How to Design

How I feel struggle to design

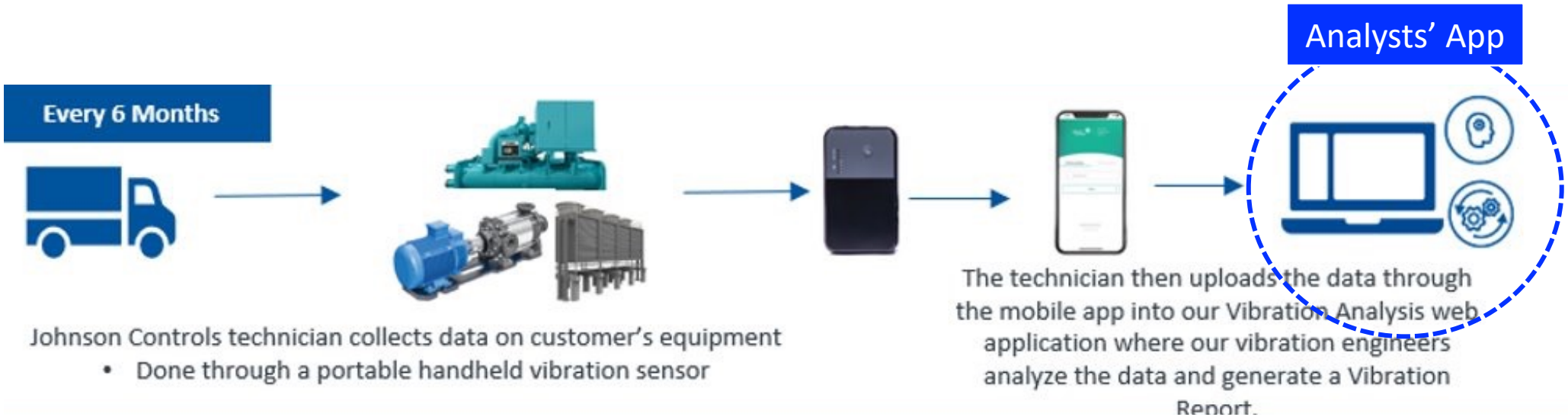
Complex Graphs

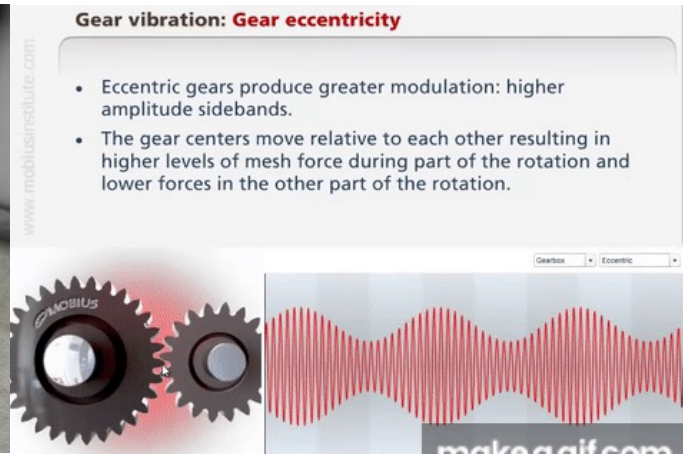
Agenda

1. OBVA Overview
2. Design Challenges
3. Design Experiment with New Tools
    - Zoom Level Experiment
    - Over-time Plots Experiment
4. Results & Future Works & Other Major Changes

1. OBVA Overview

Overview of Predictive Service

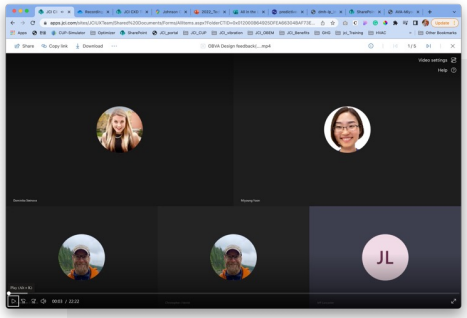




- Imbalances
- Bearing failures
- Mechanical looseness
- Misalignment
- Resonance and natural frequencies
- Electrical motor faults
- Bent shafts
- Gearbox failures
- Empty space or bubbles (cavitation
- Critical speed issues

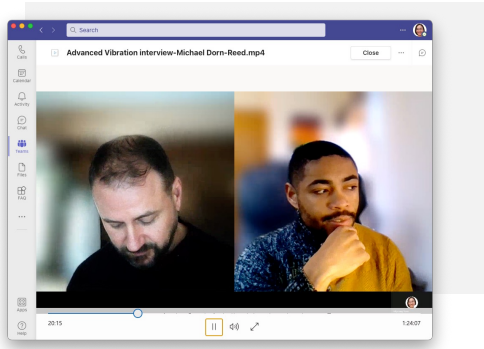
Work Process – What we have done

1 Stakeholder interviews



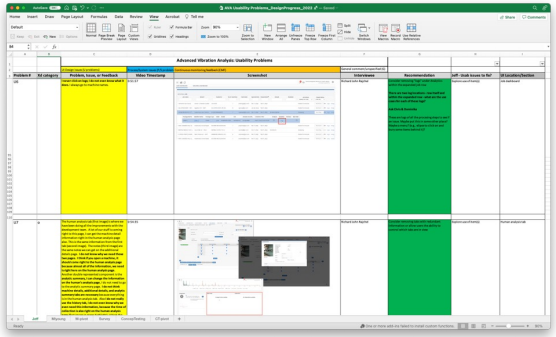
[More videos]

2 Analyst interviews



[More videos]

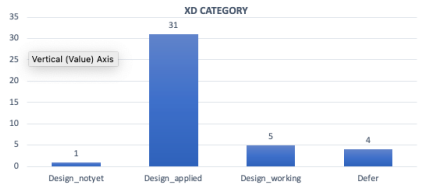
3 Usability problem lists



[Excel Lists]

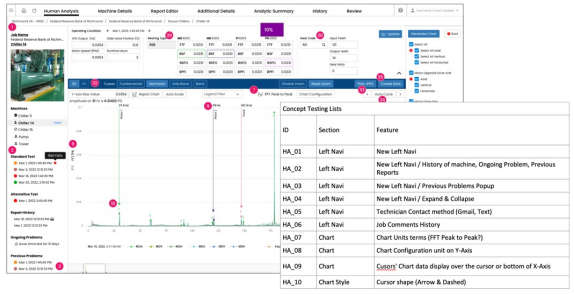
4 Categorized by SW and UX issues

Menu/visual element design	21	2	Additional details tab
Explore use of item(s)	1	1	Analytic summary tab
Graph refinement	8	27	Human analysis tab
Singular location	11	11	Job dashboard
User control of defaults	2	2	Machine details tab
Information design	9	7	Report editor tab
		5	Misc
		1	Explore use of items - potential
		56	TOTAL



[Categorized Lists with XD id]

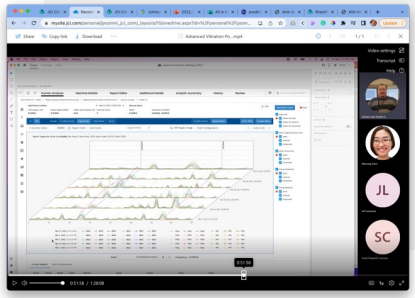
5 Design Prototypes



ID	Section	Feature
HA_01	Left Navi	New Left Navi
HA_02	Left Navi	New Left Navi / History of machine, Ongoing Problem, Previous Reports
HA_03	Left Navi	New Left Navi / Previous Problems Popup
HA_04	Left Navi	New Left Navi / Expand & Collapse
HA_05	Left Navi	Technician Contact method (Gmail, Text)
HA_06	Left Navi	Job Comments History
HA_07	Chart	Chart Units terms (FFT Peak to Peak?)
HA_08	Chart	Chart Configuration unit on Y-Axis
HA_09	Chart	Cusors' Chart data display over the cursor or bottom of X-Axis
HA_10	Chart Style	Cursor shape (Arrow & Dashed)

[XD Link]

6 Concept Feedbacks



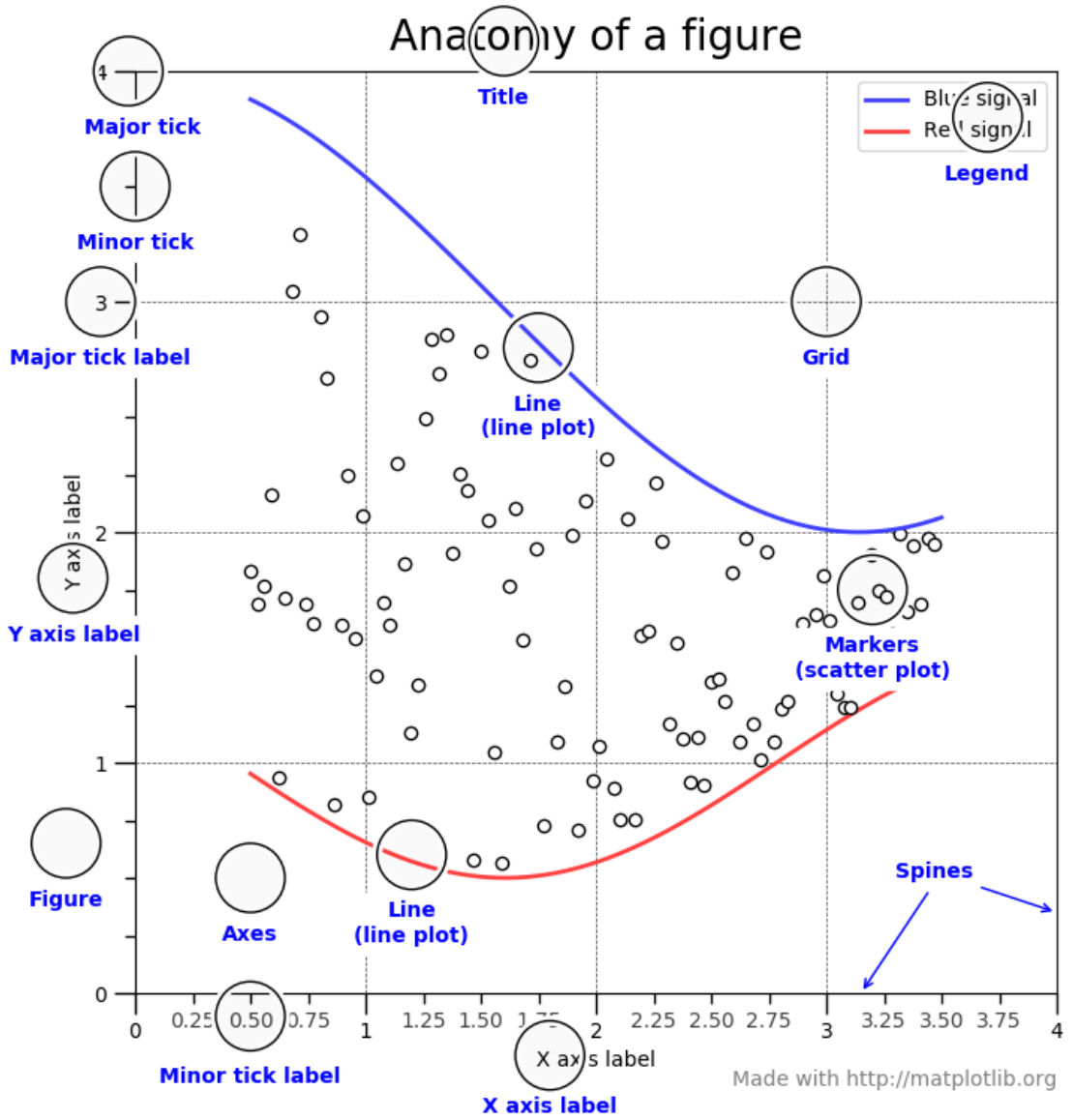
[Videos] [Interview Scripts]

2. Design Challenges

If you design a chart or plots, how could you start?

