

Data Acquisition System for Synchronous Generator Transient Performance - Team PREW Generation Meeting Minutes

Date: 9/4/18

Time: 3:30PM

Location: Vandal Ballroom

Attendees: Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu

Agenda Items:

1. Exchange contact information
2. Establish team roles
3. Establish team name
4. Pick a weekly meeting time
5. Prepare agenda for first meeting with lead instructor
6. Fill out teaming table
7. Review work with lead instructor

Action Items:

1. Phone numbers and emails exchanged. WhatsApp group created for team discussions.
2. Team roles were chosen as follows:
 - Lead: Wahab
 - Budget: Roger
 - Wiki: Elliott
 - Portfolio: Preston

Wahab will draft a presentation with questions for the first meeting. Elliott will write the minutes and send them to Dr. Hess. Roger will contact Molly about our budget.

3. Team name was not created.
4. Wahab will speak with Dr. Johnson about meeting Thursdays at 1:30PM
5. Another meeting is planned for 9/5/18 at 8:30AM in the ECE lounge to prepare the agenda for the Thursday meeting
6. The teaming table was filled out.
7. Dr. Hess informed us that Dr. Johnson is absent from the ballroom so work was not reviewed.

Other Notes:

- Logbooks will be checked at the next meeting

Date: 9/5/18

Time: 8:30AM

Location: ECE Lounge

Attendees: Wahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu

Agenda Items:

1. Create agenda for Thursday meeting with lead instructor
2. Write questions to better understand the project
3. Inspect lab equipment

Action Items:

1. Wahab is preparing an agenda and presentation for the Thursday meeting.
2. The team came up with questions to ask Dr. Johnson based on the given information and previous completed research on the project.
3. Lab equipment in the BEL basement was inspected for connections, unknown devices, and more questions were formulated. Pictures were taken for the Thursday presentation.

Other Notes:

- Wahab confirmed the meeting time with Dr. Johnson and Hussain.
- Team name was chosen to be "PREW Generation" on WhatsApp.

Date: 9/6/18

Time: 1:30PM

Location: ECE Conference Room

Attendees: Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Dr. Brian Johnson, Hussain Beled

Agenda Items:

1. Determine the goal of the project
2. Project history
3. Ask questions about equipment
4. Understand motor/generator schematic
5. Client contact information

Action Items:

1. Things to measure:
 - Speed
 - Torque
 - Load Phase Angle
 - Terminal current
 - Terminal Voltage
 - Field Current
 - Field voltage
 - Power
2. History: Previous reports can be found on wikis or given by Dr. Johnson. There is a 3rd project on synchronous generators but the poster is not up. Two members of the adjustable governor project work for SEL, Dr. Johnson can give contacts. The encoder can accurately collect frequency, but not phase.
3. Questions:
 - a. Is it necessary to display/store all the data on the HMI & storage? **Different devices measure different things but need to be recorded and time synchronized in the same place. One HMI & Storage.**
 - b. Can the UNITROL1020 calculate speed, terminal voltage, field current, and field voltage? **Question for Norman. Also figure out the sampling rate of the device. Acceptable range is currently unknown.**
 - i. If yes: can The Excitation Control of a Synchronous Generator be used?
 - ii. How accurately was the Adjustable Governor for Synchronous Generator able to calculate instantaneous radial frequency? Can we use their report as well?

- c. Can the PMU be used to calculate phase load angle? Can we use the grid as a reference angle? **Yes, the PMU can be plugged into the system to synchronize it with the power grid. Two PMUs may be needed at terminals of the grid and the machine and time synchronized.**
 - d. Is the battery in the ABB used for excitation? Or does it convert AC to DC? **Uses PWM converter. This is a battery charger from a failed project. Dr. Johnson will give the report from this.**
 - e. What does the device connected to the ABB do? **Field flash used to excite the generator. We can ignore these without disconnecting.**
 - f. What does the gray boxes do? (connected CT) Schematic? **The right box is the power input to the AC drive. Neutral are shorted together (Y-connected). Rated current of 54A. Discreet parallel loads are used to simulate difficult faults. The left box connects overhead to the model power system to synchronize the generator to the grid. Keep model power system below 5-10A. Need to use load banks to test with higher current, unconnected to the system.**
4. Can we have a schematic of the whole system? **Gone over in parts.**
 5. How often to contact Norman Fischer? **Johnson meets him 9/7, will appoint a contact person for our budget. Keep in contact with someone at SEL regularly. Norman will ask difficult questions at the design review.**

Other Notes:

- How often to email minutes?
- Logbooks checked?
- SAPA agreements submitted
- Team contract?
- Extra contact person: Andy Miles, Roger
- National Instruments has software for data acquisition. Installed on computer in GJ 208 lab
- Coordinate with department technician (Mike) for use of a load bank.
- Can most likely meet at the same time next week.

