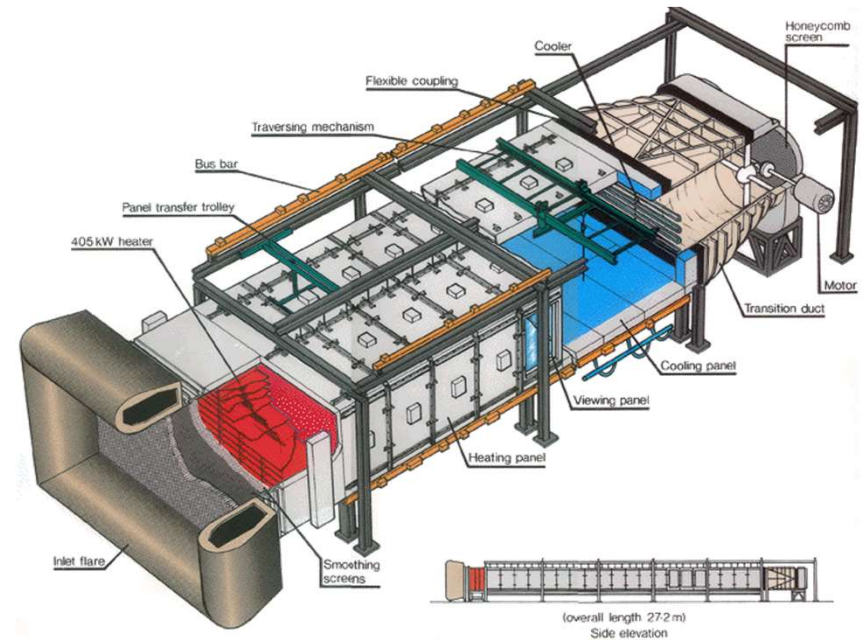


Overview of the Lab Systems

by Paul Hayden

- EnFlo Tunnel, Designed and Built by the Central Electricity Generating Board in the late 1980s moved from Leatherhead to Surrey University in 1993 - The EnFlo Lab
- Alan Robins moved with the Tunnel now Emeritus Professor
- Tom Lawton Joined a few week after myself, stayed 15 years
- Paul Nathan - 2012-2018 Electronic Boxes!! Thermistors



EnFlo Lab Formed in 1993

- PhD Building affected dispersion from elevated releases in neutral and stable boundary layers - funded by British Nuclear Fuels
- Employed for 6 weeks over the summer of 1993 to write a general-purpose measurement program in LabVIEW, still working on this!!
- Apple Centris Computer 8MB Ram (upgraded to 16MB!!)
- LabVIEW 2.5 would only run on an apple Macintosh
- Data storage SyQuest Drives (Removal Hard Disks) 60MB Cartridge ~£60



Evolution of Automation

- First profiles measuring empty tunnel background flow quality with 1D traverse
- Built 3D traverse 1995
- 8 hours at work 16 hours away
- Late 1990s First automated emails (sent 1000 for an overnight run) but could not read at home!!
- Sent SMS messages (had to buy 500) early 2000s
- mid 2000's Could read emails at home
- ~2010 vnc over Teamviewer then Tight VNC viewer
- User can run tunnel from home – decide if warnings are bad enough to warrant aborting the run.