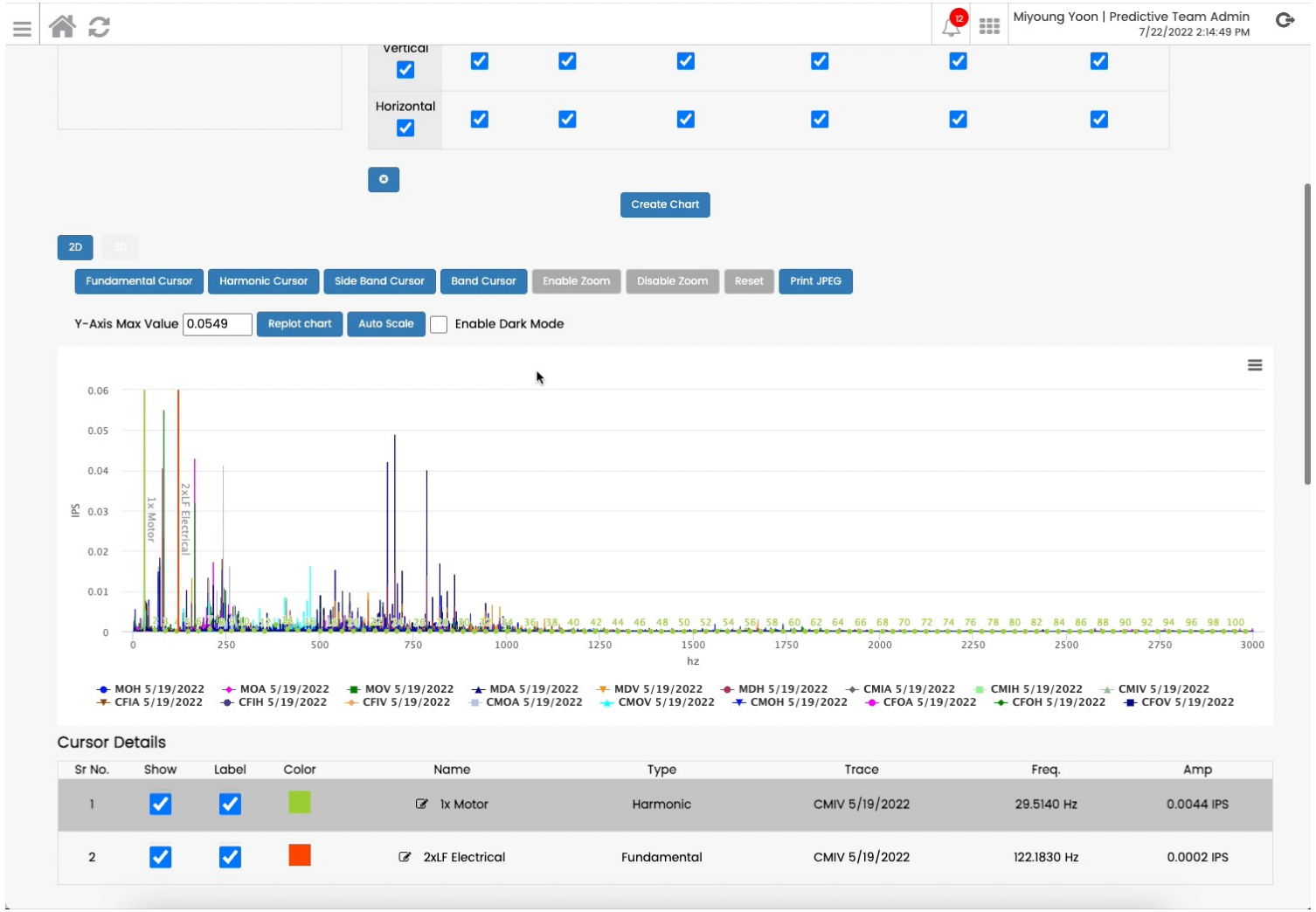
Understand…

1. Data table
2. Graph elements
3. Interactions



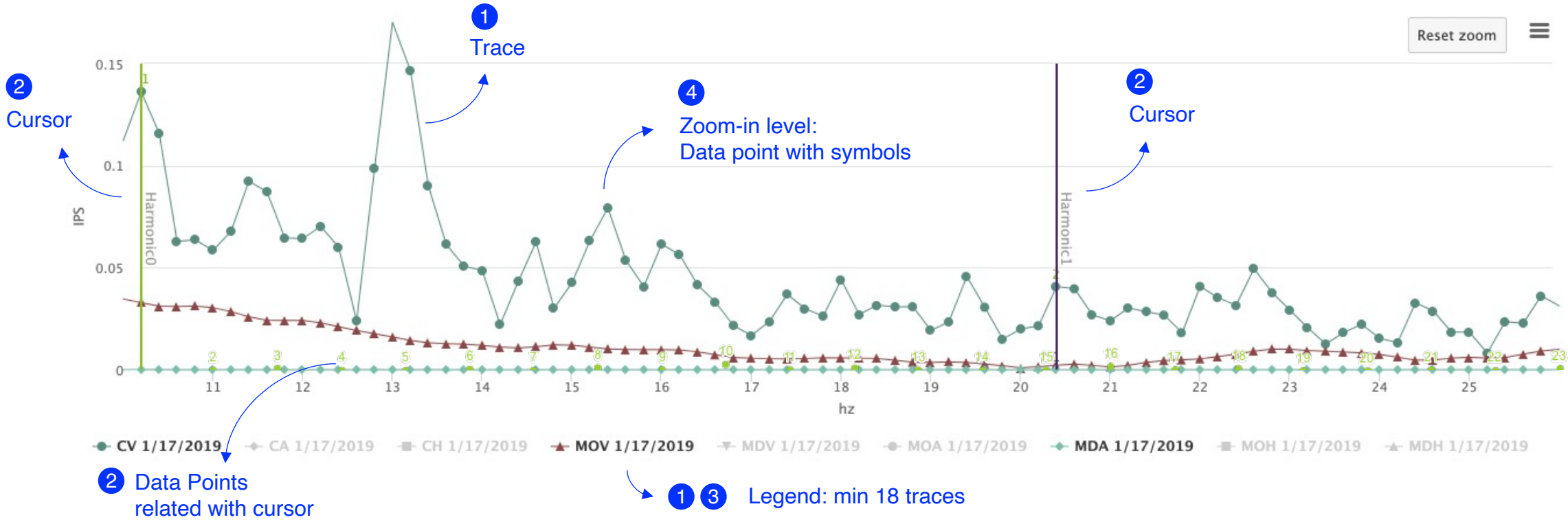
OBVA Challenges

1. Chart as a **Tool** not the information
2. Many variables
3. Chart types
4. Color accessibility



Variables Summary

1. At least **9** or **>12 Traces**
2. **9 Cursors** Colors (Harmonic, Side Band, etc.)
3. Compare btw Past vs. Current Data (>18 Traces)
4. Zoom out/in Level
    1. Zoom in Level: Symbols
    2. Zoom out Level: No Symbols



Variables: Trace Numbers & Cursor Types

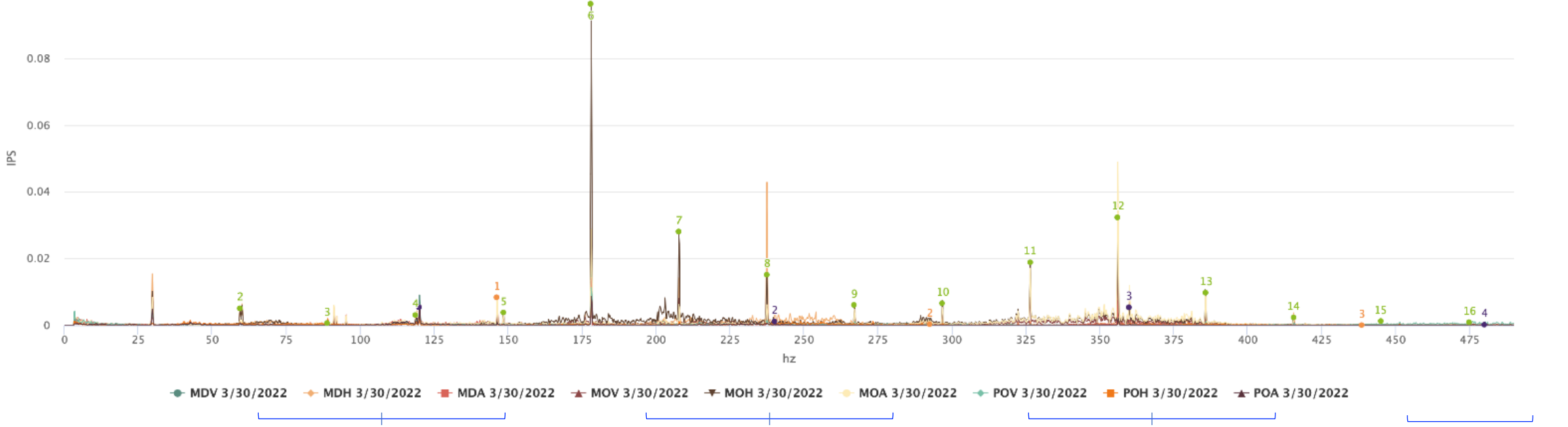
- Traces
  - **Current & Past time** should be distinguishable
  - **Each traces** represent of Machine's components should be distinguishable between lines
  - **Zoom out chart** doesn't have **trace's symbols** only colored lines should be distinguishable
  - **Light & dark** mode (Print version is Light)

Counts	Current	Past time	Total
Normal	9	9	18
Max	12	12	24
Rare 1	6	6	12
Rare 2	More than 12	More than 12	> 24

- Cursor types

Cursor Types	Usages
Harmonic	Most of cursor 90 %
Side Band	Finding pattern of Harmonic
Fundamental	Not use at all
Band Cursor	Specific customer to overall RMS

Counts	Current time	Past time	Total
Normal	3-4	Na	Na
Max	6-7	Na	Na



Motor Drive End Bearing

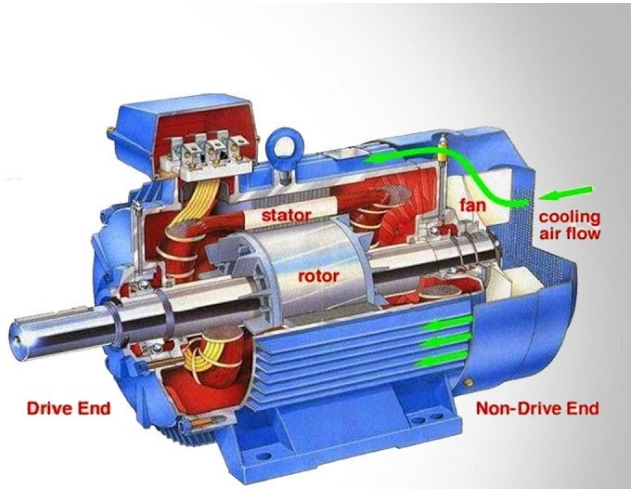
Motor Outbound Bearing

Pump Outbound Bearing

Other components…

(V: Vertical, H: Horizontal, A: Axial)

Pump



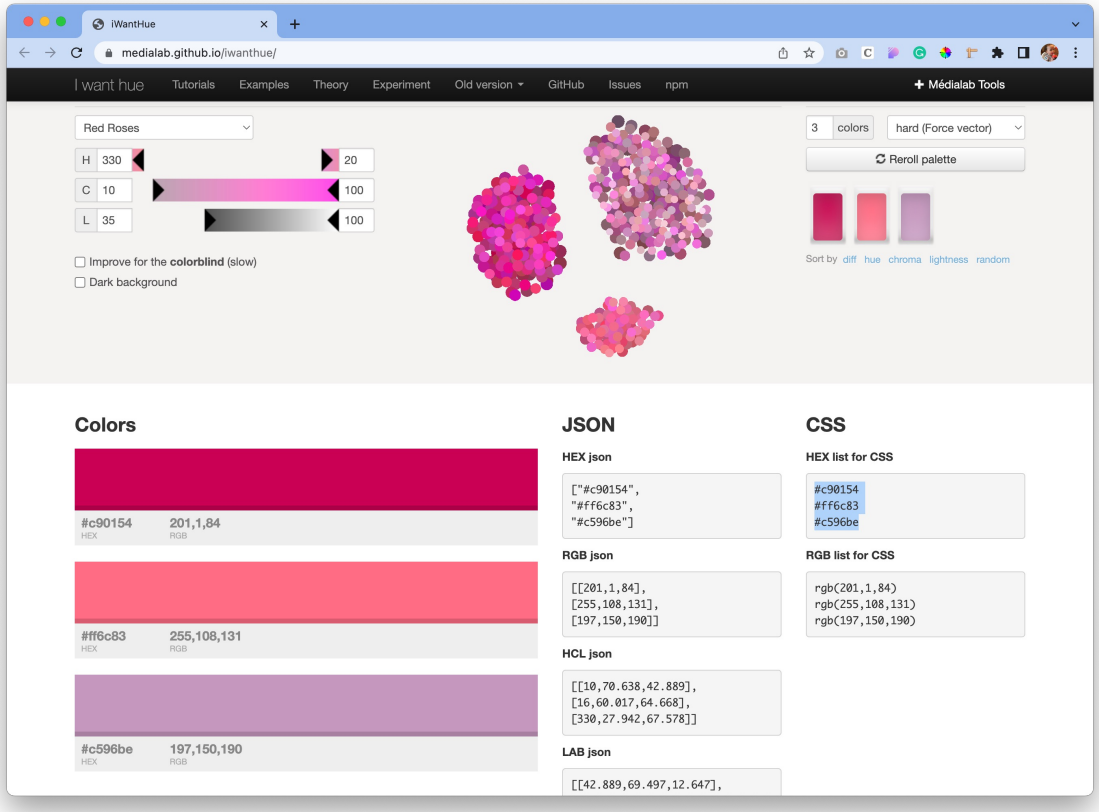
Parts of Motor

3. Design Experiment with New Tools

Color choice experiments with R

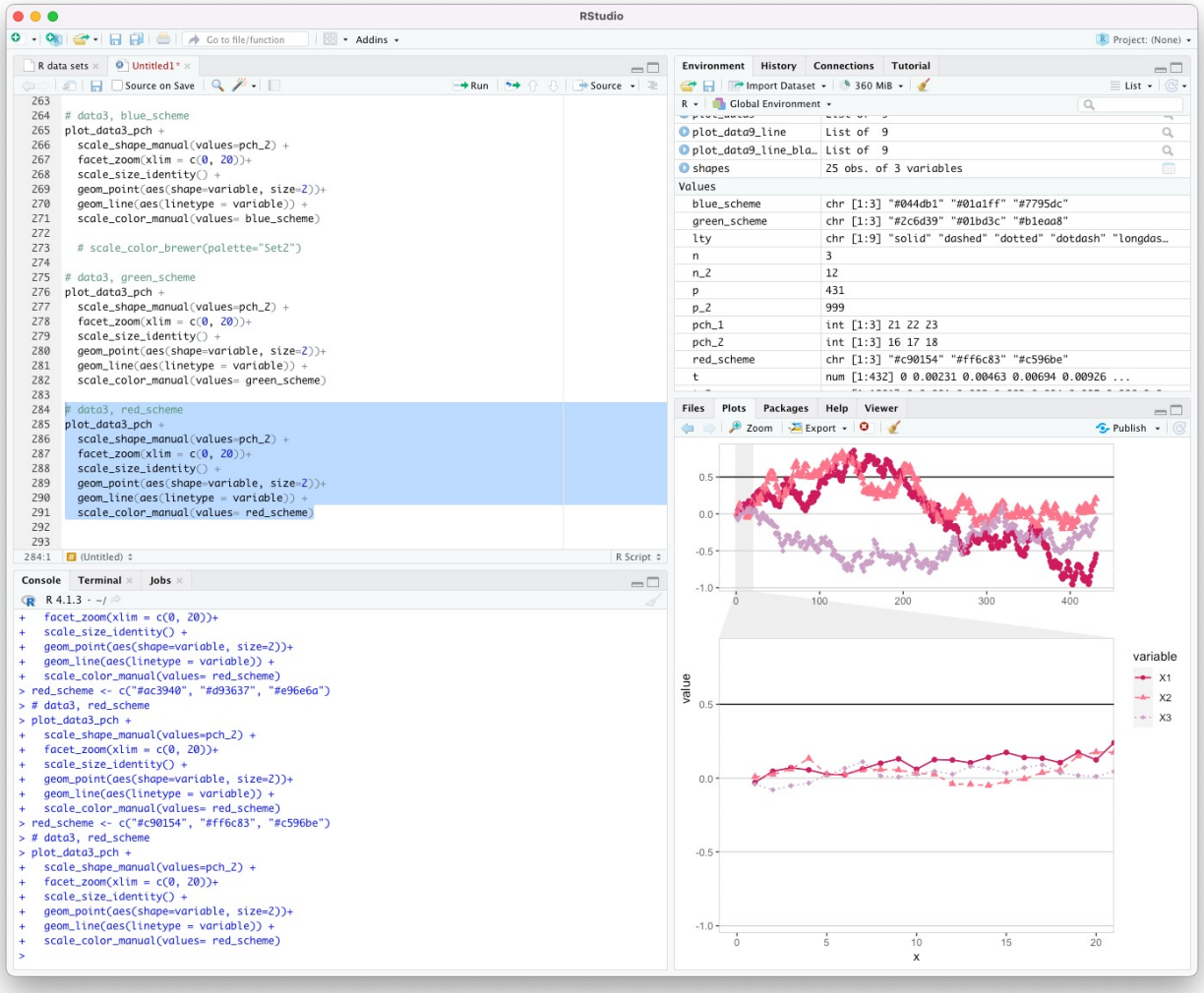
Color Choices (RGB & HCL)

