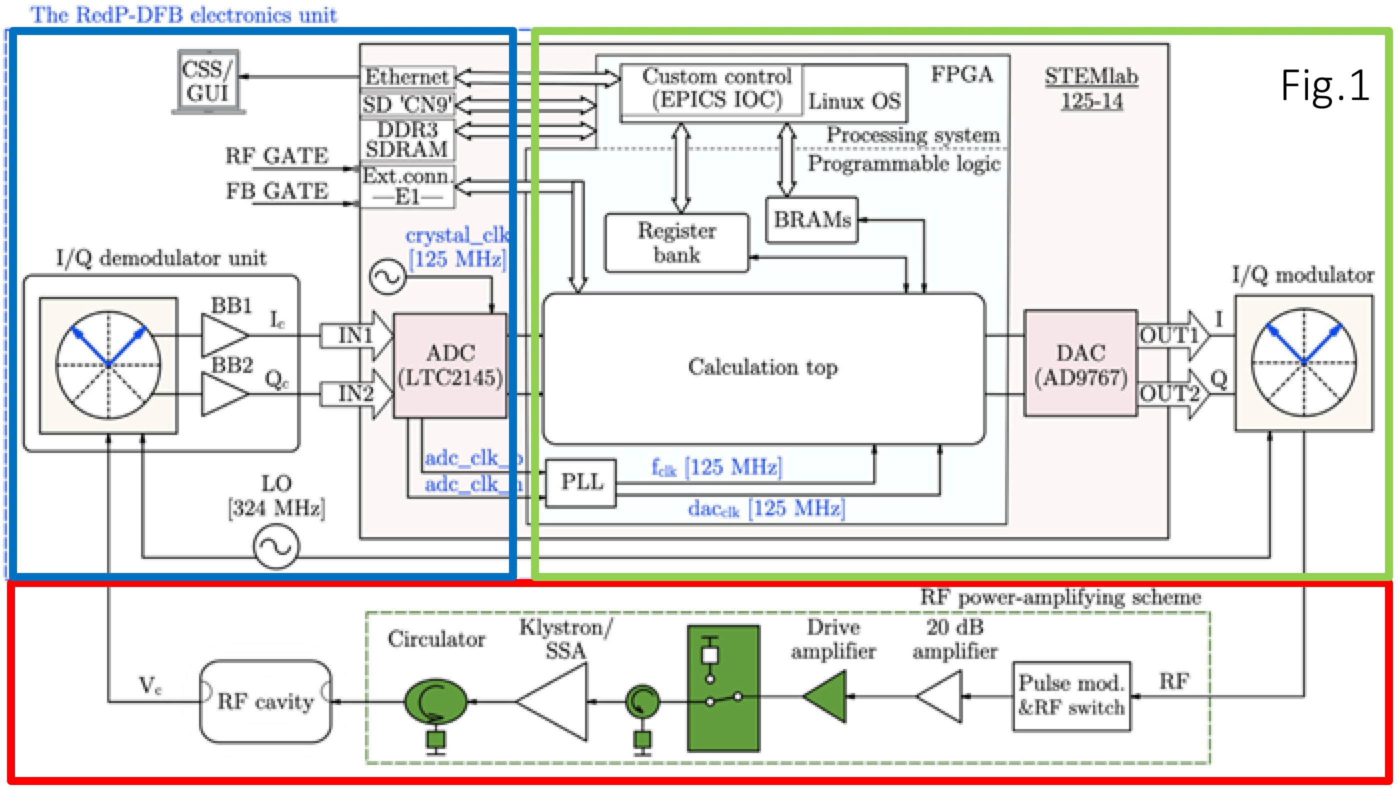
2. Interlock (ILK) systems:

→Arc Detector
→Personnel Protection System(PPS) –
→Machine Protection System(MPS)-

Custom DFF and DFB Control Architecture (FPGA-based, by Red Pitaya board)

ONGOING

→ My supervisor has developed a DFB&DFF system using the Red Pitaya board for RF field stability in accelerating cavities.
→ This is a **low-cost alternative with performance comparable** to conventional systems.
→ Low & high power RF tests were already conducted. The simulations have not been performed yet, which I'm currently working on.