EnFlo Tunnel Control

3D Traverse

Tunnel speed

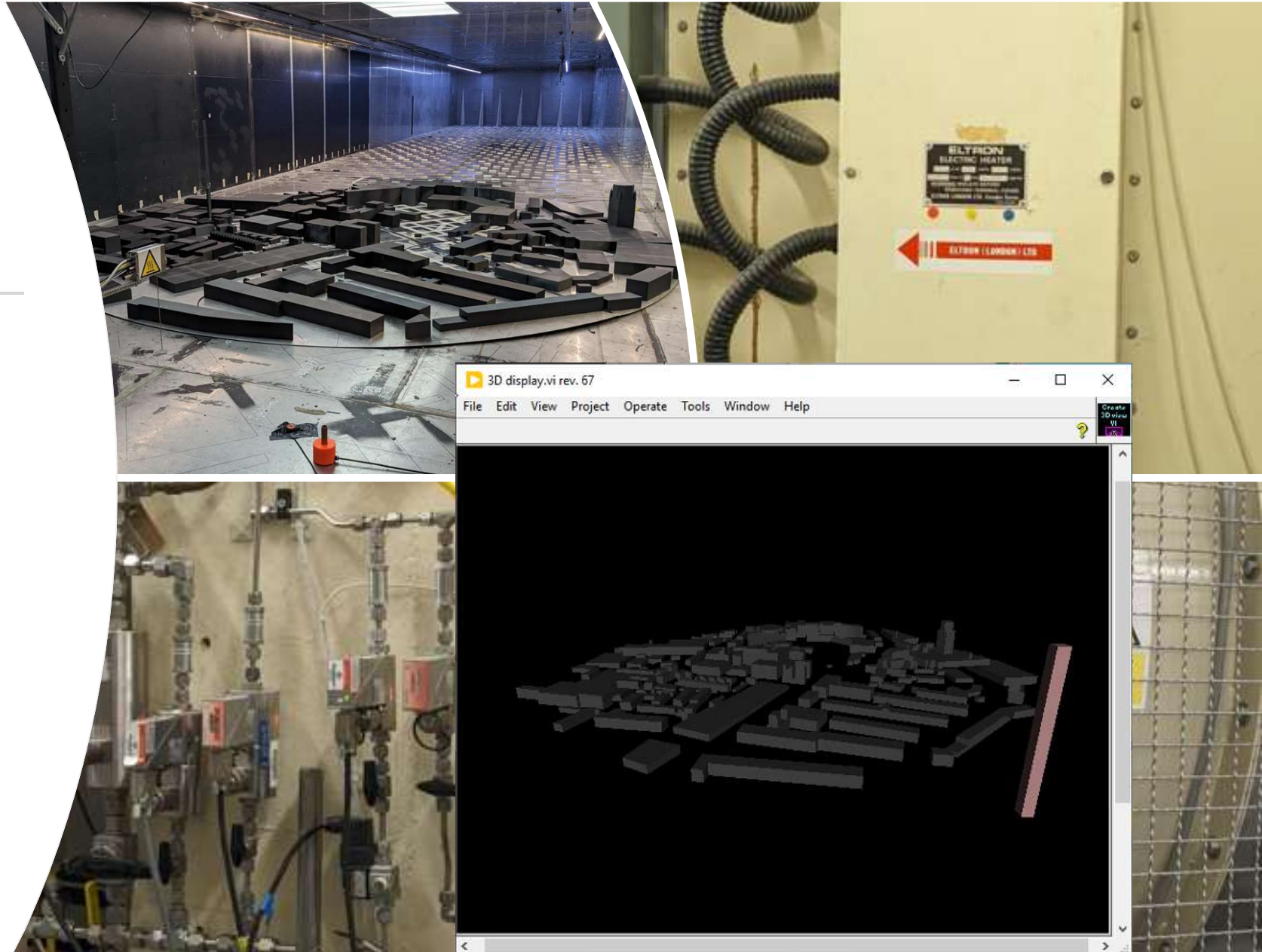
Inlet heaters

Control of heating and cooling panels

Turntable

Gas mixing system

Collision Detection



~300 ADAM
Channels



210 Thermistor
Channels (Paul Nathan)



Usonics



Gas Detector



SERVER COMPUTER

EnFlo Tunnel PC

A Tunnel PC

Aero Tunnel PC

D Tunnel PC

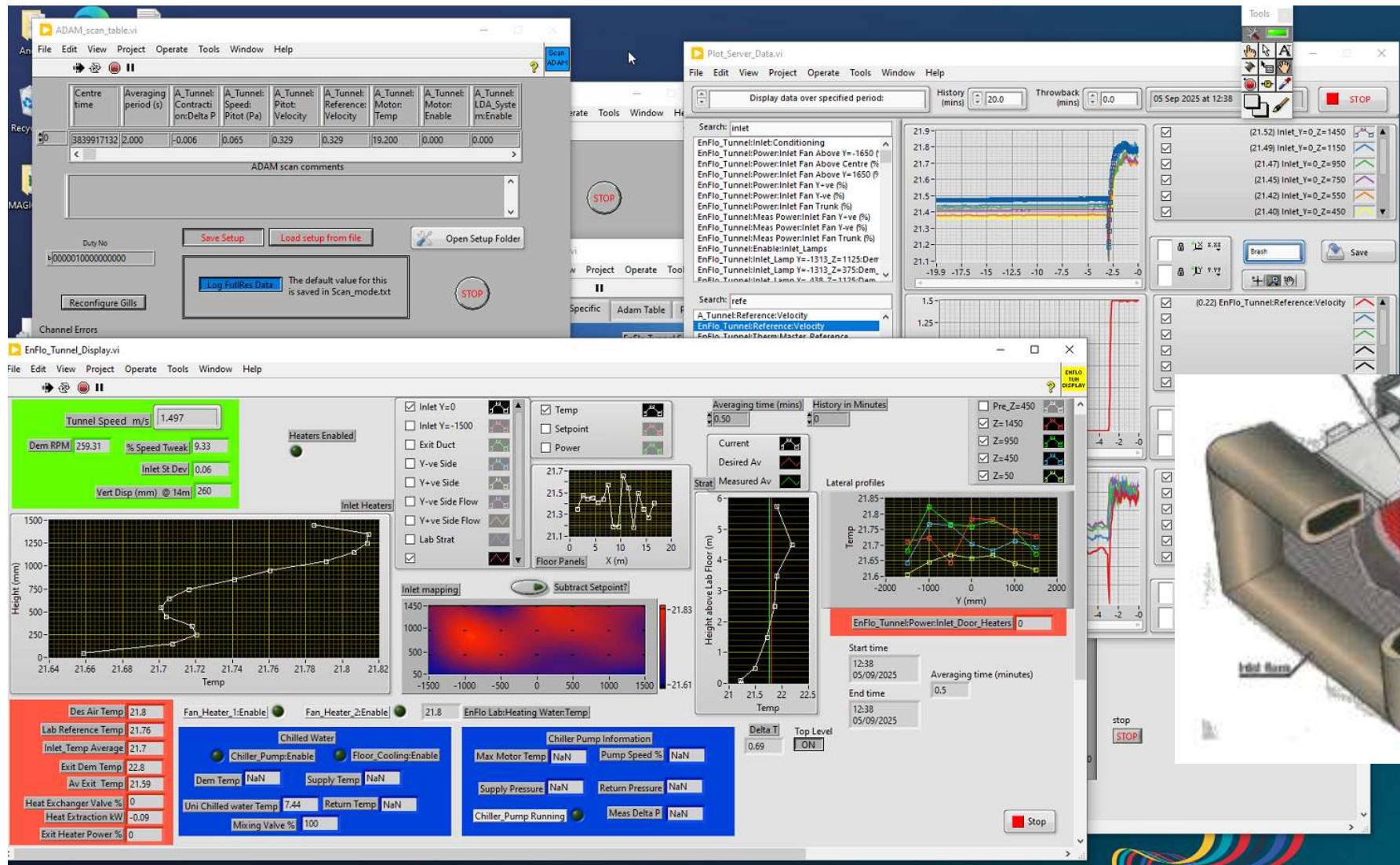
LDA FFID 7HP

7 Hole Probes

Hot wire

Pressure Scanners

The Server

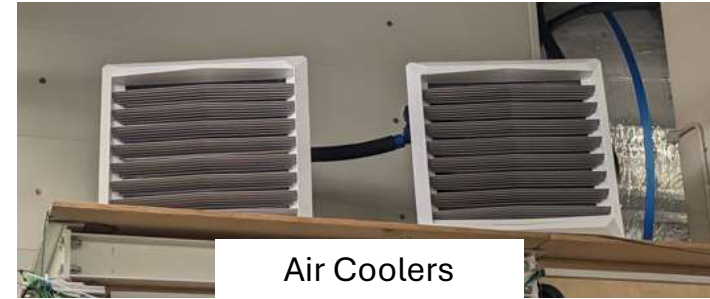


Lab Temperature Control

- Cooling



Back End Chiller



Air Coolers



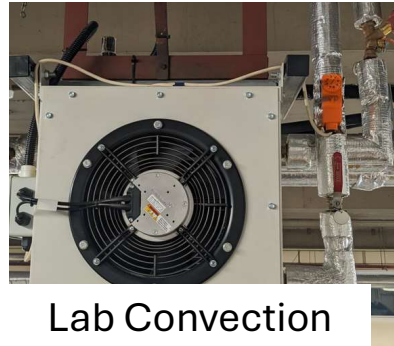
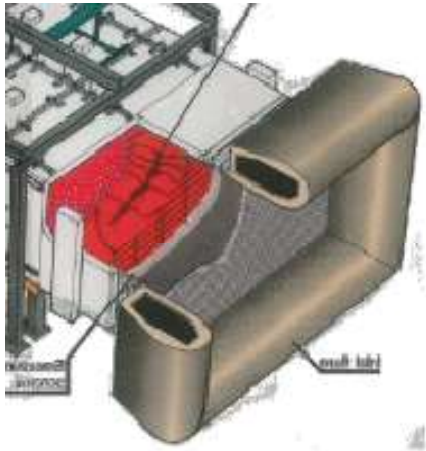
Window control



Extraction Fans

Lab Temperature Control