Algorithm; k-mean clustering of HCL



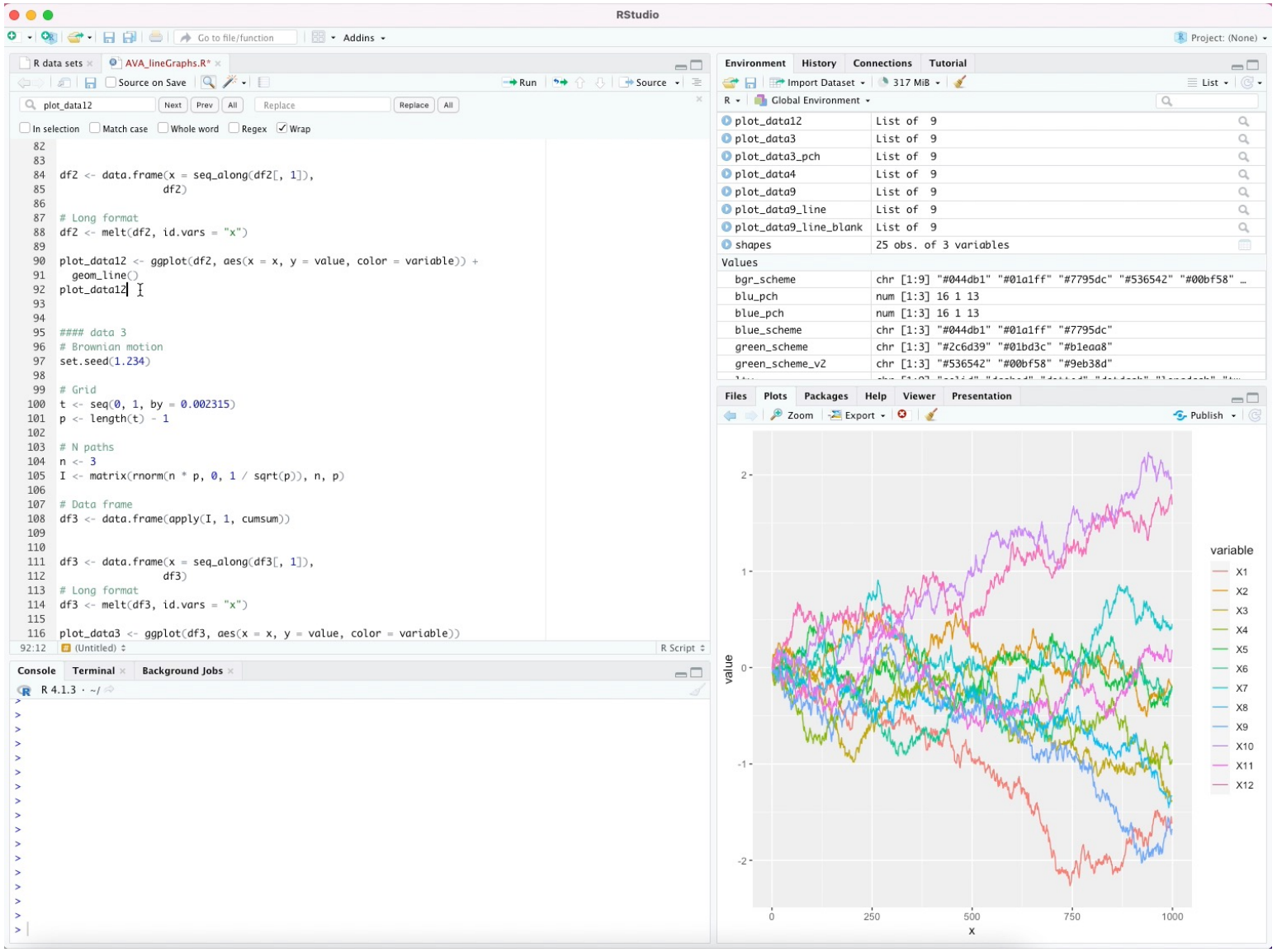
http://medialab.github.io/iwanthue/

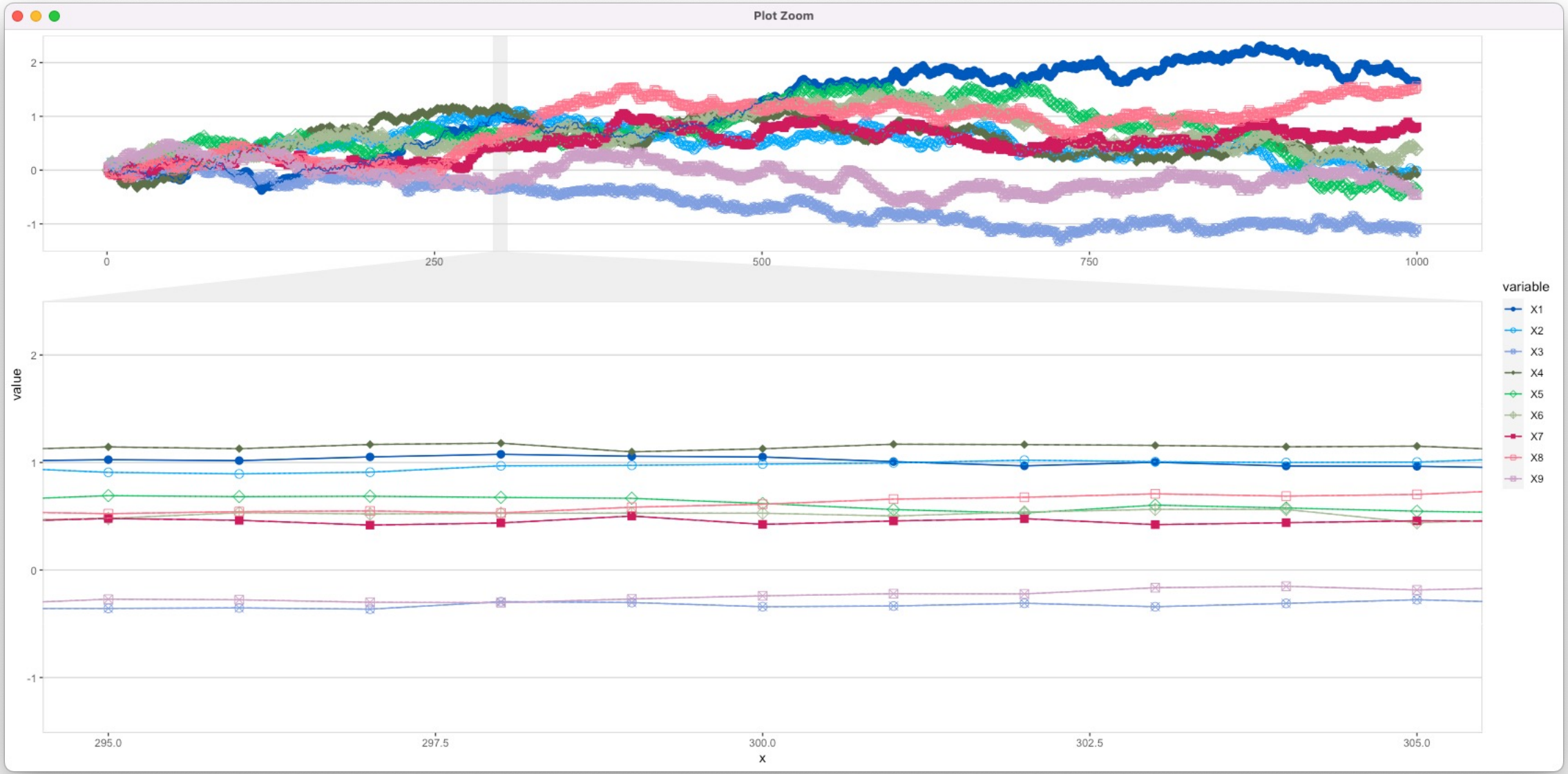
R Programming

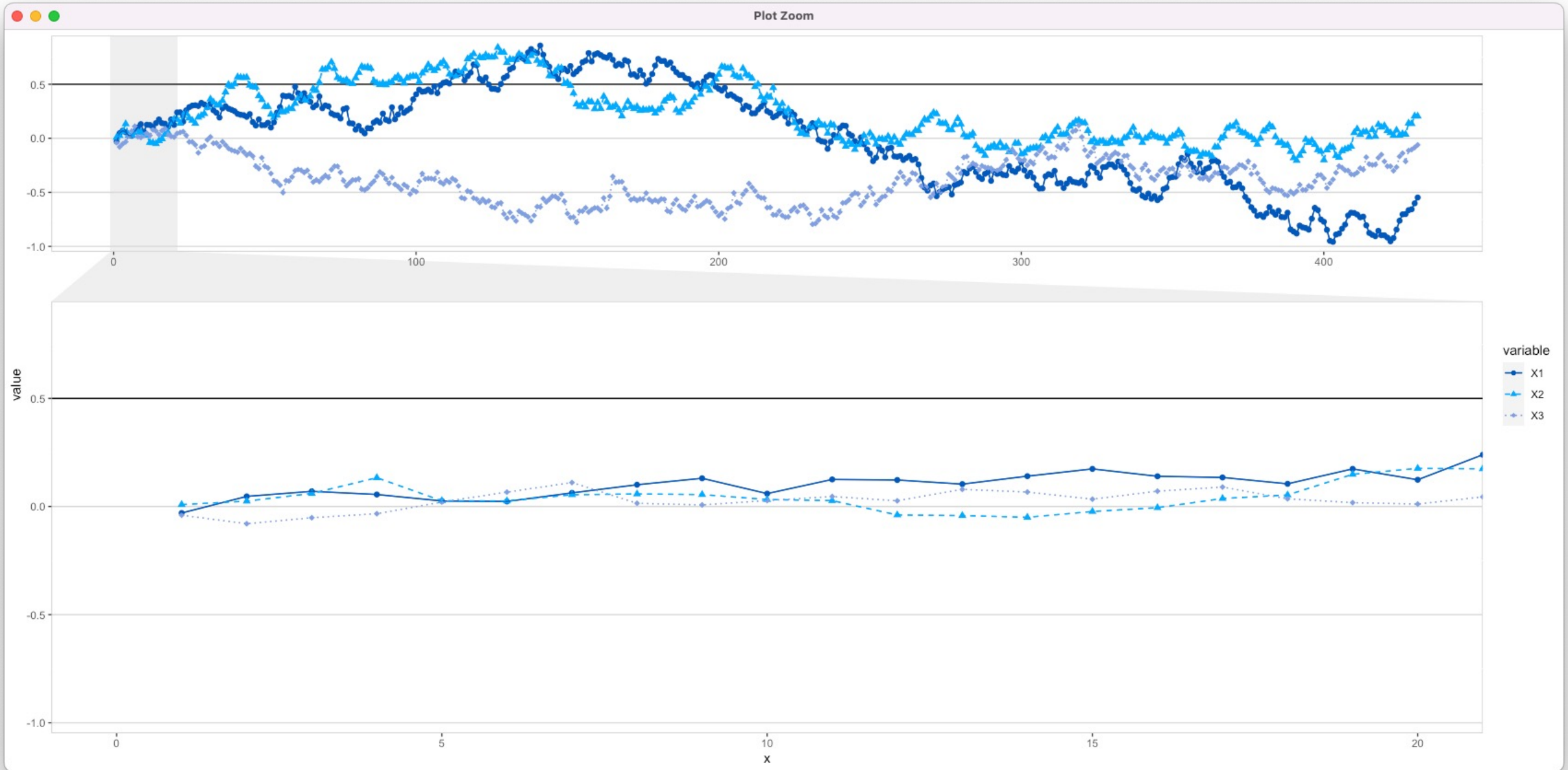


https://www.rstudio.com/products/rstudio/download/

R Demo (Duration 3:19)



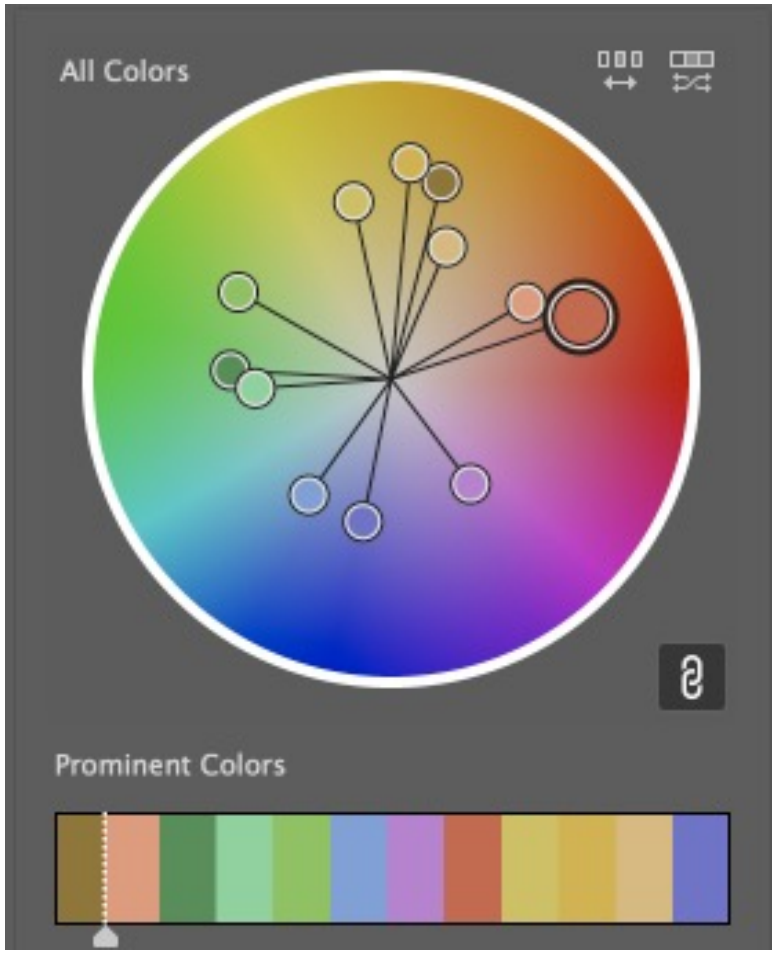

Plot Zoom
2
1
0
-1
0
250
500
750
1000
value
2
1
0
-1
295.0
297.5
300.0
302.5
305.0
x
variable
X1
X2
X3
X4
X5
X6
X7
X8
X9


Plot Zoom
0.5
0.0
-0.5
-1.0
0
100
200
300
400
value
0.5
0.0
-0.5
-1.0
0
5
10
15
20
x
variable
X1
X2
X3