Date: 9/13/18

Time: 1:30PM

Location: ECE Conference Room

Attendees: Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Dr. Brian Johnson, Hussain Beled, Dr. Feng Li

Agenda Items:

1. Last meeting discussion
2. Project status
3. Topology of system

Action Items:

1. ABB UNITROL 1020
 - Can't be used to acquire data
2. The range of acceptable sampling rate
 - 10kHz sampling
3. Access to GJ 208 Lab
 - Vandal card reader, talk to Dr. Hess
4. Documents relevant to project
5. Contact info of Andy Miles & Rogu
6. Learning about SEL 487E, 3530
7. Searching for GUI software
 - SEL Synchronwave Central, check max sampling rate support
 - Clearview - designed for SCADA, not our sampling rate
 - Labview, university has license
8. Learning about VFD project to measure torque and speed

Other Notes:

- Rogu is the SEL point of contact
- Norman does not want existing relay or ABB
- Wants a single data recorder getting all measurements
- Files in IEEE comtrade format preferred
- Check out Microsoft Project
- Budget: Come up with some reasonable options for data acquisition boards
- Figure out what we have already in GJ 208

Date: 9/20/18

Time: 1:30PM

Location: ECE Conference Room

Attendees: Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Dr. Brian Johnson, Hussain Beled

Agenda Items:

1. Last meeting discussion
2. Progress this week
3. Specification of data acquisition device
4. Next week tasks

Action Items:

1. We checked the GJ208 lab
 - Only one device might work
2. Might be able to get a microsoft project license from the department
3. Talk to Dr. Hess about Labview CD
4. Went over budget estimation
5. The design review in the fall will have a more finalized budget
6. PXI 6251 in 208 lab
 - Doesn't mention sampling all devices at same rate
 - Would need extra hardware to sync multiple devices
7. USB 6356
 - Limited to voltage inputs
 - Maybe use shunt resistor
 - We have high precision resistors somewhere
 - They are metal bars attached to wood
8. NI USB 9218
 - Only 2 inputs, might need multiple devices and synchronized together
9. How does the encoder work?
 - Talk to Chad
 - Andi is expecting to hear from us too
 - Might know where encoder data sheet is

Other Notes:

- Current lamps are sitting around somewhere
- Roju should be back in Pullman now

Date: 9/27/18

Time: 1:30PM

Location: ECE Conference Room

Attendees: Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Dr. Brian Johnson, Hussain Beled, Roju, Andy Miles

Agenda Items:

1. Project Specification
 - Data Acquisition Device Specification
 - Measurement Specification
2. Methodology
3. Current & Voltage LEMs

Action Items:

1. PXI 6251
 - Can't send all channels at the same clock rate, multiplexed
2. USB 6356
 - Only accepts voltage input
3. NI USB 9218
 - Only 2 inputs, would need multiple devices
4. Measurement
 - Use line to ground, generator neutral
 - Max Voltage/Current AC/DC
 - 230V L-L terminal, L-N can be full voltage, not divided by $\sqrt{3}$
 - DC - ABB datasheet
 - Measure all 3 L-N
5. Current LEM
 - Dr. Johnson might have schematic
 - What is the capacitor for?
 - Need DC as reference
 - Might be able to buy 3

Other Notes:

- We can measure the flux in the machine, there are flux probes
- Want to measure phase angle from the encoder
 - Something to ask Chad
- Find time sampling window for USB 6356
- Are the cables electromagnetic induction free?
 - How to mitigate this? Shield cables? Ask Chad

- Check the casing on the PXI 625
 - Might need new torque transistor, encoder
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Date: 10/4/18

Time: 1:30PM

Location: BEL G10

Attendees: Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Dr. Brian Johnson, Hussain Beleed, Andy Miles, Roju, Harry

Agenda Items:

1. Project status
2. Topology
3. Next week tasks

Action Items:

1. We found a d sub connector cable we can use, takes 16 analogue or 8 differential
2. Offline and online LEMs
 - Need to test the LEMs
 - Roju wants to push the current limits of the model power system
 - Idaho Power says the model power lines are rated 20A
 - Rack only accepts voltage inputs
 - We first thought we would use a shunt resistor
 - Stator current may need to be 100A
 - Need to find the ratings of the model power before picking shunt resistors
 - We can purchase a new encoder
3. Next week test DC voltage into the chassis if we can get the computer installed in the lab

Other Notes:

- Find out how to use the microcontroller at the same time as the ABB exciter from Chad
- 2 LEM boxes combined, A/B/GND and C/N/GND

Date: 10/11/18

Time: 1:30PM

Location: ECE Conference Room

Attendees: Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Dr. Brian Johnson, Hussain Beled, Andy Miles

Agenda Items:

1. Project Status
2. LEM Testing
3. Termination Accessory

Action Items:

1. Installed Labview and computer in lab, snapshot, and LEM testing
2. LEM measurement is confusing
 - Is it measuring current or voltage?
 - We came up with equations
3. Screw Terminal Block
 - Few hundred dollars
 - Shielded connection from rack to port

Other Notes:

- Create a list of questions and things we need for Roju
- Might need to request facility to do wiring in the lab room
- Can get cabling from G10 or Mike's shop, rating will be on the cable
- Need to design a 3rd box for DC measurement, maybe 4th
- Have the measurement interface and some of the measurement done by the end of the semester
- We can test with the generator and bank next week
- Coordinate 3 phase bank use with 420 TAs
- Do a 0 current LEM measurement to find offset with the generator

Date: 10/18/18

Time: 1:30PM

Location: ECE Conference Room

Attendees: Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Dr. Brian Johnson, Hussain Beled, Andy Miles

Agenda Items:

1. LEM Testing w/ AC
2. Encoder
3. Termination Accessory

Action Items:

1. How does Chad's code work for the encoder
 - Will the fixed 16ms offset drift the values?
 - How does it calculate a single 0 crossing from 3 values?
 - Roju can buy the termination accessory next week

Other Notes:

- Look at torque transducer in lab, might need to be updated
- Dr. Johnson will be busy the next 3 weeks

Date: 10/25/18

Time: 1:30PM

Location: ECE Conference Room

Attendees: Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Dr. Brian Johnson, Hussain Beleed, Andy Miles

Agenda Items:

1. Measuring the load angle
2. LEM box reverse engineer
3. Design DC LEM box, print pcb
4. Test PXI 6251

Action Items:

1. Why did Chad not use a filter?
 - His plan was only for data collection, not analysis
2. Why half wave rectification?
 - Might just be a measurement specification
3. L-L measurements are likely not as high priority
4. Found another termination box to test PXI (unshielded)
5. Need to make sure the PXI is not multiplexing the samples together at a lesser sample rate

Other Notes:

- Can the national instruments box do the job of the microcontroller?
- Does Norman want measurements off the physical rotor position or off the electrical part?

Date: 10/30/18

Time: 5:00PM

Location: NASA Conference Room

Attendees: Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Dr. Brian Johnson, Hussain Beled, Andy Miles, Raju, Dr. Normann Fisher, Dr. Feng Li, Dr. Yacine C

Agenda Items:

1. Project specifications, constraints, and deliverables
2. Project learning
3. Project topology
4. Project cost estimation
5. Project schedule
6. Potential problems

Action Items:

1. Need data acquisition board meeting sampling requirements and a step down sensor
2. We already have the PXI 6251
3. Two topologies, one with 17 analogue with no microcontroller and an incremental encoder, one with 11 analogue and no microcontroller
4. AC/DC LEM voltage and current test results

Other Notes:

- Pay attention to polarities on LEM boxes
- LEM might give too small of an input to read on the data acquisition board
- Check if the LEM will output too high of a voltage too
- Going to need to higher resolution, effective bits, for the LEMs
- Noise on the A to D converter
- Use VT for the AC voltage
- Use CT for the DC
- Find instrument transformers to take 180V to within 10
- Understand how LEMs work in 2 weeks and why they are not perfect
- Keep LEMs for the DC, low magnetizing current (negligible)
- No ripple in the DC
- Want the machine to not go out of step, but be stable
- $PE = PM + Losses$
- Find effective number of bits
- Find of the A to D clips the waveform
- Know how the torque transducer works
- Know how the angle encoder works
- Have a load bank with small increments, fine steps

Date: 11/8/18

Time: 2:00PM

Location: ECE Conference Room

Attendees: Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Hussain Beleed, Andy Miles, Raju

Agenda Items:

1. Individual Tasks
2. Project Status
3. Project Topology

Action Items:

1. Preston transformers, Roger encoder, Elliott torque transducer, Wahab national instruments/labview
2. 120V is standard, find auxiliary PT from 180V to around 15V
3. Use 100:1 CT across 1 ohm resistor
4. Figure out how the conversion or scaling ratio works for the torque transducer
5. Working on getting the library drivers installed with JJ
6. Automatic test relay system
 - Can't find software for it
 - Hussain can get a code for software for the device
 - Can do basic testing manually
 - Is this device calibrated?