- Heating



Lab Convection
heaters 2kW



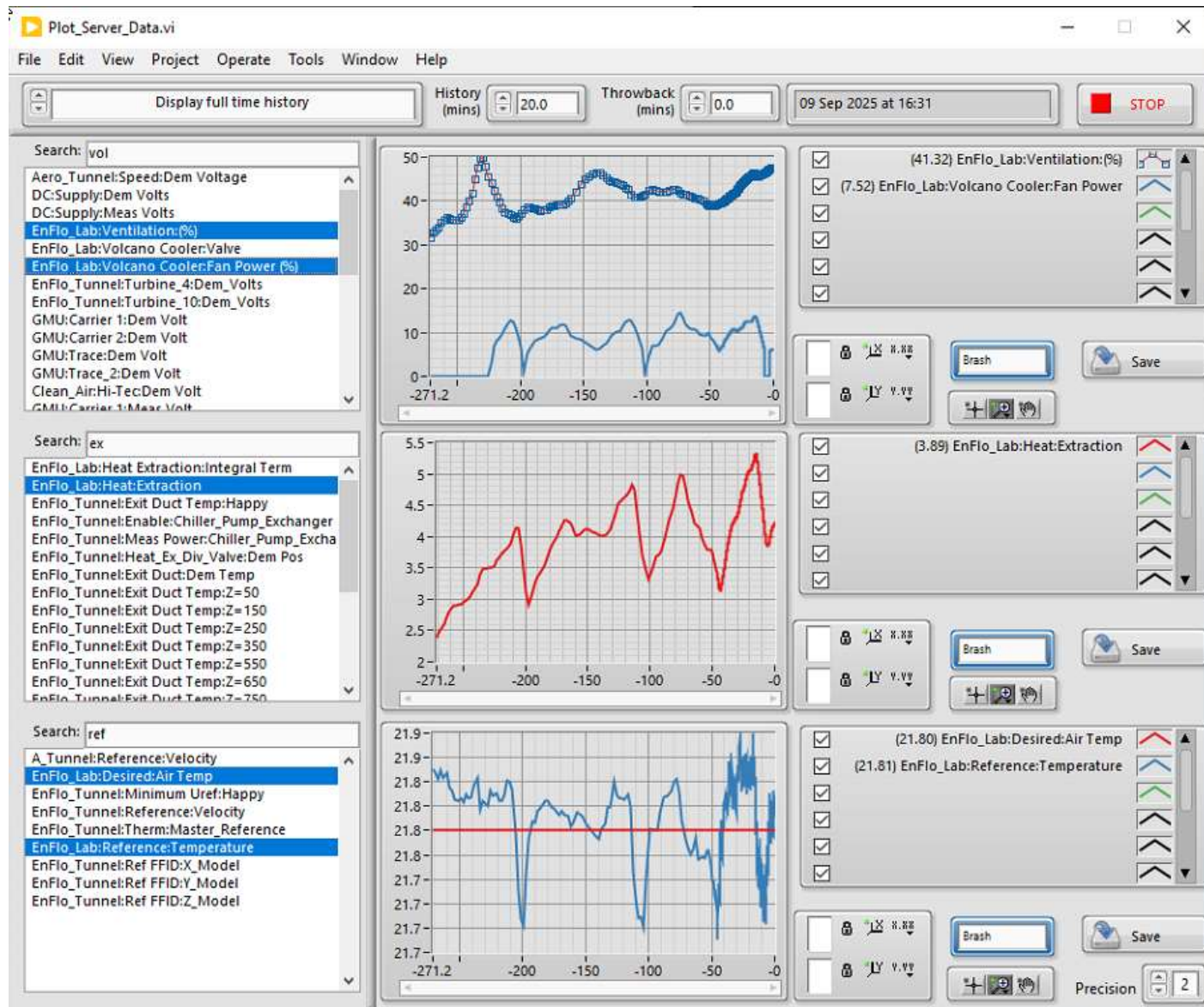
Bank of heaters
~12kW



Back End Chiller



Inlet Heaters
405kW



Lab Temperature Control

Principles of Safety

LabVIEW Software control to operate Tunnel inside a safe envelope
But Hardware Trip Sensors for:

- Watchdog heartbeat from LabVIEW on Server <5mins
- Inlet heaters too hot
- Exit temperature too high
- Chilled water pressure too high
- Source gas above flammable limit
- Water leak indicator

Emergency stop button pressed or Fireman's switch
Unattended Apparatus – Silent Hour Running Form to Security
Documented in the EnFlo lab Risk assessment



Run Monitoring - Stopping a rubbish run

When running heated tunnel can use ~200kW expensive!