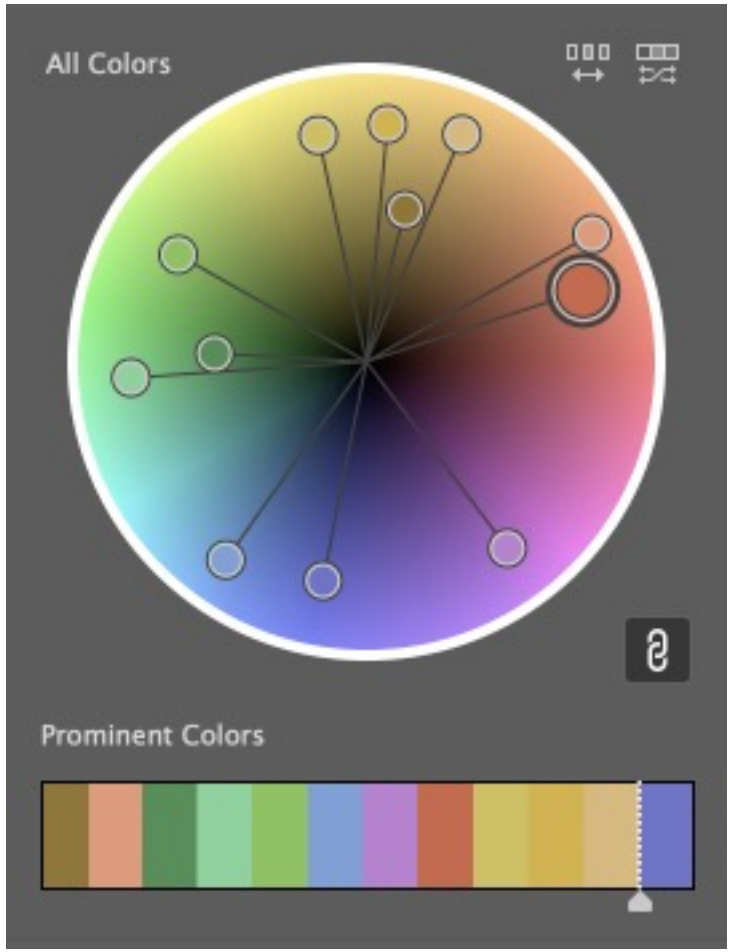
Design Reasoning & Color Rules

Color Reasoning

Traces

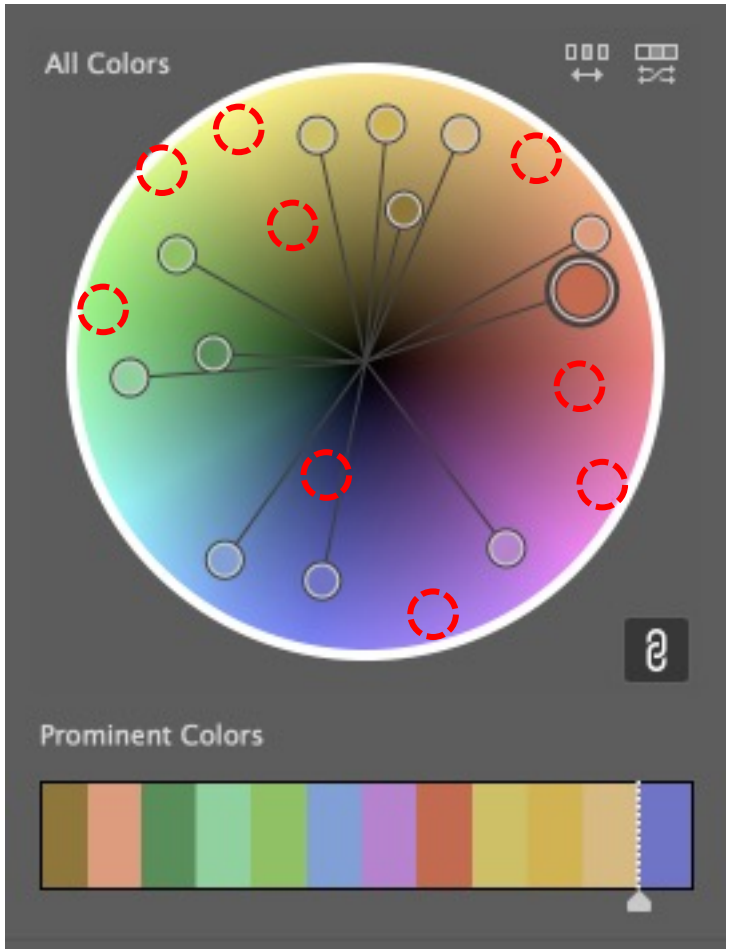


HUE



Saturation

Cursors



Potential Cursor colors

Rule Summary

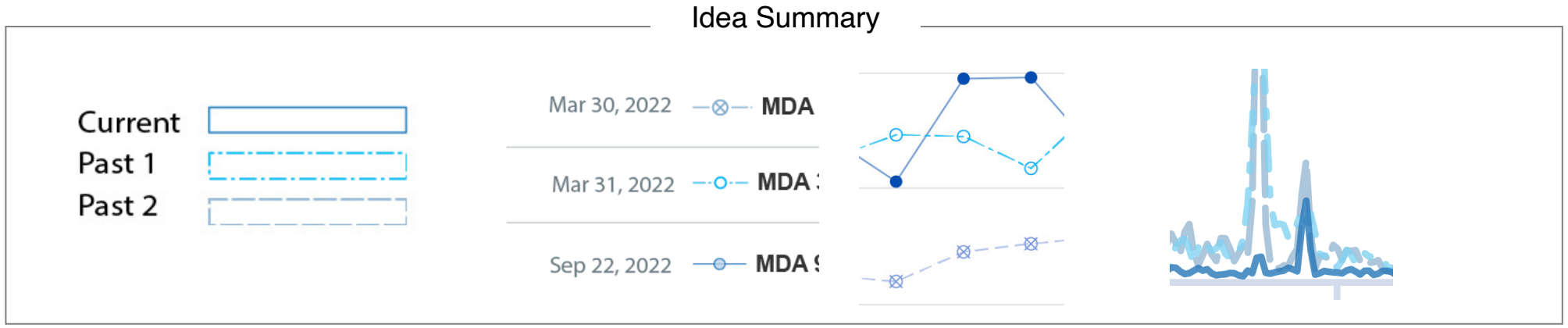
1) Component category color
   - Motor: Cooler color
   - Pump or Compressor: Warmer color
2) Work-flow order: MO > MD > PO > PI
3) Past data (dashed line+lower saturations)

Time	Current measurement
Machine	Motor / Pump Or (Compressor)
Component	MO / MD / PO / PI
Location	A V H A V H / A V H A V H
Color	Saturation Baseline
Symbol	○ □ △ ○ □ △ / ○ □ △ ○ □ △
Line types	Solid

Time	Past measurement
Machine	Motor / Pump
Component	MO / MD / PO / PI
Location	A V H A V H / A V H A V H
Color	Saturation Baseline – 20%
Symbol	○ □ △ ○ □ △ / ○ □ △ ○ □ △
Line types	Dashed

Past Measurement Rules (Line-types & Symbol fill)

Idea Summary



Rules

Motor

		MO			MD		
		A	V	H	A	V	H
Past 1							
	Line	Dash 4px, Gap 4px					
	Symbol	Hollow					
Past 2							
	Line	Dash 4px, Gap 2px					
	Symbol	Hollow and X mark					
Past n							
	Line	Dash 6px, Gap 2px					
	Symbol	?					

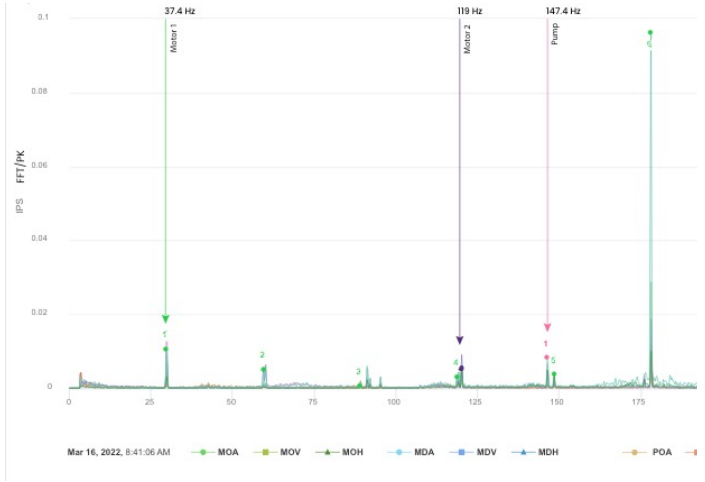
Line types

Graph Types

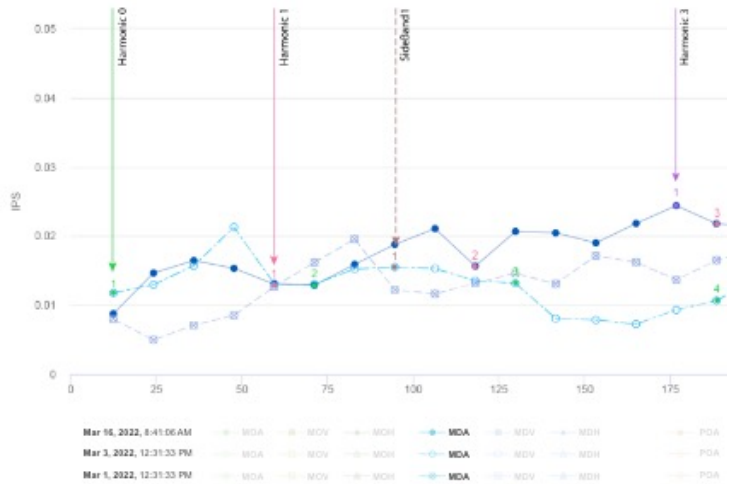
Graph Types

2D

2D-A) Zoom-out

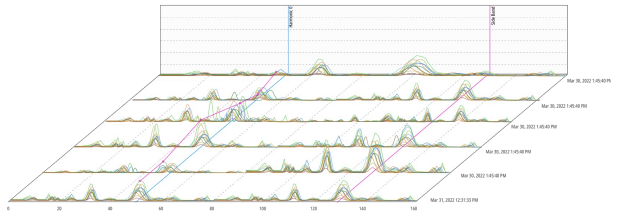


2D-B) Zoom-in

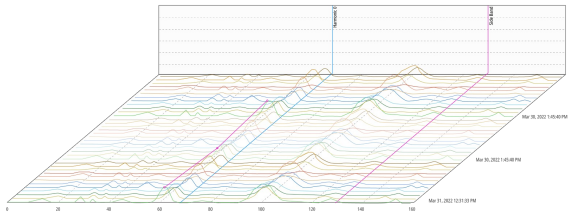


3D

3D-A) 45 Skewed & Stacked traces



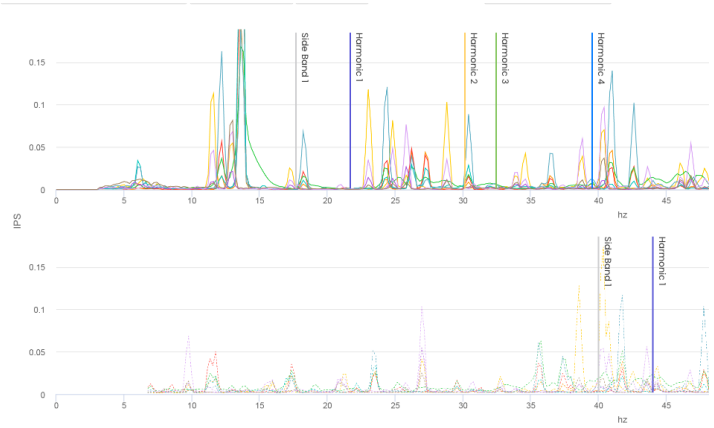
3D-B) 45 Skewed & Even placed traces



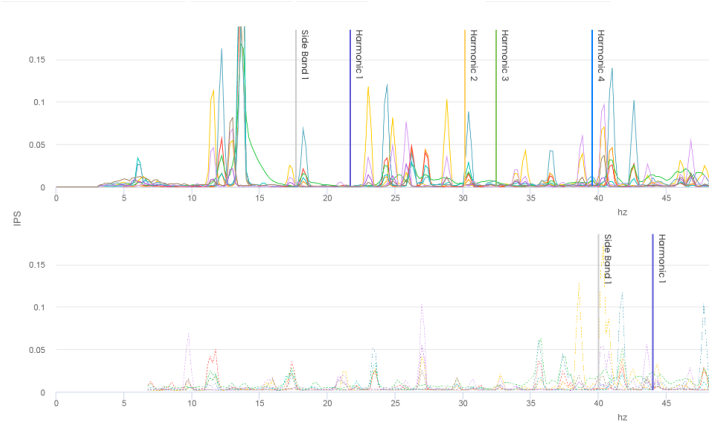
3D-C) 90 Skewed & Even or & Stacked

2D Multi-plots

Multi-A) Same data with different resolutions



Multi-B) Same data comparing current and past

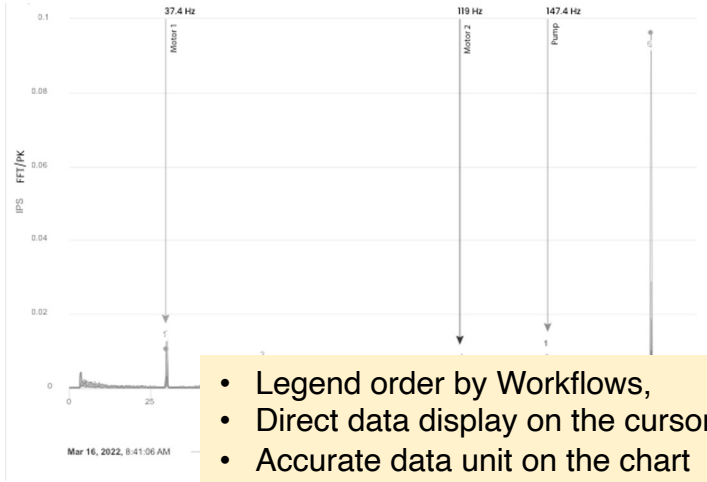


Potential Outcomes by Graph Types

Various chart types:
Analyze the data in different ways

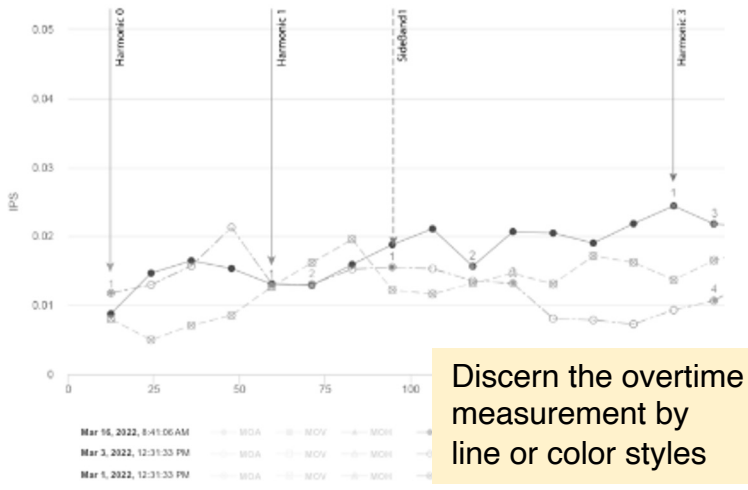
2D

2D-A) Zoom-out



- Legend order by Workflows,
- Direct data display on the cursor
- Accurate data unit on the chart