Post-I/Q RF Amplification
RF Generation & Feedback Input
Feedback and Feedforward Computations and Pulse Error Compensation

E. Cicek et al., "Compact and efficient RF digital feedback control system for accelerator applications", Nucl. Instrum. Methods Phys. Res. A, 1046, 167700, 2023. DOI: https://doi.org/10.1016/j.nima.2022.167700

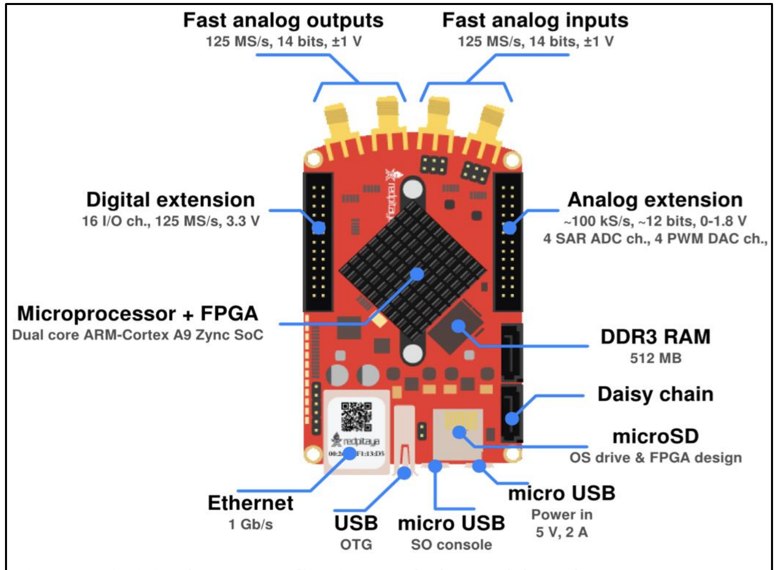


Figure 1: Red Pitaya STEMLab board hardware overview [1].

E. Cicek et al., "Present status of Digital Feedback and feedforward project using Red Pitaya STEMlab", in: Proc. of the PASJ'20, 2020, WEOO09.