Fibre optic loose efficiency with number of hours ~5K to repolish

Gas bottles, expensive

Run will shut down if:

Tunnel computer locks up (Server computer does this)

Run out of gas

Tunnel speed error

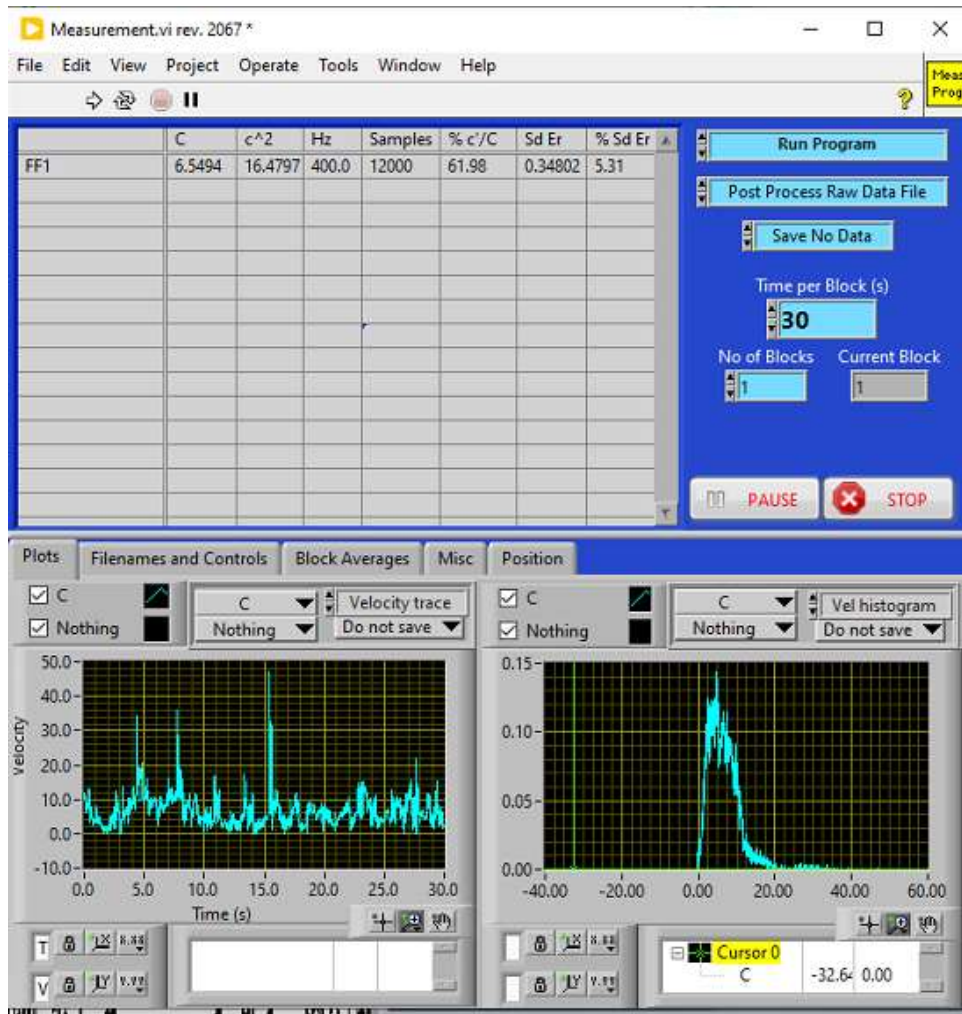
Any inlet heater not working

NaN from Acquisition systems

Very poor Fast Flame Ionisation detector Calibration

Laser power goes to zero from probe etc etc etc

Taking data – Measurement.vi



This takes the high Frequency Data $>0.5\text{Hz}$

Such as:

Flame Ionisation Detectors

Pressure probes Pitot 7HP

Laser Doppler Anemometry

Hot wire, Cross wire

Analogue data

Can write your own Acquisition plugins

Saves raw data in binary format

All metadata channels from the server also stored

Results File contains all the Stats

Two modes:

Take New Data

Post Process raw data file ~25 years of data

Measurement Setup File

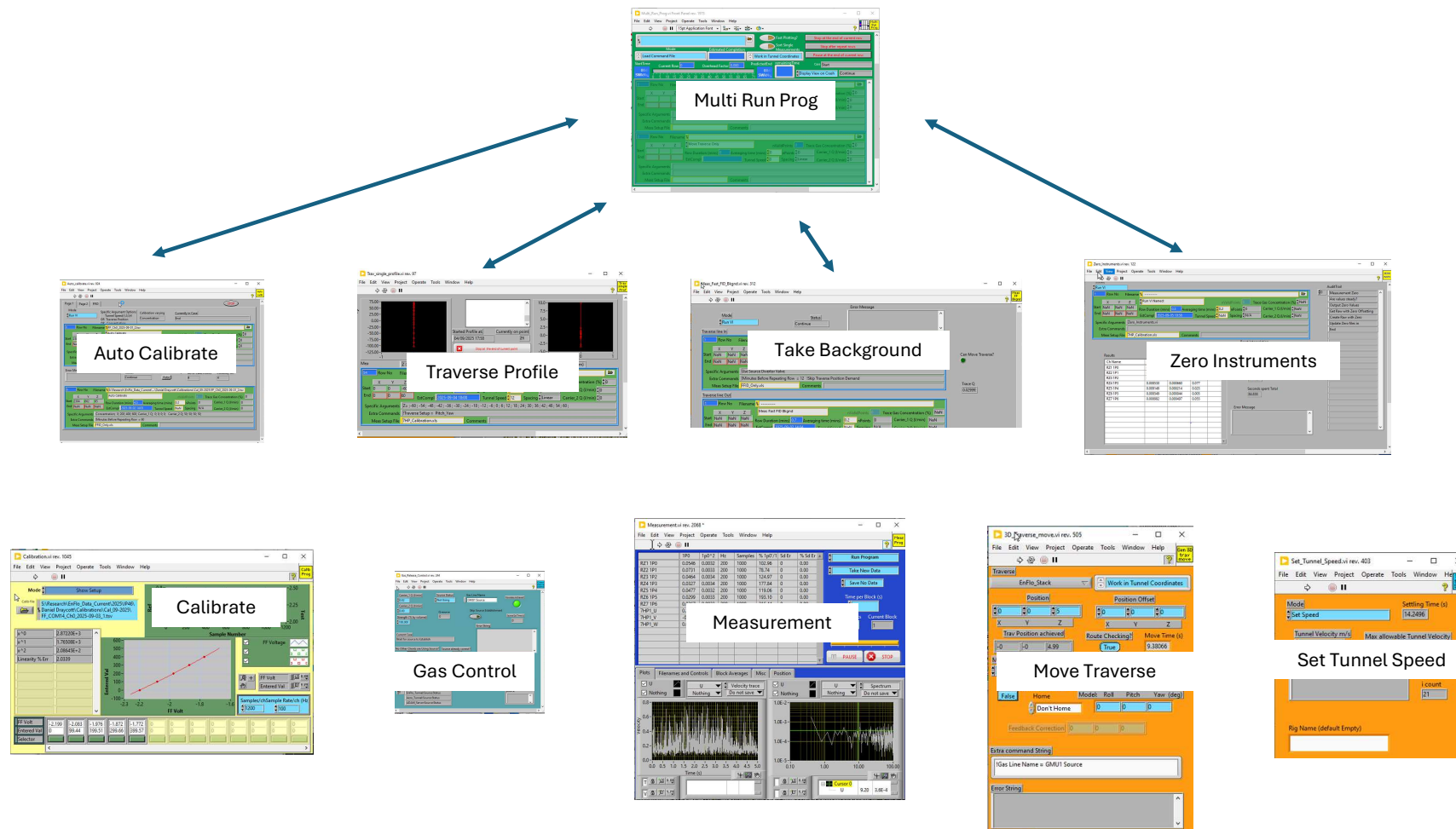
The screenshot displays a Microsoft Excel spreadsheet titled "FFID_Only.xls" with a ribbon menu showing tabs like File, Home, Insert, Draw, Page Layout, Formulas, Data, Review, View, Automate, Add-ins, Help, and Acrobat. The spreadsheet contains a table with columns for various measurement parameters. A LabVIEW "Measurement_input_panel.vi rev. 1135" window is overlaid on the spreadsheet, showing a configuration interface for analogue instruments.

Inst Array	Port	Inst type	Units sym	Sampling	Device ID	Sync Dela	Ch No	Use latest	Calib filename	Label	X Pos	Y Pos	Z Pos	Initial X	Initial Y	Initial Z	Traverse S	On Axes	ADAM_Ch	Code nam	Metadata	Metadata	chState	Input Config
Analogue	COM8	Fast FID		10000	Na-DAS_7609.vi	0	0	TRUE	S:\Research\EnFlo_C		2000.006	-0.003	14.994	0	0	0	EnFlo_Tra	X Y Z	1FF:C	FF1:FFID:T	HFR500;27;ESN 250	- Channel 2;OD 0.56mm	I	

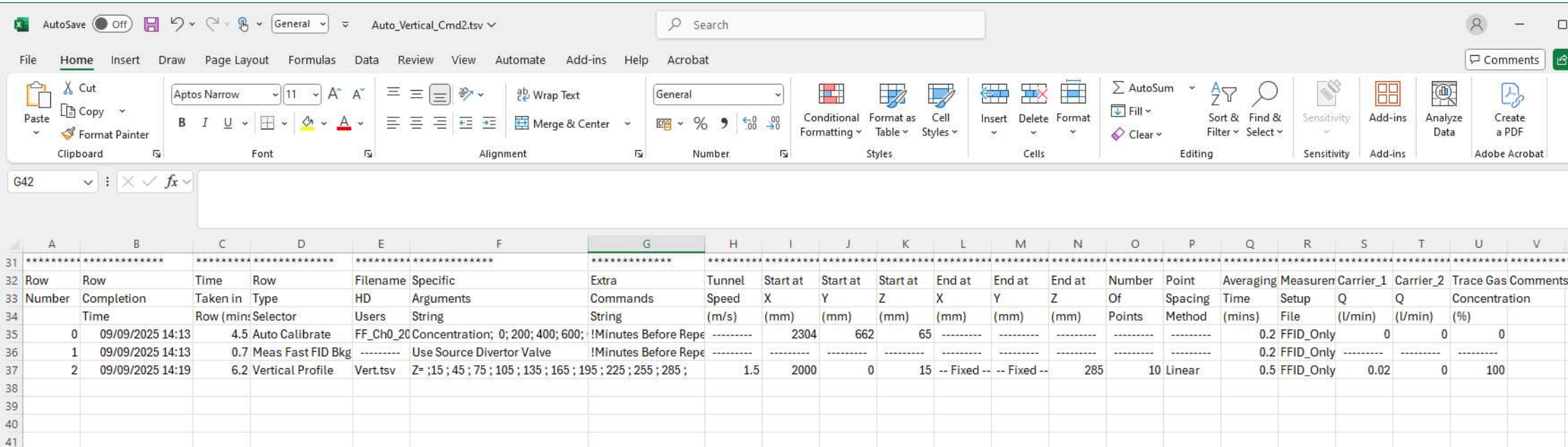
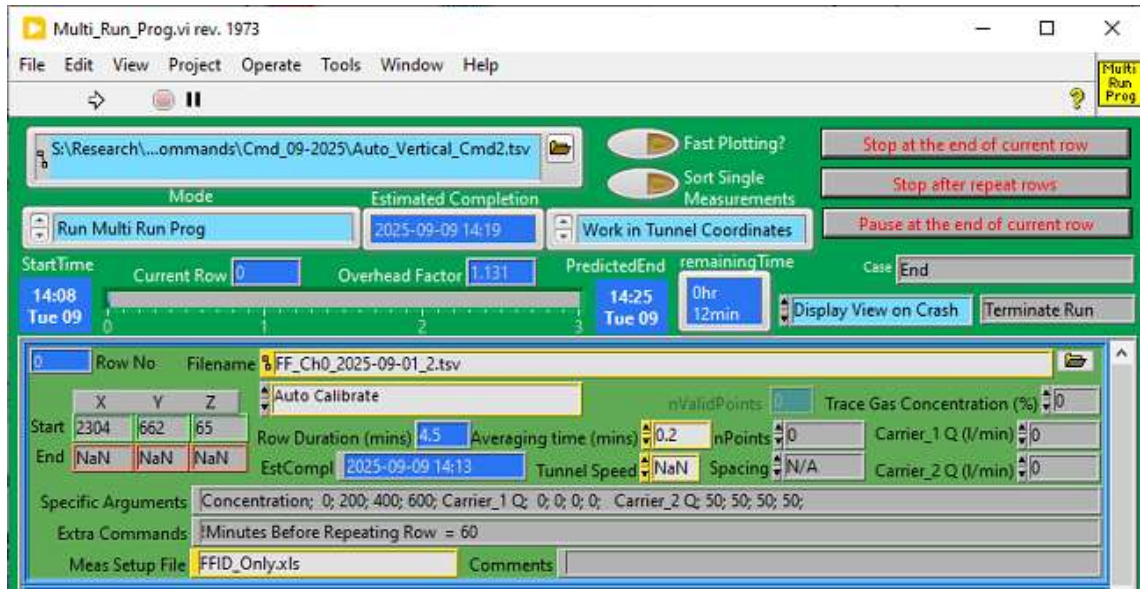
The LabVIEW panel shows the following configuration:

- Number of Analogue Instruments: 1
- Use Analogue channel to software sync with LDA: [checked]
- No LDA data: [button]
- Number of LDA Chs: 0
- Edit LDA Setup: [button]
- No PWA Data: [button]
- Instrument 1: Fast FID, Label C, Fs 10kHz, Sync Delay 0ms, DAQ Na-DAS_7609.vi, CAL: Latest, Input Config, Port /Dev COM8, Ch 0
- Instrument 2: Raw voltage, Label, Fs 0Hz, Sync Delay 0ms, DAQ, CAL: Latest, Input Config, Port /Dev, Ch 0
- Instrument 3: Raw voltage, Label, Fs 0Hz, Sync Delay 0ms, DAQ, CAL: Latest, Input Config, Port /Dev, Ch 0

The Multi-run Program Hierarchy



Multi Run Command File



Run Monitoring – Warning User

Calibration drift great than 8%

Bkgnd Variance Too High

Signal clipping FF1 has 0.4% Overflows at ADC.

Unsteady Point

Poor Data Warning instrument has NaN values

Wind Turbine Speed Error

The Server IP No 131.227.181.108, is not responding.

Traverse Error Z Dem Pos = 0.0 Achieved Pos = 326.7 mm

With VNC the user can make a decision on what to do from home

Example Email

IP46Tun Calibration Drift



Enflo Lab (FEPS Faculty Admin)

To: Enflo Lab (FEPS Faculty Admin); Draycott, Daniel J (PG/R - Sch of Engineering)



Tue 09/09/2025 16:07

We removed extra line breaks from this message.

Fast FID calibration "S:\Research\EnFlo_Data_Current\2025\IP46\Daniel Draycott\Calibrations\Cal_09-2025\FF_COM12_Ch0_2025-09-09_6.tsv" has changed by 5.12% since the previous one "FF_COM12_Ch0_2025-09-09_5.tsv" which was taken 1.7 hours before.

Fast FID calibration "S:\Research\EnFlo_Data_Current\2025\IP46\Daniel Draycott\Calibrations\Cal_09-2025\FF_COM14_Ch0_2025-09-09_6.tsv" has changed by 5.12% since the previous one "FF_COM14_Ch0_2025-09-09_5.tsv" which was taken 1.7 hours before.

Results File:
FF_COM14_Ch0_2025-09-09_6.tsv

Raw Data File:
<DATA_ROOT>\2025\IP46\Daniel
Draycott\Raw_Calibrations\Raw_Cal_09-2025\FF_COM12_Ch0_2025-09-09_6_tsv\
Raw Data\FF_COM12_Ch0_2025-09-09_6_12.xls

EnFlo_Stack Position in Tunnel Coordinates X=-0, Y=-0, Z=17749mm The Multi Run Prog that started 2025-09-09 16:01 is in Row 2 of command file Cmd 115 Rotate Meas.tsv Row Type Auto Calibrate Current overhead Factor = 26.9%, Estimated completion time is 2025-09-09 16:14.