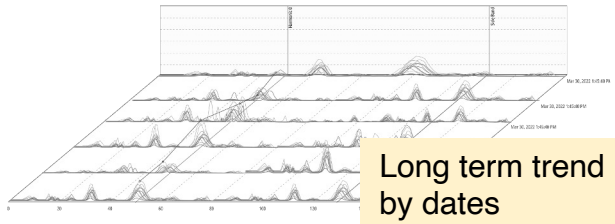
2D-B) Zoom-in



Discern the overtime measurement by line or color styles

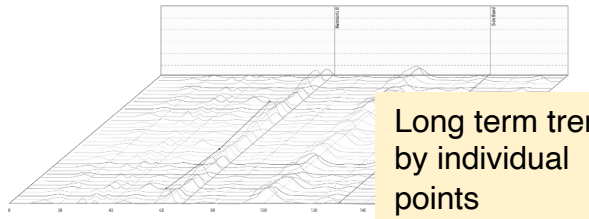
3D

3D-A) 45 Skewed & Stacked traces



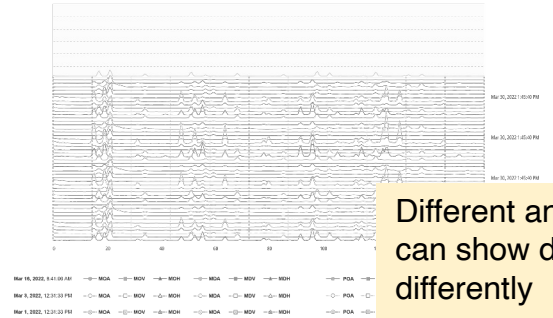
Long term trend by dates

3D-B) 45 Skewed & Even placed traces



Long term trend by individual points

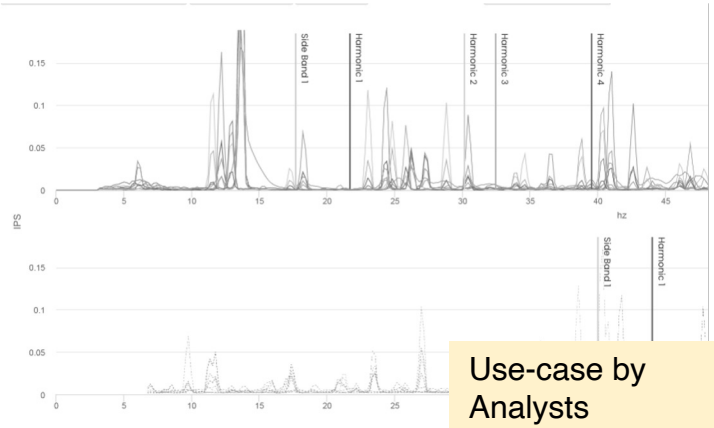
3D-C) 90 Skewed & Even or & Stacked



Different angles can show data differently

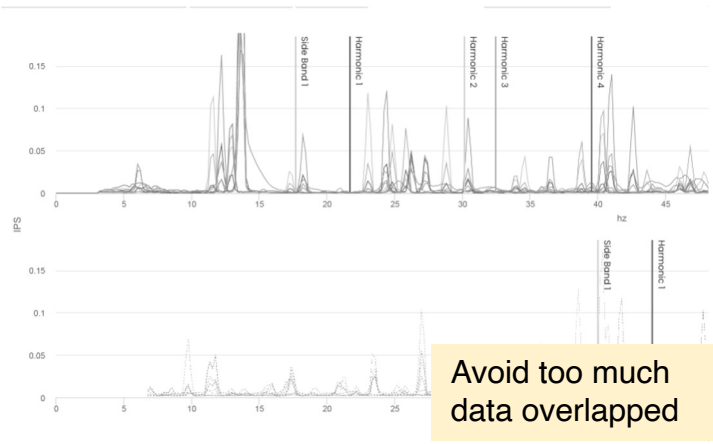
2D Multi-plots

Multi-A) Same data with different resolutions



Use-case by Analysts

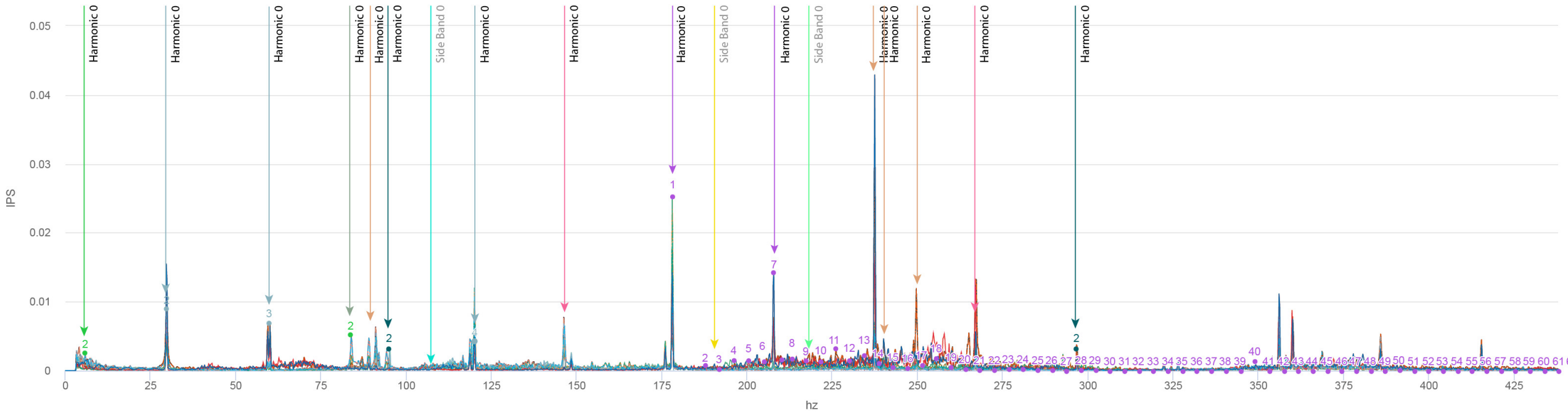
Multi-B) Same data comparing current and past



Avoid too much data overlapped

Zoom Level Experiment

Zoom-Out



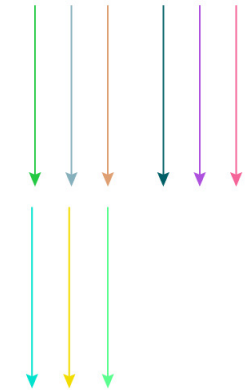
Trace colors & Symbols

	MDA	MDH	MDV
Mar 30, 2022	MDA 3/30/2022	MDH 3/30/2022	MDV 3/30/2022
Mar 31, 2022	MDA 3/31/2021	MDH 3/31/2021	MDV 3/31/2021
Sep 22, 2022	MDA 9/22/2021	MDH 9/22/2021	MDV 9/22/2021

Trace line types by timeline

Cursor Colors

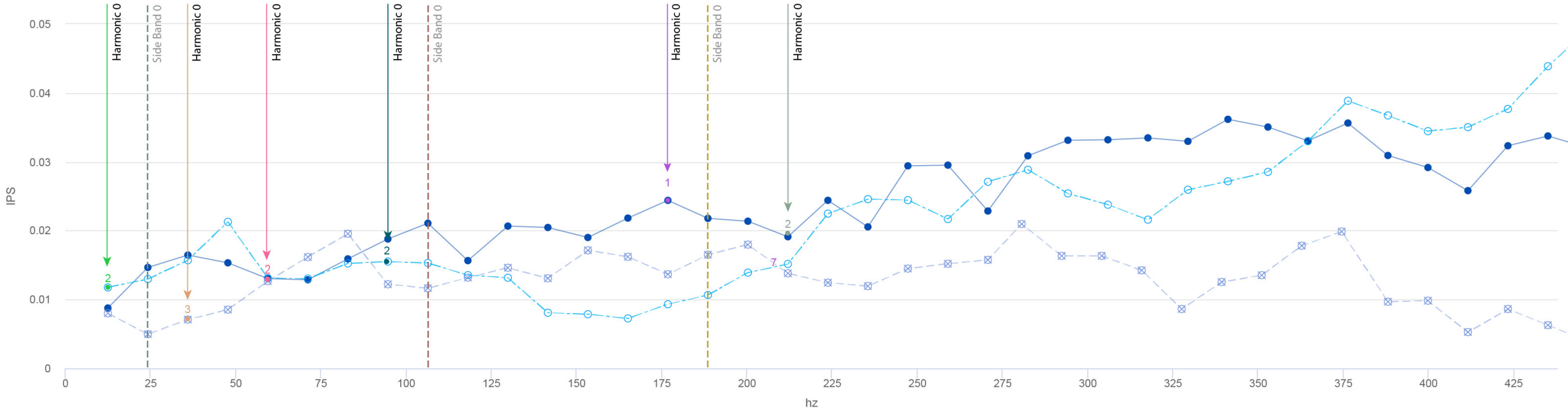
- Harmonic



- Side Band

Trial2: Neon color for side band,
Does the side band need to be an arrow?

Zoom-in



Trace colors & Symbols

	MDA	MDH	MDV
Mar 30, 2022	MDA 3/30/2022	MDH 3/30/2022	MDV 3/30/2022
Mar 31, 2022	MDA 3/31/2021	MDH 3/31/2021	MDV 3/31/2021
Sep 22, 2022	MDA 9/22/2021	MDH 9/22/2021	MDV 9/22/2021