PRELIMINARY RESULTS

→ Fig.2 FPGA Feedforward and Feedback Control block

→ Fig.3, MATLAB Feedforward Model

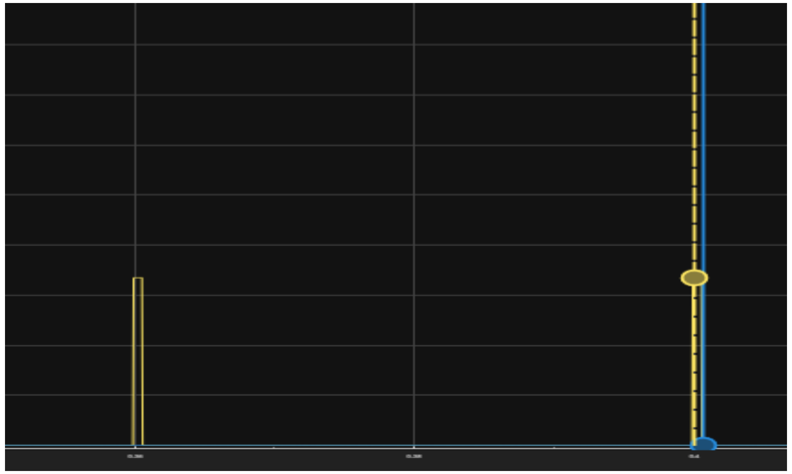


Fig.4

Scope at the I/Q Output on the Simulink model

ONGOING

Fig.2

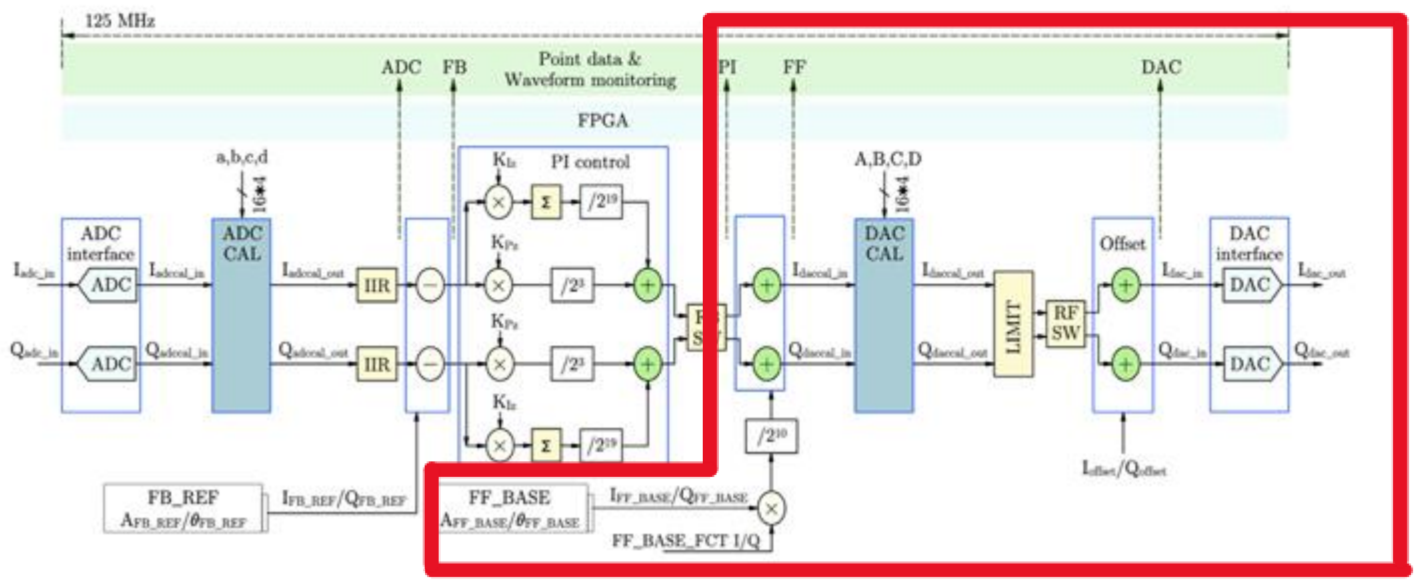
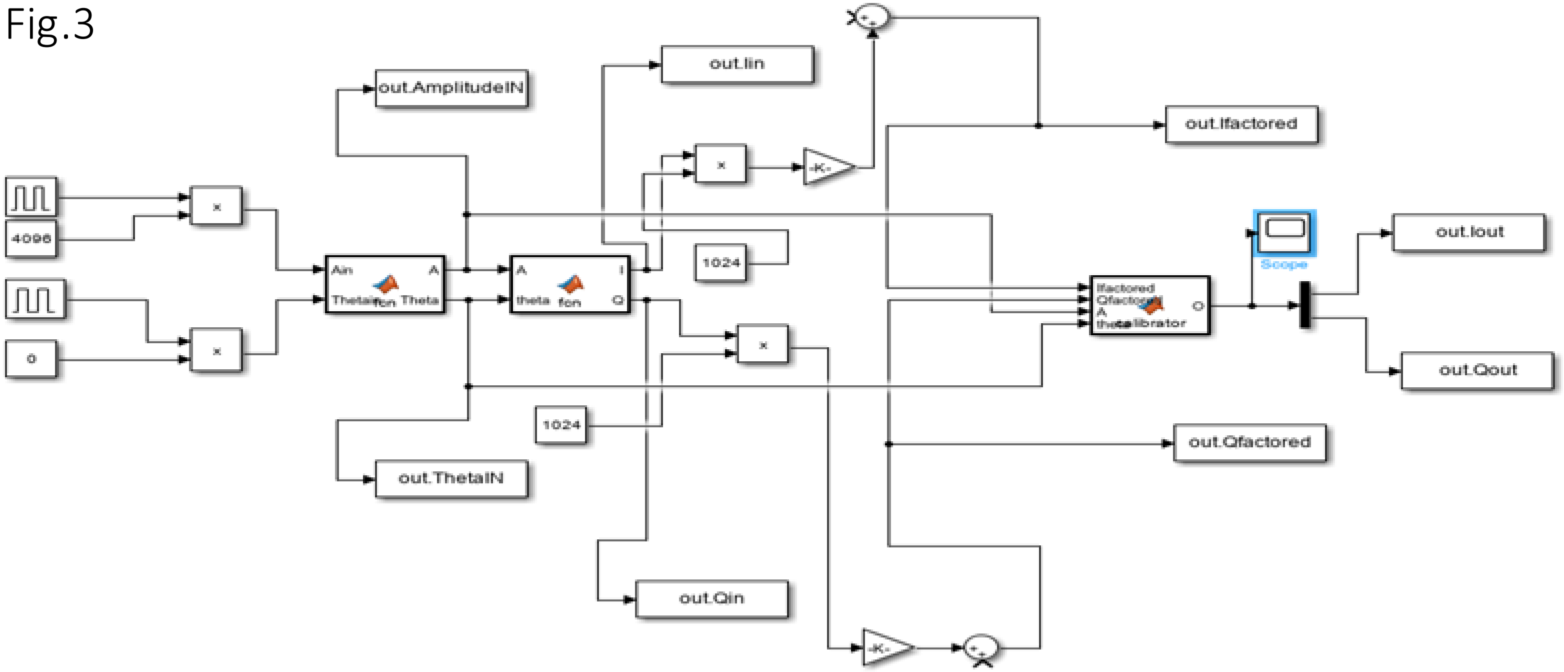


Fig. 2. RedP-DFB system firmware block diagram; I/Q datapath implementation in FPGA. RF SW and FB SW represent RF and FB switches, respectively; and IIR represents infinite impulse response.