Call chain:
Multi_Run_Prog.vi
Execute_Row.vi
Execute_remote_call.vi
Auto_calibrate.vi

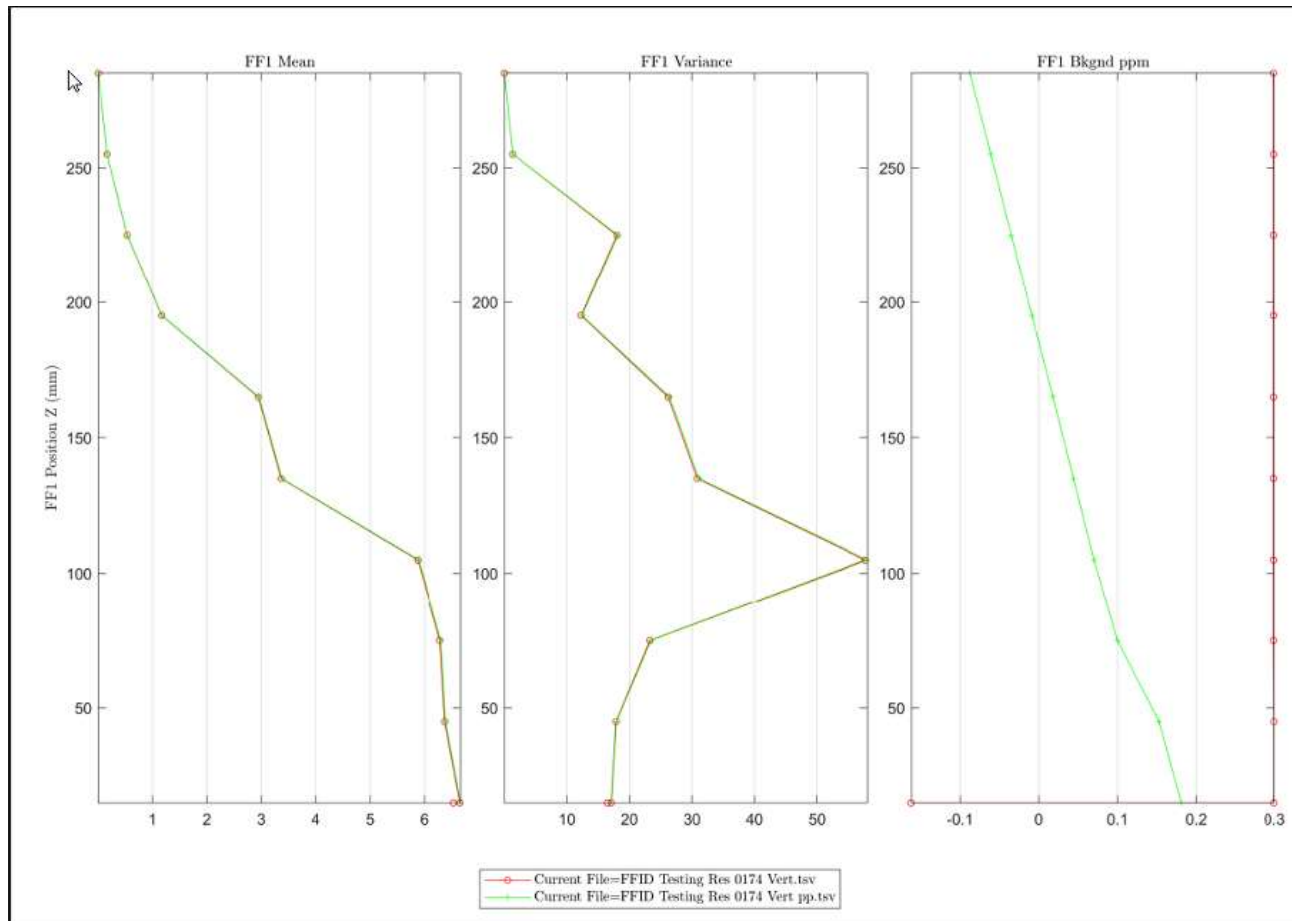
File Home Insert Draw Page Layout Formulas Data Review View Automate Add-ins Help Acrobat

Paste **Clipboard** **Font** **Alignment** **% Number** **Conditional Formatting** **Format as Table** **Cell Styles** **Cells** **Editing** **Sensitivity**

A1 : fx FF1

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	FF1	FF1	FF1	FF1	Raw	Current	Template	Seconds	Current	FF1	FF1	FF1	
2	Position	Position	Position	Mean	Data	Filepath	File	since	File	Variance	Calibration	Bkgnd	
3	X (mm)	Y (mm)	Z (mm)		Filename		Used	1st Jan			Drift	ppm	
5	2000	0	15	6.6672	<DATA_RC S:\Research\Dan FFID I			3.84E+09	FFID Testi	17.0908	0.26	0.30011	
6	2000	0	15	6.6796	<DATA_RC S:\Research\Dan FFID I			3.84E+09	FFID Testi	17.1526	0.26	0.18114	
7	2000.006	-0.00342	44.9946	6.3868	<DATA_RC S:\Research\Dan FFID I			3.84E+09	FFID Testi	17.8513	0.26	0.30011	
8	2000.006	-0.003	44.995	6.4017	<DATA_RC S:\Research\Dan FFID I			3.84E+09	FFID Testi	17.9313	0.26	0.15275	
9	2000.006	-0.00342	74.9946	6.2969	<DATA_RC S:\Research\Dan FFID I			3.84E+09	FFID Testi	23.2899	0.26	0.29952	
10	2000.006	-0.003	74.995	6.3162	<DATA_RC S:\Research\Dan FFID I			3.84E+09	FFID Testi	23.4314	0.26	0.099944	
11	2000.006	-0.00342	104.9946	5.878	<DATA_RC S:\Research\Dan FFID I			3.84E+09	FFID Testi	57.828	0.26	0.29952	
12	2000.006	-0.003	104.995	5.8987	<DATA_RC S:\Research\Dan FFID I			3.84E+09	FFID Testi	58.2168	0.26	0.070161	
13	2000.006	-0.00342	134.9951	3.3652	<DATA_RC S:\Research\Dan FFID I			3.84E+09	FFID Testi	30.8633	0.26	0.29952	
14	2000.006	-0.003	134.995	3.3787	<DATA_RC S:\Research\Dan FFID I			3.84E+09	FFID Testi	31.1017	0.26	0.044096	
15	2000.006	-0.00342	164.9946	2.943	<DATA_RC S:\Research\Dan FFID I			3.84E+09	FFID Testi	26.207	0.26	0.29952	
16	2000.006	-0.003	164.995	2.9561	<DATA_RC S:\Research\Dan FFID I			3.84E+09	FFID Testi	26.4308	0.26	0.018003	
17	2000.006	-0.00342	194.9946	1.1703	<DATA_RC S:\Research\Dan FFID I			3.84E+09	FFID Testi	12.2919	0.26	0.29952	
18	2000.006	-0.003	194.995	1.1764	<DATA_RC S:\Research\Dan FFID I			3.84E+09	FFID Testi	12.407	0.26	-0.00867	
19	2000.006	-0.00342	224.9946	0.5334	<DATA_RC S:\Research\Dan FFID I			3.84E+09	FFID Testi	18.0153	0.26	0.29952	
20	2000.006	-0.003	224.995	0.53666	<DATA_RC S:\Research\Dan FFID I			3.84E+09	FFID Testi	18.1844	0.26	-0.03496	
21	2000.006	-0.00342	254.9946	0.16342	<DATA_RC S:\Research\Dan FFID I			3.84E+09	FFID Testi	1.3807	0.26	0.29952	
22	2000.006	-0.003	254.995	0.165	<DATA_RC S:\Research\Dan FFID I			3.84E+09	FFID Testi	1.3958	0.26	-0.06101	
23	2000.006	-0.00342	284.9946	0.00683	<DATA_RC S:\Research\Dan FFID I			3.84E+09	FFID Testi	0.028033	0.26	0.29952	
24	2000.006	-0.003	284.995	0.00779	<DATA_RC S:\Research\Dan FFID I			3.84E+09	FFID Testi	0.028367	0.26	-0.08757	
25	2000.006	-0.00342	14.9946	6.5494	<DATA_RC S:\Research\Dan FFID I			3.84E+09	FFID Testi	16.4797	FF_Ch0_20	-0.16217	