Other Items:

1. Test PXI voltage limits
2. Might be more CTs in the lab
3. Might need to calibrate torque transducer

Date: 11/29/18

Time: 1:30PM

Location: ECE Conference Room

Attendees: Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Hussain Beleed, Andy Miles, Dr. Brian Johnson, Raju

Agenda Items:

1. CT & PT
2. DAQ Testing
3. Snapshot 2

Action Items:

1. CT: Less voltage across the magnetizing current creates a more accurate transformer, more current to the meter
2. Avoid non-removable fixed ground (H2?)
3. Use a 50-5 rating so the system can be more universal
4. Don't want to see slot ripples, Raju can give detailed spec needs for the filter
5. Test more pins on the termination device

Other Items:

1. Going to make sure if the shielded connector block will solve the problem or not before purchasing
2. Going to test PXI 6289 to see if it will work, then we won't need to buy another DAQ
3. Custom transformers might take a long time to ship

Date: 12/6/18

Time: 1:30PM

Location: ECE Conference Room

Attendees: Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Hussain Beleed, Andy Miles, Dr. Brian Johnson

Agenda Items:

1. SCXI Medium Voltage Input Module
2. DAQ Test 2
3. CT & PT Options

Action Items:

1. SCXI has one mux, 32 differential signals
2. Filter clears the signal up
3. Makes CT & PT options more flexible

Other Items:

1. Use university support contract with NI to find other options
2. Get a clear list of everything we need to buy

Date: 1/17/19

Time: 2:30PM

Location: NASA Conference Room

Attendees: Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Hussain Beleed, Andy Miles, Dr. Brian Johnson

Agenda Items:

1. Settling time options
2. CT/PT
3. Torque transducer

Action Items:

1. All mux based DAQs have a settling time issue. Lots of delay with 16 inputs
2. PXIe4305, 32 separate ADCs, 51.2kS/s, +/-43Vpeak
3. Would need new terminal board, chassis, controller, and PCI card
4. NI9220, analogue only, 16 separate ADCs, small chassis, cheaper
5. NI9229, 4AI, 24 bit resolution, +/-60Vpeak, 50kS/s (for transformers)
6. Would need programming to synchronize the 2
7. Table of ideal transformer ranges for each option
8. Need to test torque transducer with string commands
9. How do we synchronize the results with the DAQ?
10. How accurate is the clock?

Other Items:

1. Protection CT vs metering CT
2. Maybe get an input board from a relay (can be up to 250V peak)
3. Get Andy and Dr. Johnson or Dr. Hess to see the generator vibration next time we power on
4. Work on the torque transducer and wait for Raju to make a decision
5. What kind of resolution do we need on the torque measurement?
6. Be realistic, get some kind of measurement with timestamp

Date: 1/24/19

Time: 2:30PM

Location: NASA Conference Room

Attendees: Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Hussain Beleed, Andy Miles, Dr. Brian Johnson

Agenda Items:

1. Torque transducer

Action Items:

1. Need another cable for power and another cable for analog
2. Microprocessor in transducer gives clock signal in serial communication

Other Items:

1. Raju will be back next week
2. Map out a Spring schedule
3. How are we gonna pay
4. Write parts of final report while we wait for equipment

Date: 1/31/19

Time: 5:00PM

Location: NASA Conference Room

Attendees: Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Hussain Beleed, Raju, Dr. Normann Fischer, Dr. Brian Johnson

Agenda Items:

1. Settling Time
2. CT/PT
3. Torque Transducer

Action Items:

1. 2 options for settling time:
2. New PXIe will suit needs but expensive, larger buffer, higher throughput, more module types
3. cDAQ is much cheaper, directly connected to PC, less module options

Other Items:

1. What is the input impedance of the DAQ?
2. Need a much smaller transformer, little iron, small turns
3. Does the delay on our current DAQ matter?
4. 43.6us per degree
5. Deskewing method
6. 3 pole, 1200 rpm, 20Hz mechanical
7. Redesign filters
8. Settling time is time for AD to take a measurement
9. Email individual channel delay time
10. 10V into torque, what do we get out?
11. Figure out max torque reading
12. Check NI against scope with relay test

Date: 2/7/19

Time: 5:00PM

Location: NASA Conference Room

Attendees: Abdulwahab Aljabrine, Elliott Sher, Hussain Beleed, Andy Miles, Dr. Brian Johnson

Agenda Items:

1. DAQ synchronization of 2 devices
2. Engineering release

Action Items:

1. Will test torque on monday

Other Notes:

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Date: 2/14/19

Time: 5:00PM

Location: NASA Conference Room

Attendees: Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Hussain Beleed, Andy Miles, Dr. Normann Fischer, Raju, Dr. Brian Johnson, Dr. Feng Li

Agenda Items:

1. Project goals and specifications
2. Project topology
3. Project progress
4. Plan of completion
5. Project Budget

Action Items:

1. The AD comparison of the same signal should ideally be identical

Other Notes:

- Filter is analogue design, but implemented as a digital
- Who works on what
- Design upfront 5kHz anti-aliasing filter
- Does not want passband ripple with chebyshev
- Make one in matlab with Andy
- Find noise level in DC
- Put in higher harmonics w/ white noise into filter and get it out
- Probably don't need termination shield
- 480-600Hz cutoff freq for lowpass filter
- Get cables
- 50mohm for R1
- 1Mohm for R1, 10Mohm for R2

Date: 2/28/19

Time: 5:00PM

Location: NASA Conference Room

Attendees: Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Hussain Beleed, Andy Miles, Raju, Dr. Brian Johnson

Agenda Items:

1. Purchased Items
2. Torque Testing
3. Encoder Testing
4. CT Testing

Action Items:

1. Show data in terms of power, current, not loads
2. Use calculated torque and compare to see if the transducer is operating within parameter
3. Might go beyond senior design scope, where we are heading is good
4. Meter might be the source of error in CT
5. List error for each resistor for the field measurements
6. Figure out what frequency the encoder signal starts to decompose

Other Notes:

- Get the poster done early

Date: 3/21/19

Time: 5:00PM

Location: NASA Conference Room

Attendees: Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Hussain Beleed, Andy Miles, Raju, Dr. Brian Johnson

Agenda Items:

1. Torque
2. CT/PT
3. Encoder

Action Items:

1. Measure the load angle with both methods to ensure we don't miss a pulse
2. Use series and shunt exciter
3. We can see the z pulse between 50kHz and 70kHz
4. How to measure between the voltage falling edge and rising pulse?
5. One DAQ at one frequency and another DAQ at the 70kHz

Other Notes:

- Use terms like electrical torque and mechanical torque
- Use LabVIEW to take the derivative of the change in pulses over time
- Do tests at lower voltage to avoid saturating the DAQ for now

Date: 4/4/19

Time: 5:00PM

Location: NASA Conference Room

Attendees: Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Hussain Beleed, Dr. Brian Johnson

Agenda Items:

1. Voltage and current measurements
2. Torque test
3. Encoder test

Action Items:

1. Transformer ratio is wrong from the data sheets, stepped down voltage exceeds 11V by 0.3V, the waveform is cut off
2. DC circuit
3. Analog to digital torque conversion
4. Reverse the order of the torque slides
5. Torque transducer is currently not working
6. Phase angle measurement is working with labview and the encoder

Other Notes:

- Use absolute error for the phase angle
- Encoder is mechanical and sin zero crossing is electrical
- Change "measurement" to "measured"
- Less tight of a scale on the speed
- Contact vendor about transformer ratios
- Calculate rated torque

Date: 4/18/19

Time: 5:00PM

Location: NASA Conference Room

Attendees: Abdulwahab Aljabrine, Elliott Sher, Roger Xia, Preston Wu, Hussain Beleed, Raju

Agenda Items:

1. Voltage & Current Measurements
2. Torque Test
3. Encoder Test

Action Items:

1. Buy 5 new PTs with a higher ratio, maybe new company
2. Torque Transducer is broken
3. Data is logged and exported to excel

Other Notes:

- Fix the units on the torque measurements
- Delete DC values
- Take the generator field measurements when we run the machine