Fig.3



Progress in RF measurement

I have gained hands-on experience using essential RF lab instruments, including the

→ Pulse&delay generator

→ Function generator

→ Oscilloscope

Purpose of the following instruments in my research plan

→**For Simulation:** Generate and control test signals to simulate accelerator conditions (pulse, RF, timing).

→**For Real Test:** Measure and analyze waveforms to verify signals and system behaviour.

A detailed table of specifications will be provided below

Name	Model/Version	Type	Brand
Pulse Generator	DG535	Digital, 8 channel	Stanford Research Systems
Funtion Generator	AFG3102C	Digital 2 channel	Tektronix
Oscilloscope	Infiivision DSOX6004A	Digital 4 channel	KEYSIGHT
MATLAB Simulink	R2025A	Software	Mathworks

More planned:

→Signal generators

→Spectrum analyzer (RF spectrum measurements)

→Power meter (RF power measurements)

→Vector network analyzers (spectrum, phase noise/jitter measurements)

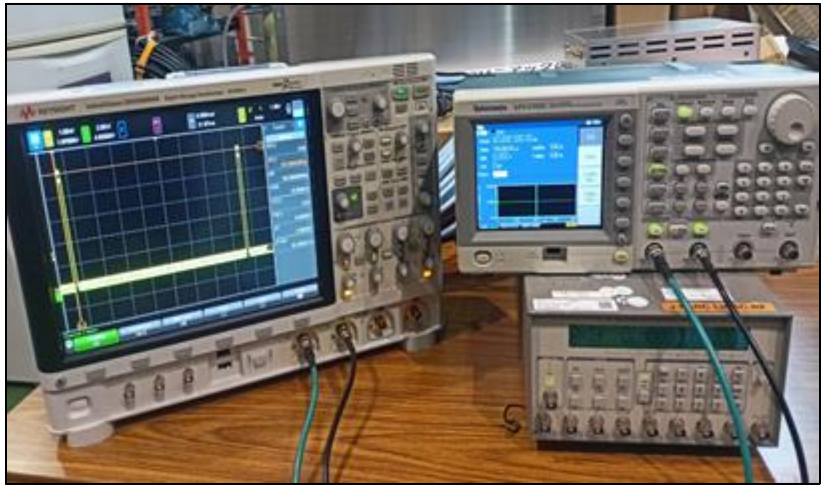


Fig.5

Experimental setup for RF measurement

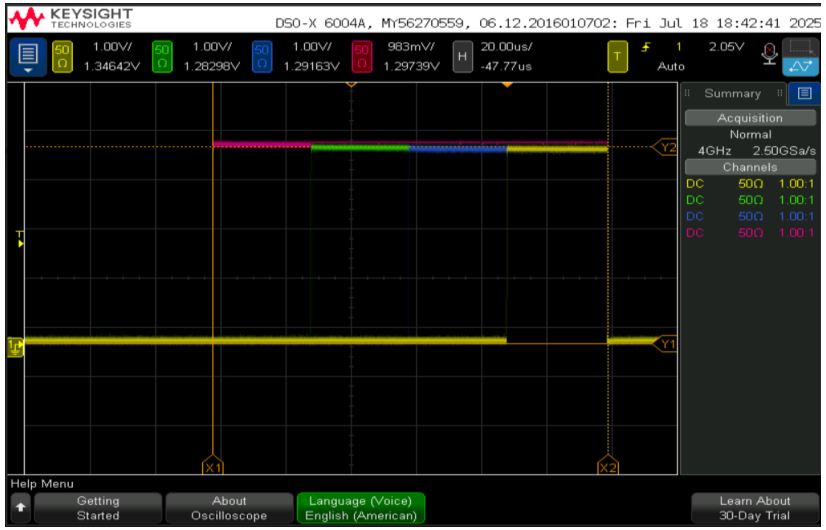


Fig.6 Pulse generation with 30us delay to every consecutive pulse