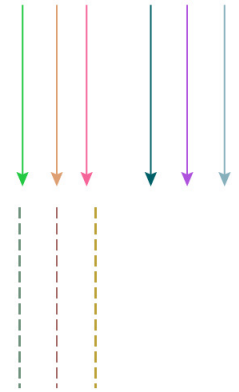
Trace line types by timeline

	MDA	MDH	MDV
Current			
Past 1			
Past 2			

Cursor Colors

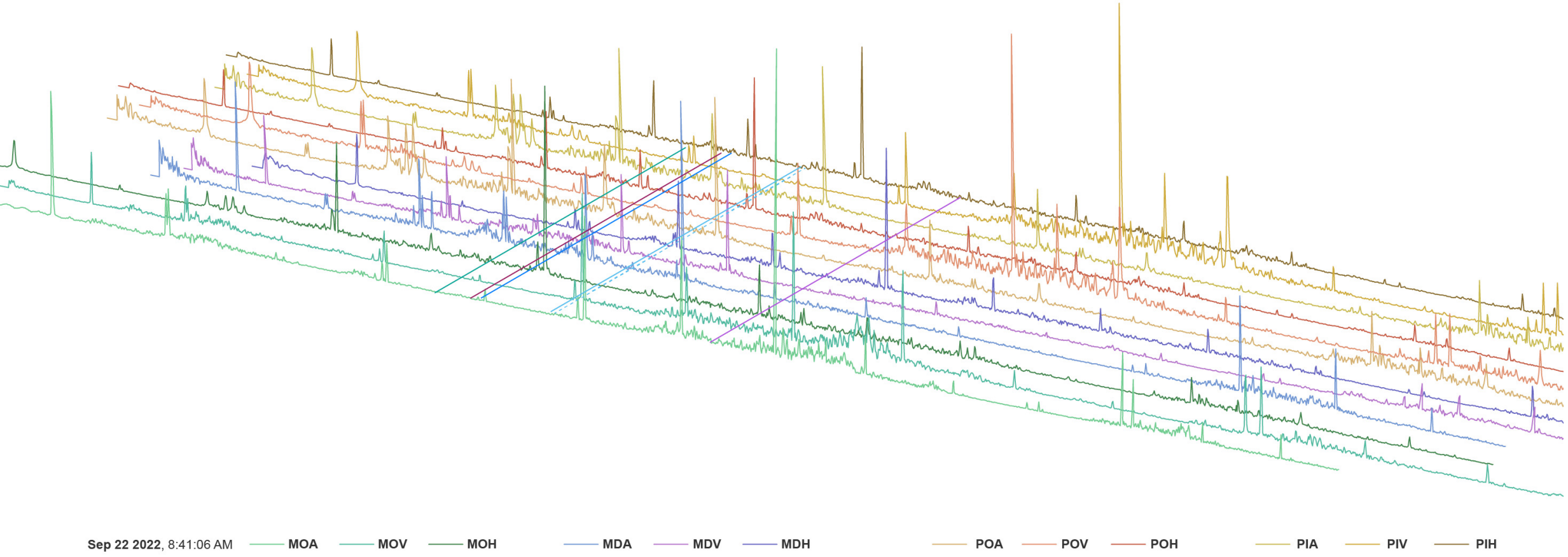
- Harmonic

- Side Band

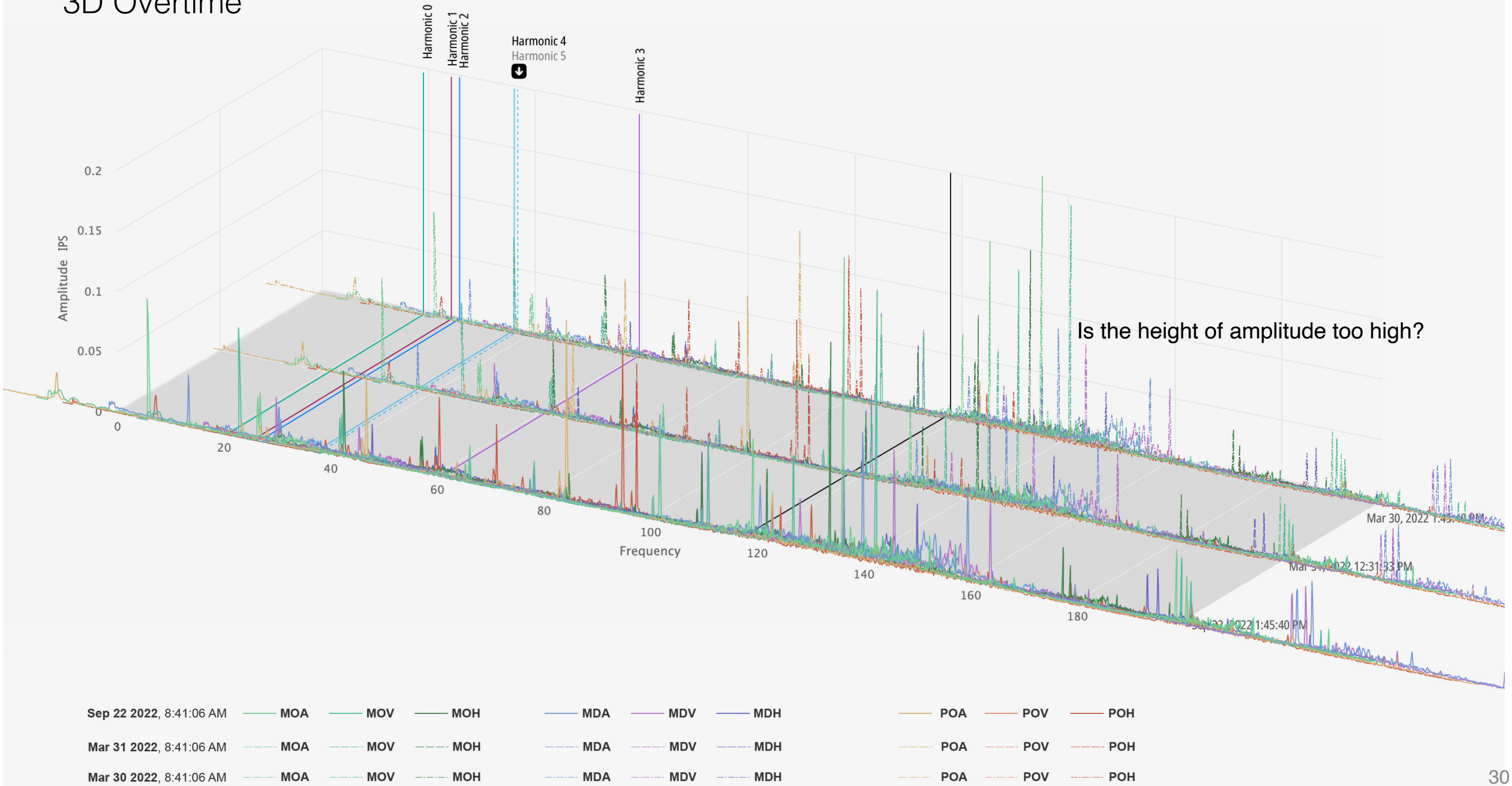


Over-time Plots Experiment

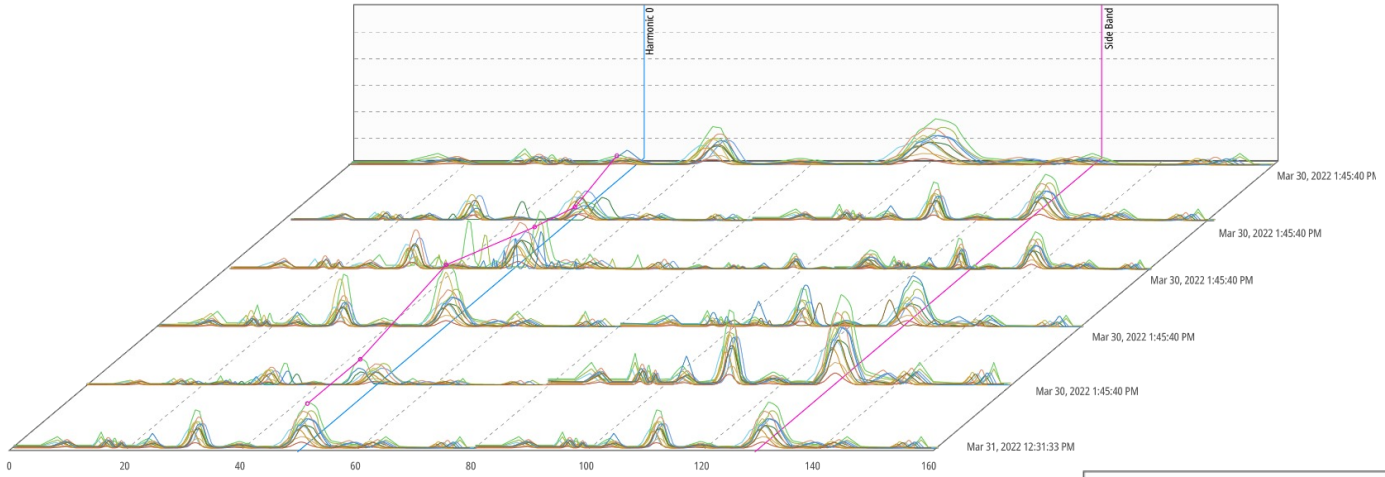
3D Current

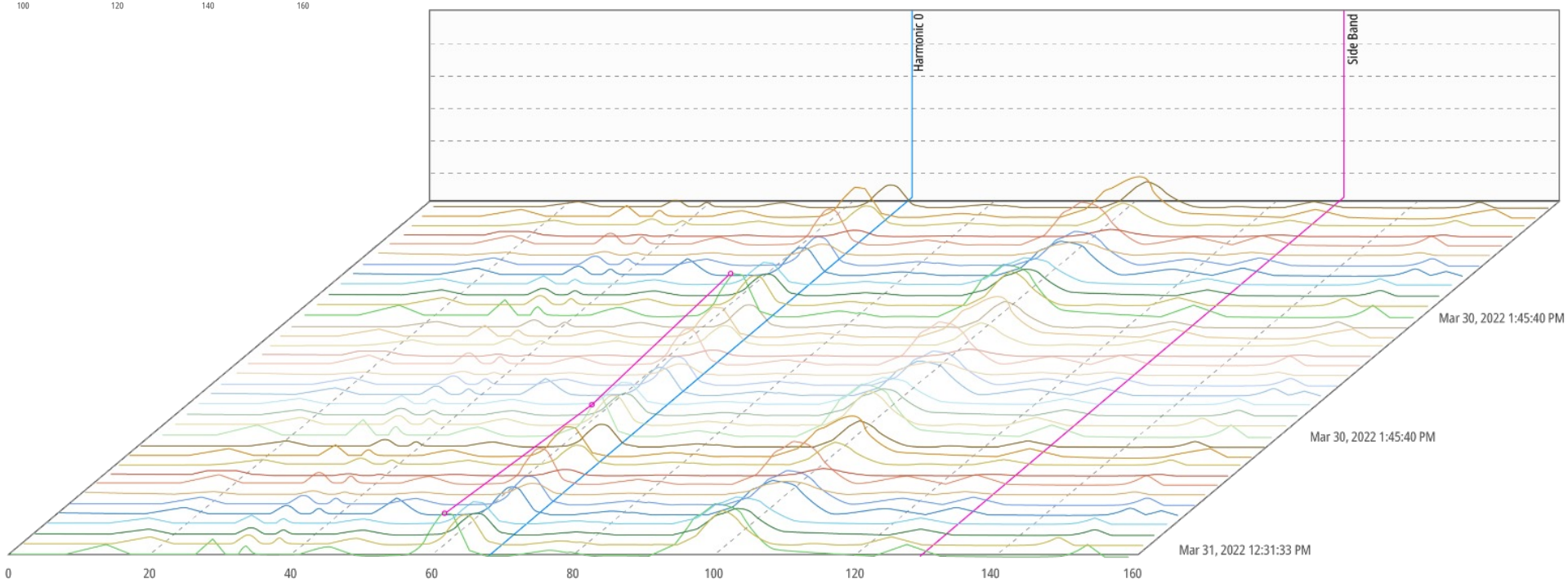

Sep 22 2022, 8:41:06 AM
MOA
MOV
MOH
MDA
MDV
MDH
POA
POV
POH
PIA
PIV
PIH

3D Overtime

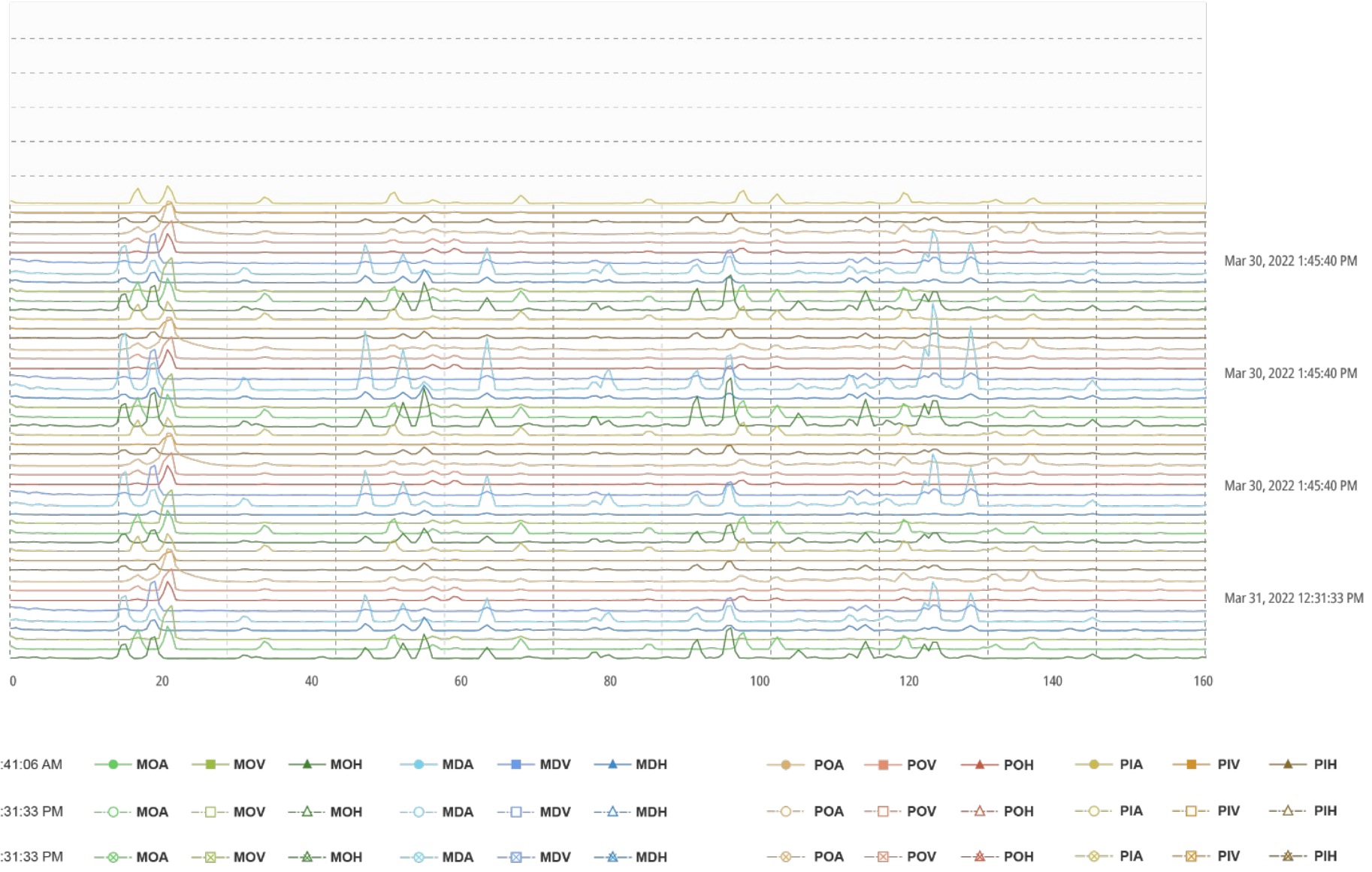

Harmonic 0
Harmonic 1
Harmonic 2
Harmonic 4
Harmonic 5
Harmonic 3
Amplitude IPS
0.2
0.15
0.1
0.05
0
0
20
40
60
80
100
120
140
160
180
Frequency
Is the height of amplitude too high?
Mar 30, 2022 1:45:40 PM
Mar 31, 2022 12:31:33 PM
Sep 22, 2022 1:45:40 PM
Sep 22 2022, 8:41:06 AM MOA MOV MOH MDA MDV MDH POA POV POH
Mar 31 2022, 8:41:06 AM MOA MOV MOH MDA MDV MDH POA POV POH
Mar 30 2022, 8:41:06 AM MOA MOV MOH MDA MDV MDH POA POV POH