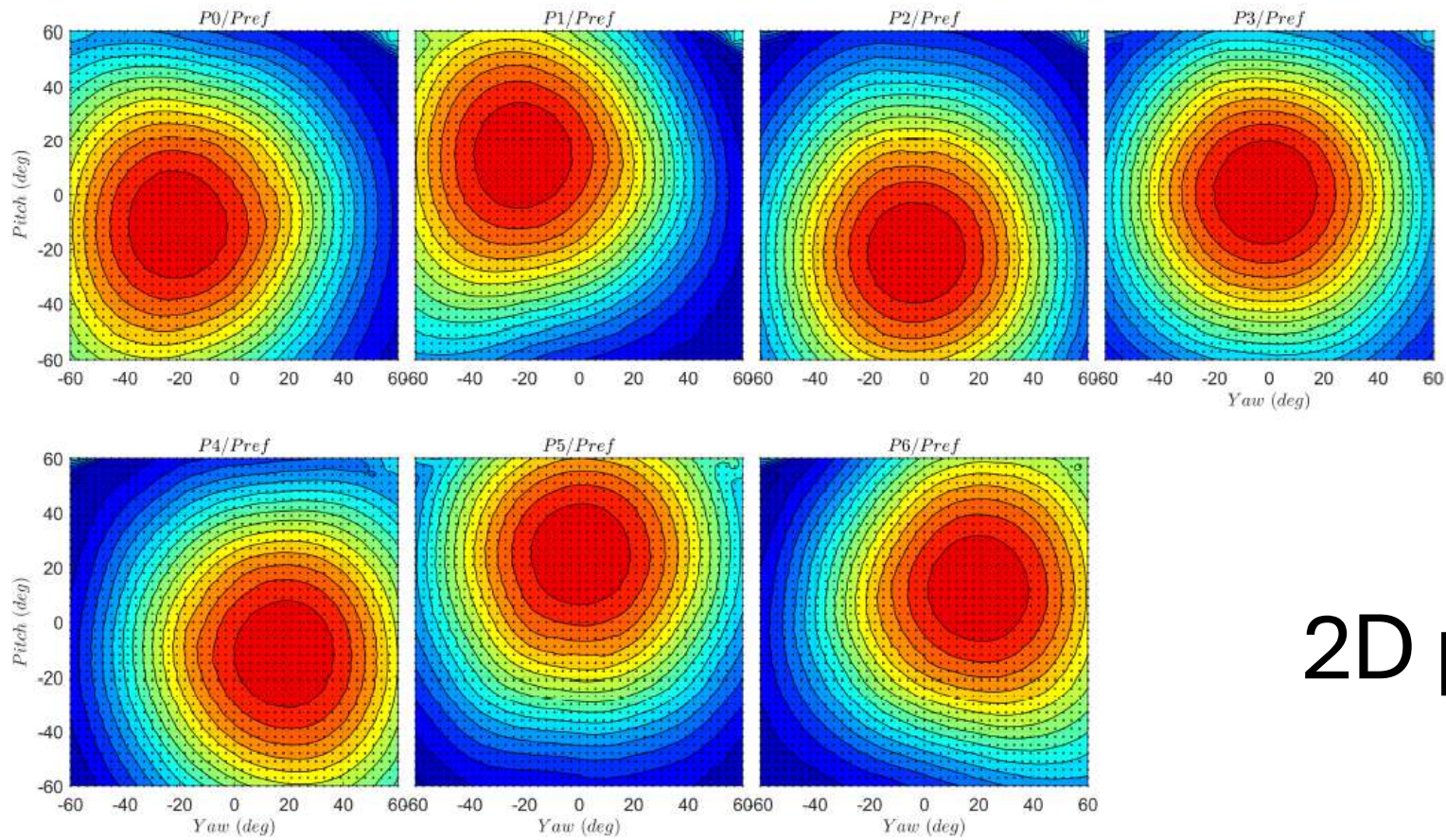
LabVIEW to MATLAB





Any
Questions?

File = Probe Calib Res 0065 calib SN1067 pp.tsv Date = Thu 04 Sep 2025 7HP SN = 1067



2D plotting