3D 90 Skewed & Even or & Stacked



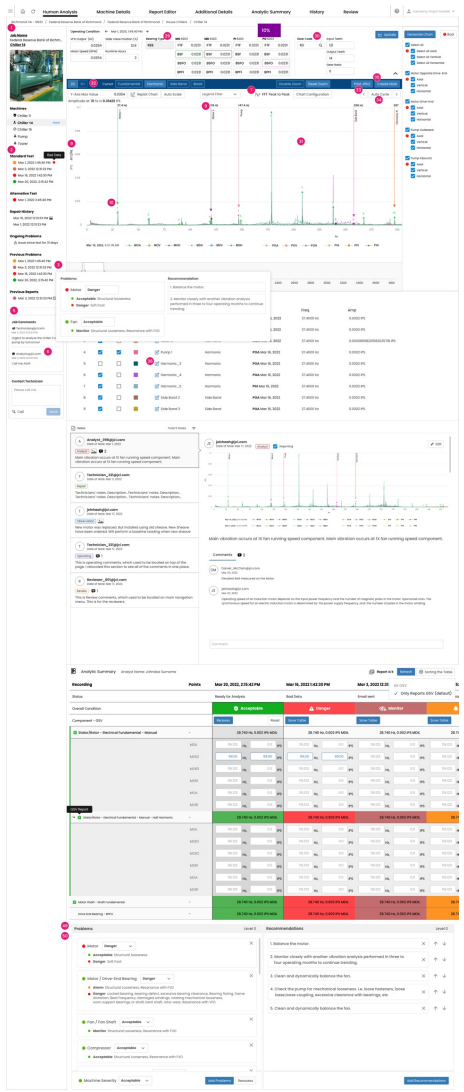


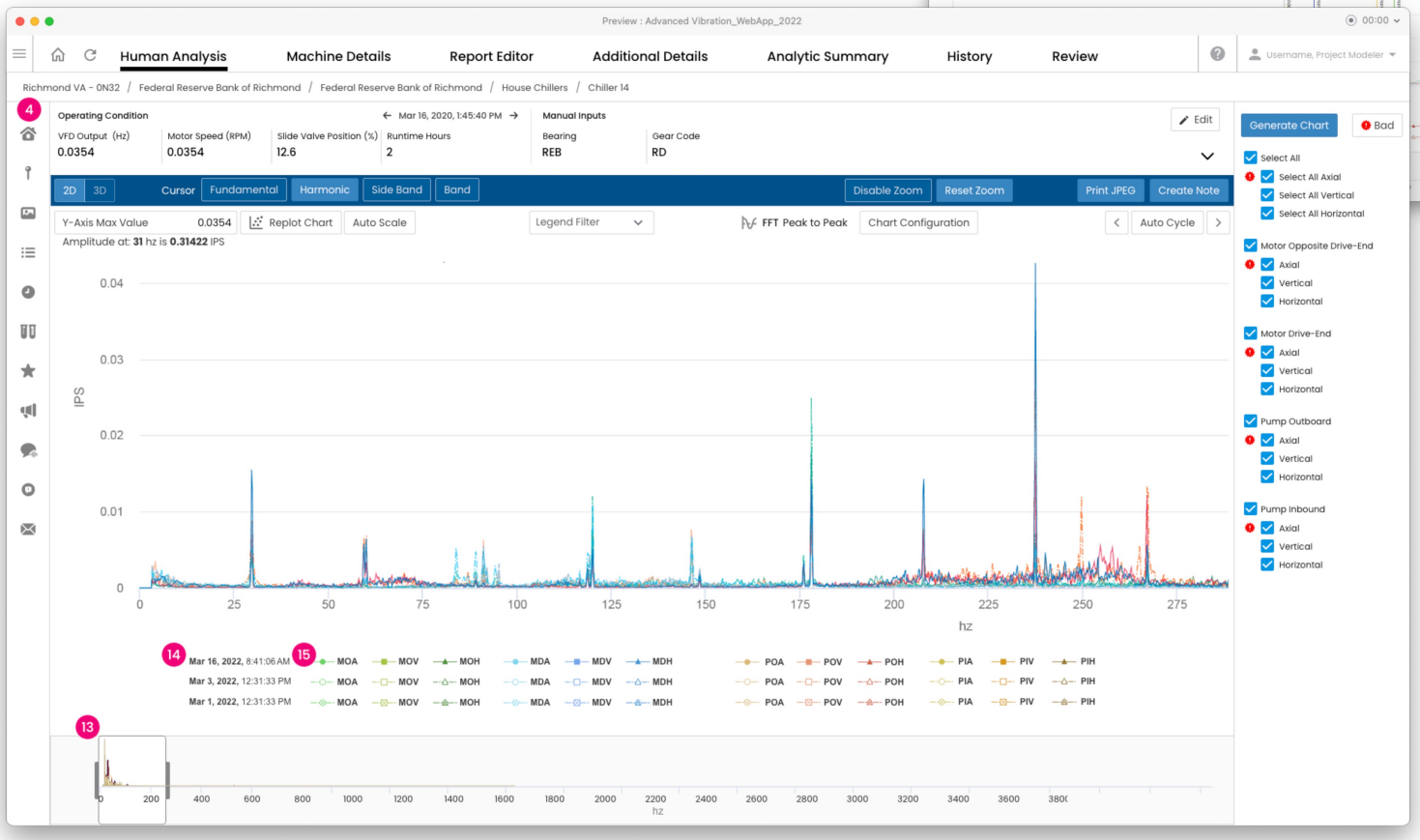
3D 90 Skewed & Even placed traces

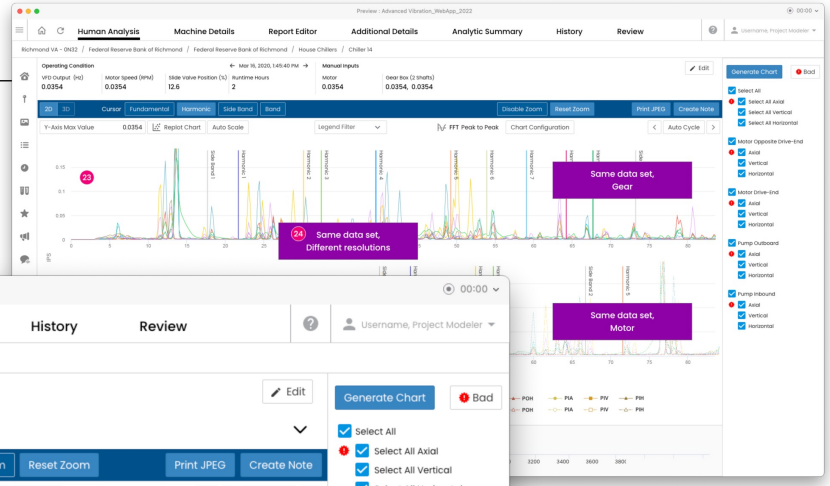


Results

Graphs in the web app



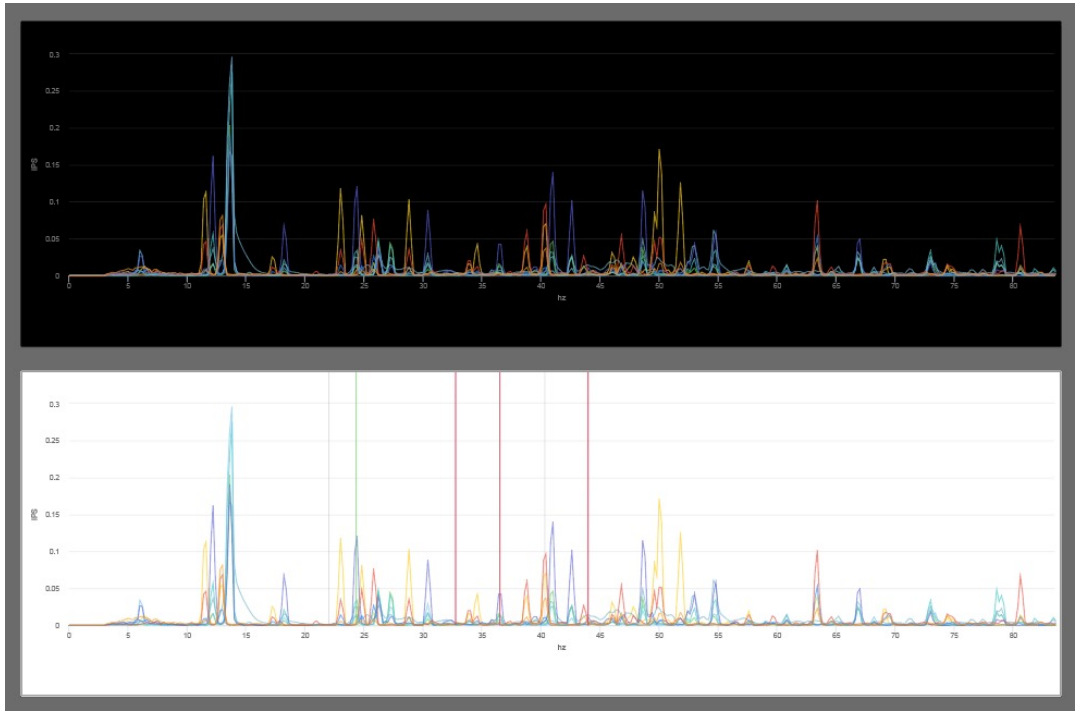




https://xd.adobe.com/view/0d1f5ce9-44f3-496b-aaea-738c2a765f90-584c/

Future Works

Dark mode



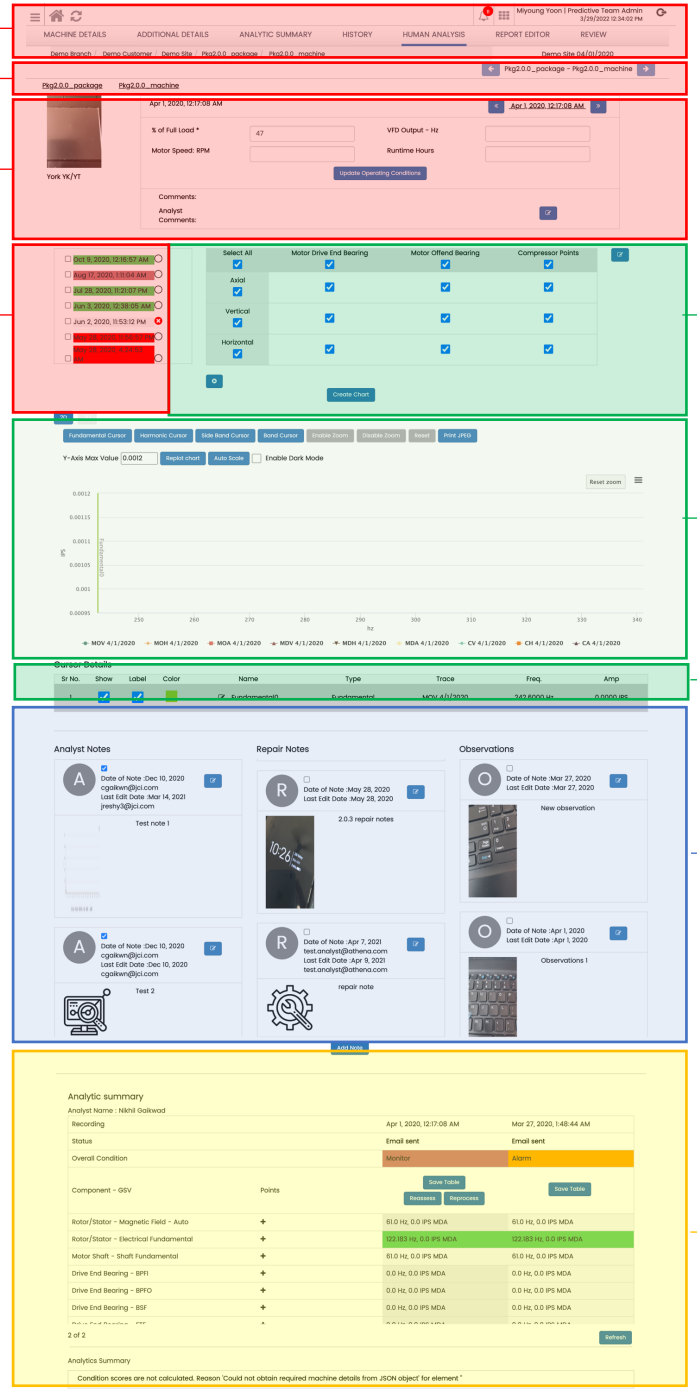
Thank you!

Web App Other Major Changes

Navigation

Top(Global) navi

Sub navi:
machines



Current: **Human Analysis**

Top(Global) navi

Sub navi

All about the machine
and analysis and test history

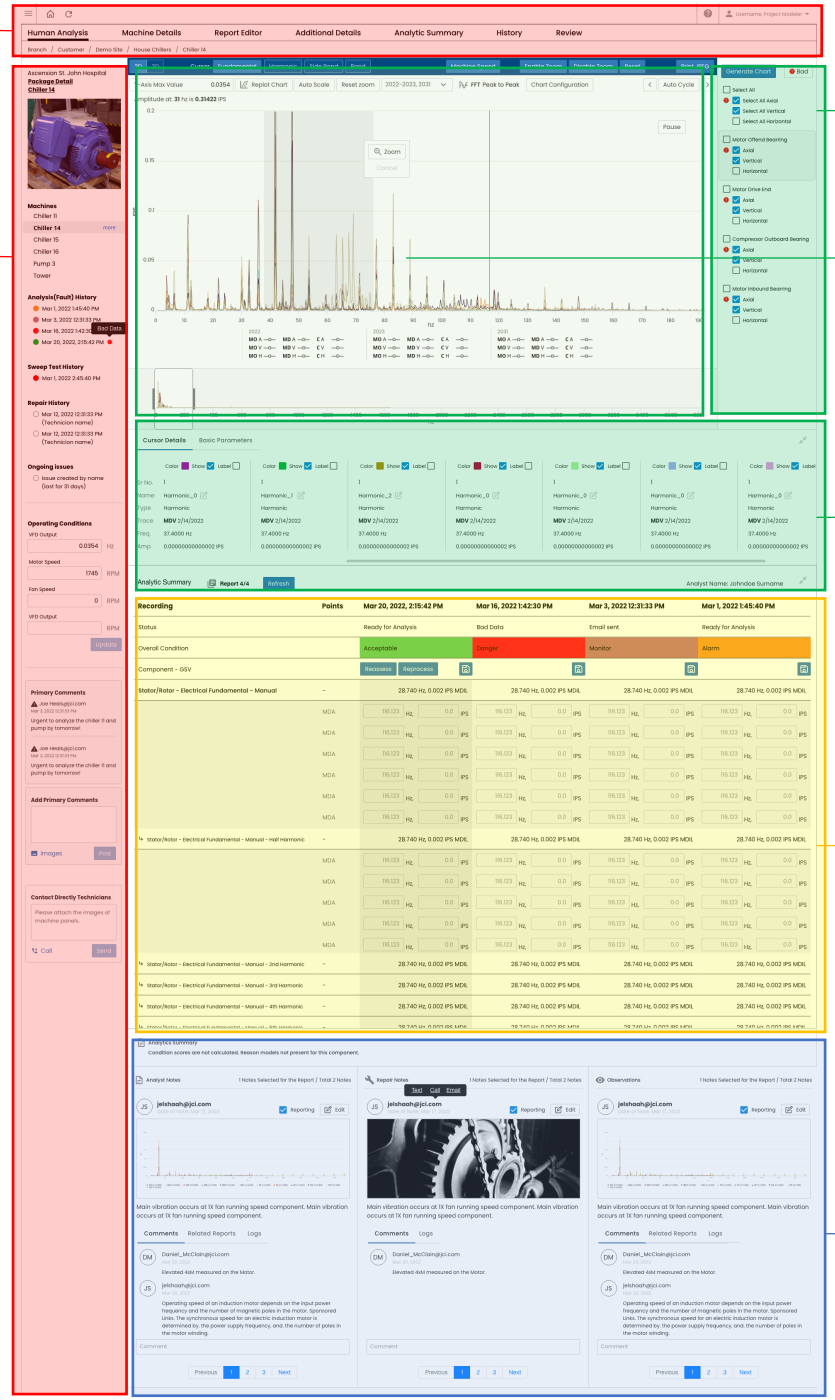


Chart filter / Bad data filter

Chart & Chart controls

Cursor detail / Basic Parameter

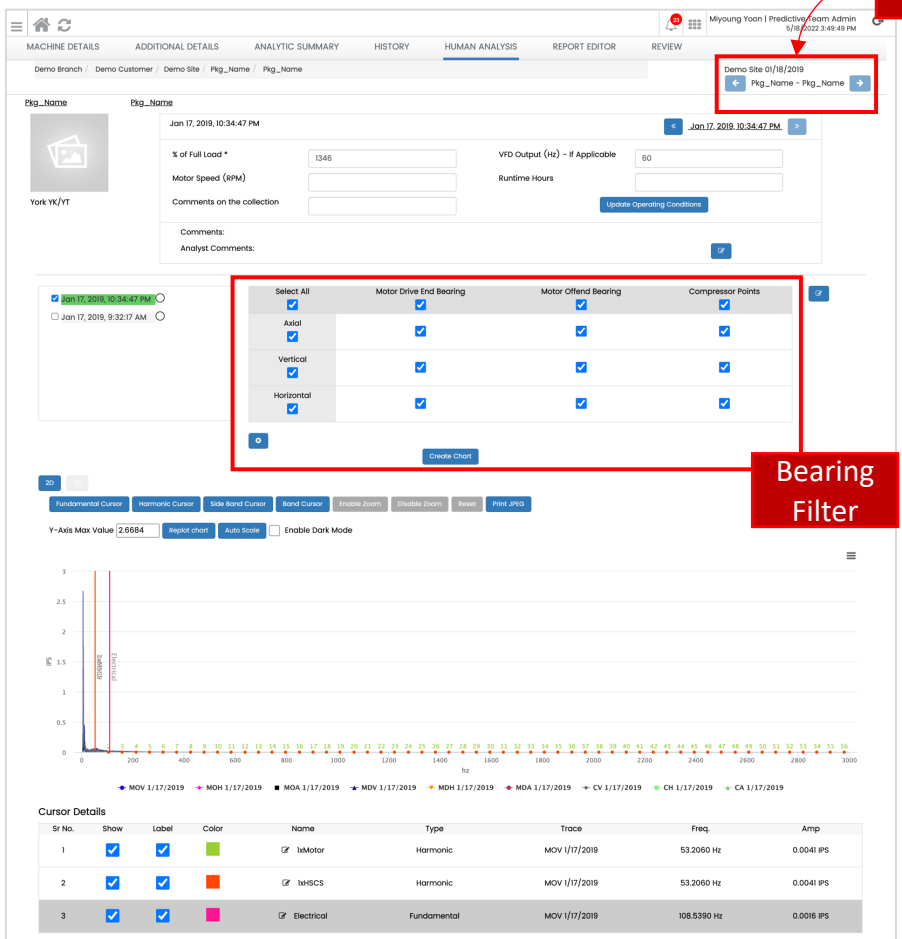
GSV table

All notes
(Analysts, Repair, Observation)

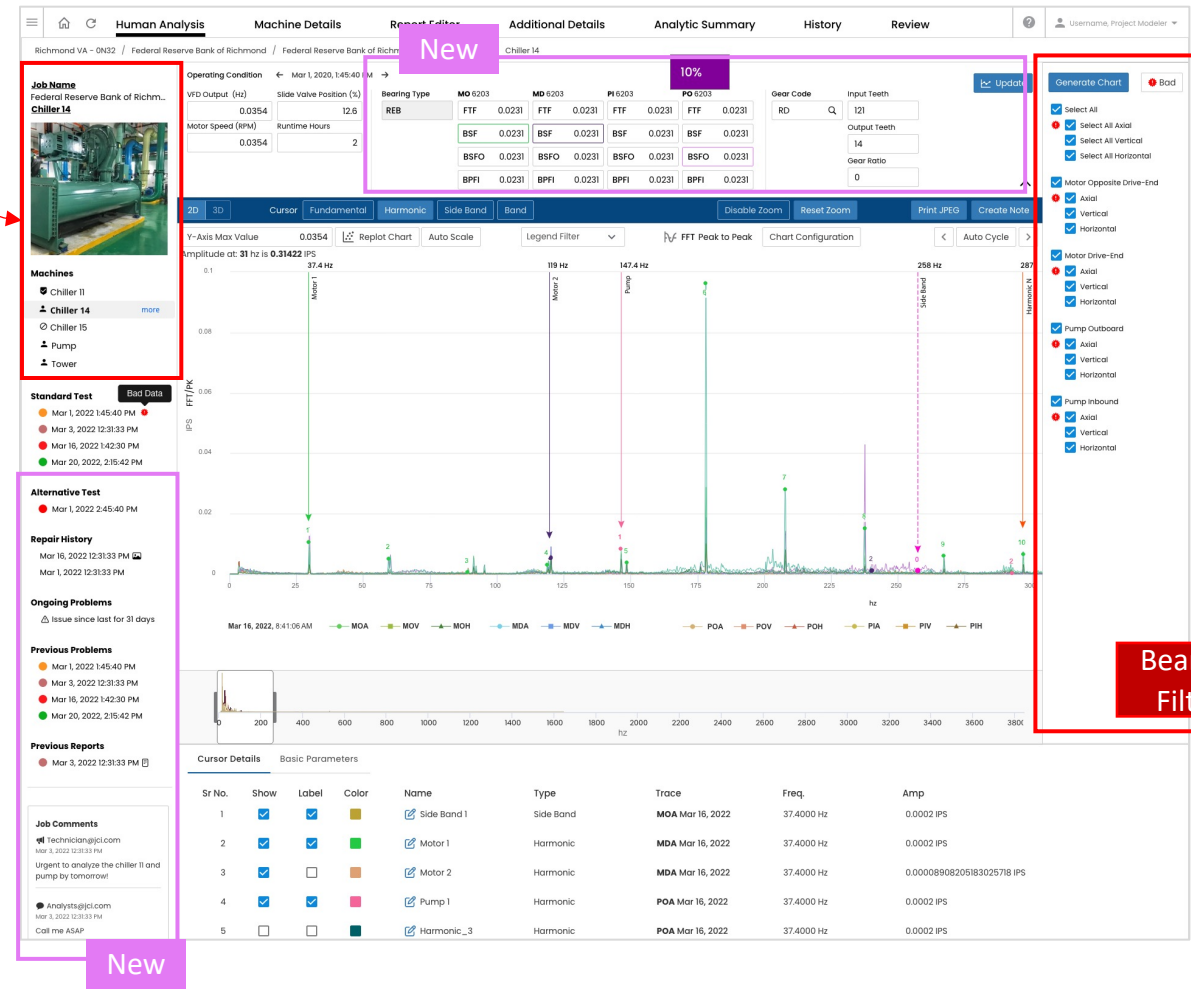
Concept Design: **Human Analysis**

Major changes (1)
Human Analysis/Navigate machines & Filters

Current



Prototype

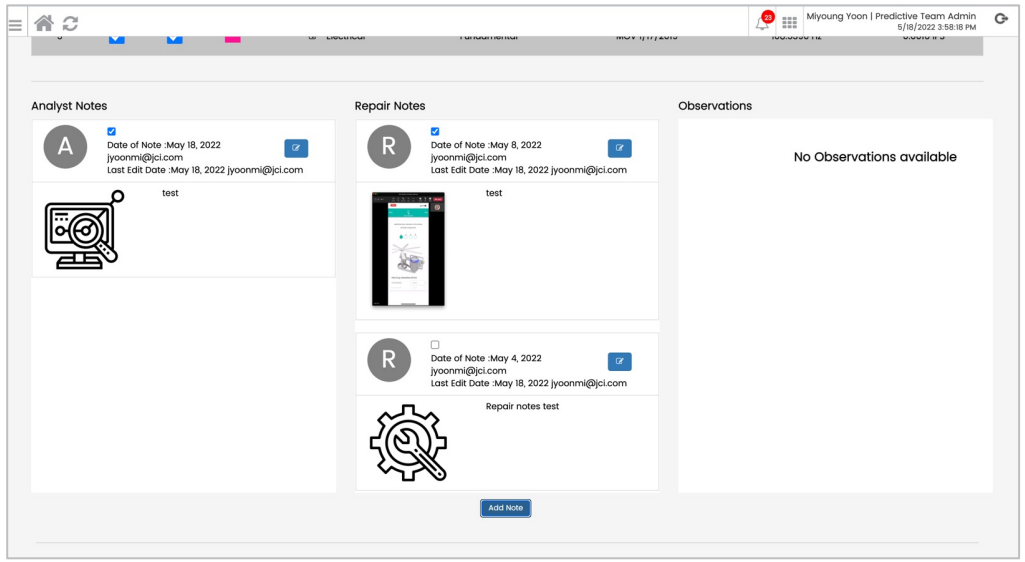


Major changes (2)
Human Analysis /Notes

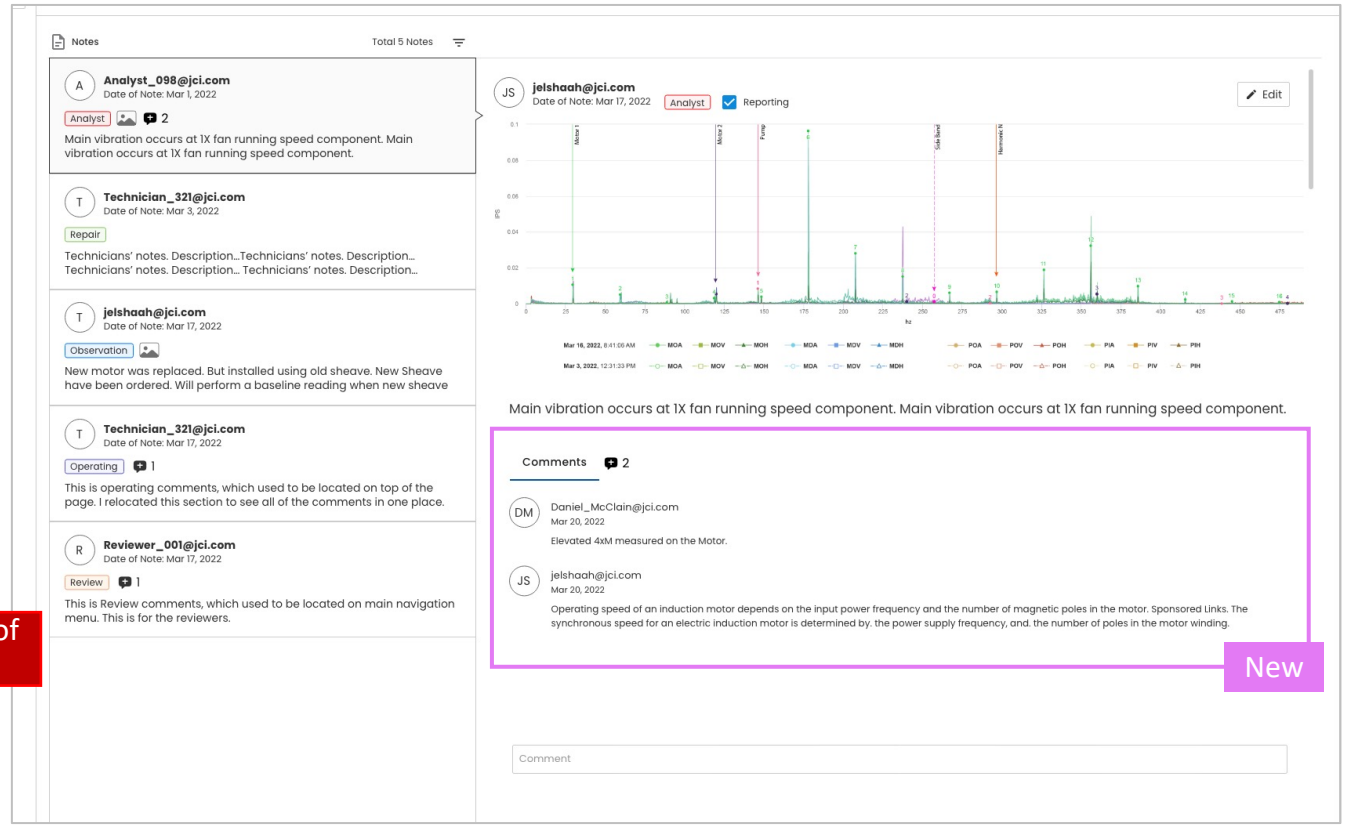
Create Note:

- Easy to capture the spectrum images with one click
- Reduce the error of wrong images uploaded to reports

Current



Prototype



5 types of notes

New

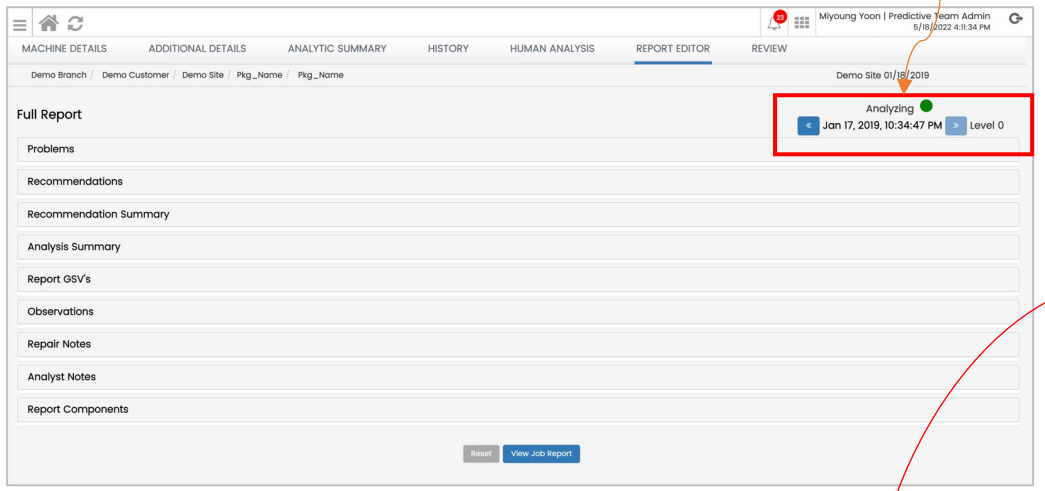
※ Consider:

- Remove the other notes sections, and structures change impacts
- Comments notification

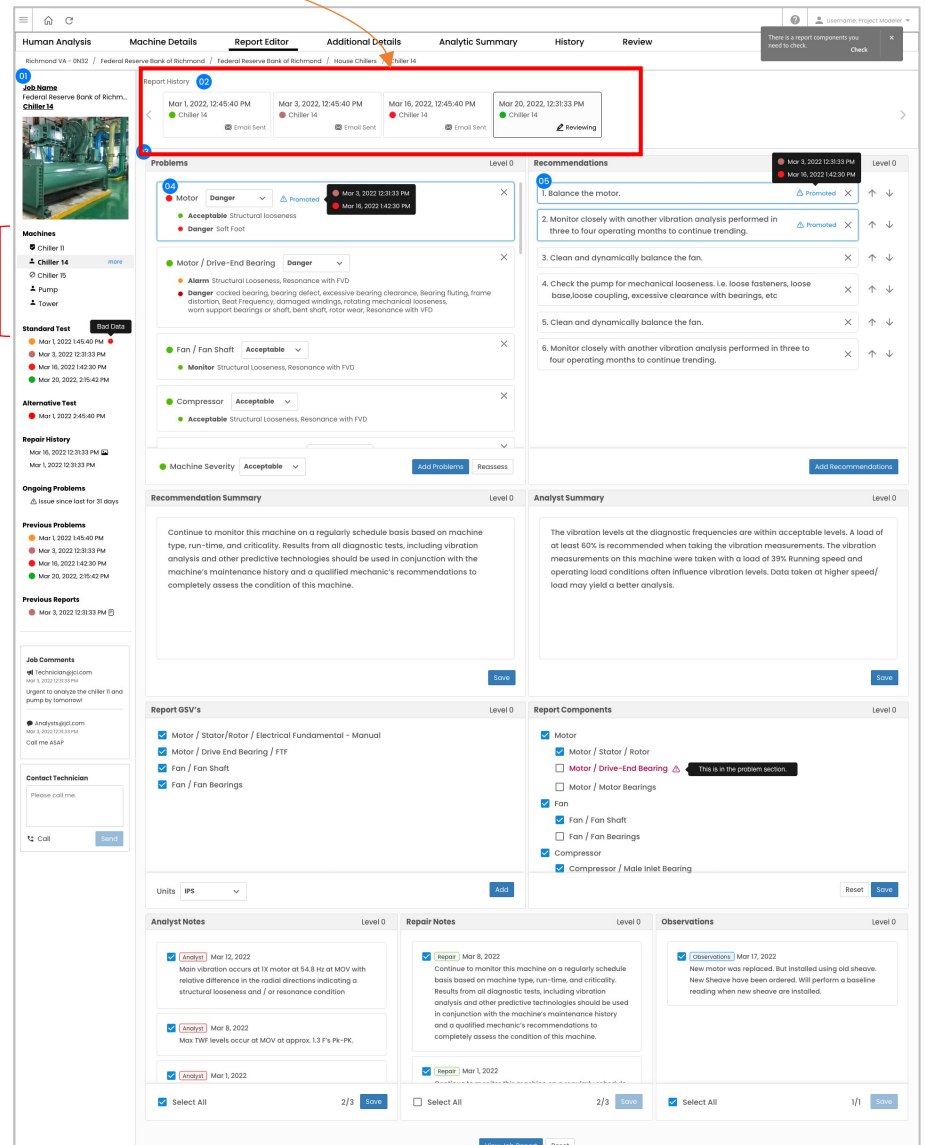
Major changes (2)
Report/Navigation & Sections

Navi for Previous reports

Current



Prototype



Left Navi / Machine lists:
Faster to move to different machines report per jobs

Past Reports Navi:
Move around previous reports and compare the ongoing problems easily

Thank you ☺