

GT 37 Turbo A402090up

compressor angle 120 deg
feed pressure 20 psig
temperature 90 F

$\theta_C := -8.0$

ORIGIN := 0

TC Data Analysis 0603:

Luis SanAndres 2001

Program to display/analysis of waterfall measurements (TC DAQ LABVIEW program)

User must be aware if spectrum is Linear or RMS, Type of windowing, etc

Physical units should be set in LabVIEW: MILS for displacements

Select Number of channels to display data (ch:0 tachometer)

$N_{ch} := 7$

channels

Compressor X Channel CXch := 2

Compressor Y Channel CYch := 3

Turbine X Channel TXch := 6

Turbine Y Channel TYch := 7

Notes:

Colors:

yellow: comments

sky blue: other info

lavender: user entry

green: important calculation / call to function

▶ Start transfer + ALL functions

▶ Info - data files structure

▶ compressor map characts.

▶ mass flow rate calcs

DAQ settings:

$N_{time} = 2.048 \times 10^3$ # of time samples

$N_{freq} = 1.024 \times 10^3$

Sampling_rate = 2×10^4 samples/sec = [Hz]

$\Delta freq = 9.766$ [Hz]

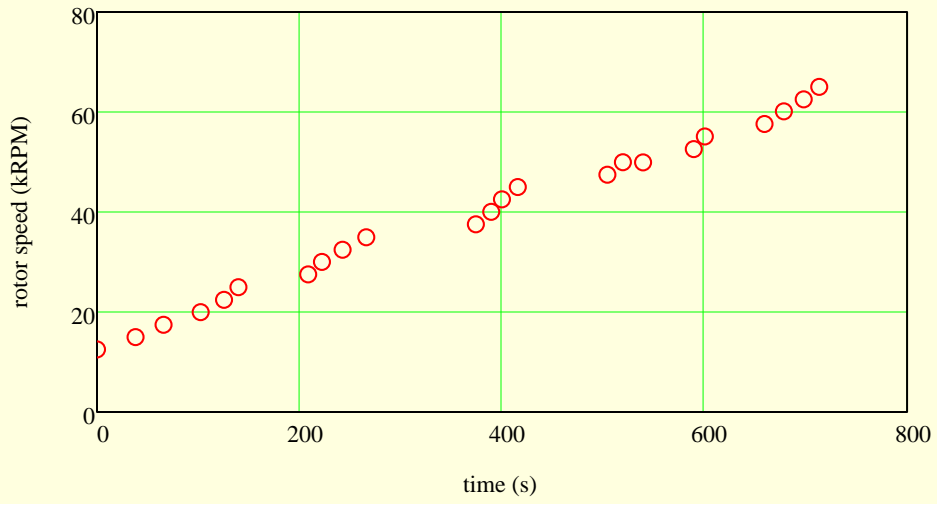
$N_{RPM} = 22$

minkRPM = 12.5 maxkRPM = 65.01

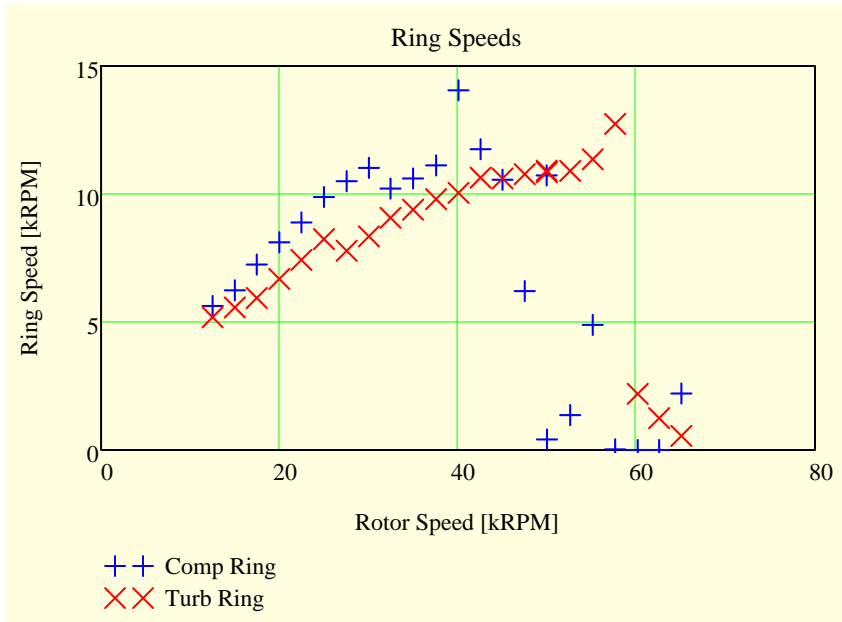
Freq_{max} = 1×10^4 [Hz]

GRAPH: ROTOR SPEED vs TIME

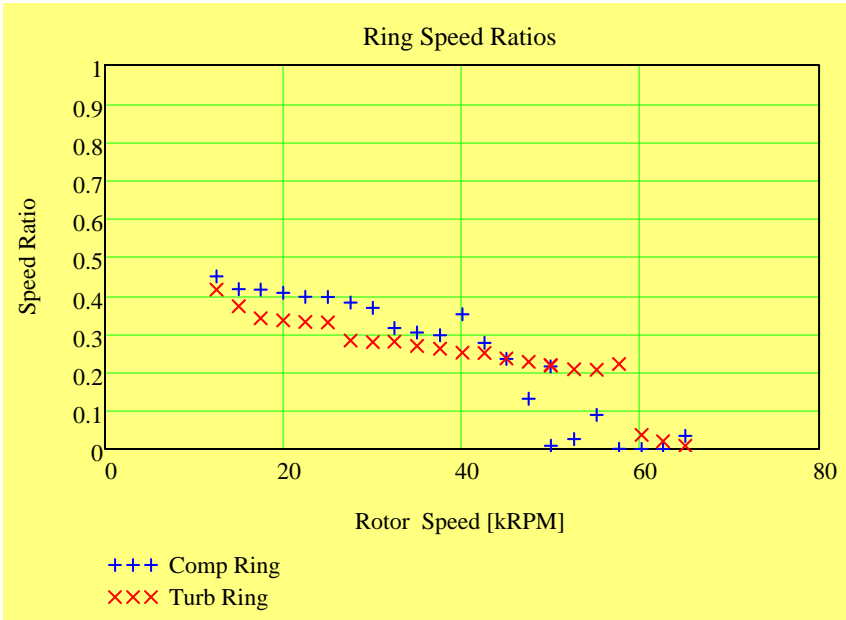
kRPM versus time (experiment)



GRAPH: FLOATING RING vs ROTOR SPEED



GRAPH: FLOATING RING SPEED/ROTOR SPEED



Transfer time data and FFT Setup

max value from DA $F_{\text{req}_{\text{max}}} = 1 \times 10^4$

Select Max freq (Hz) for spectrum display

$F_{\text{max}} := 2500$

$N_{\text{freq}} = 1.024 \times 10^3$

READ time & FFT data

$i_{\text{max}} = 256$

index corresponding to $F_{\text{max}} = 2.5 \times 10^3$ [Hz]

Max amplitudes
in spectra
[mils]

$TX_{\text{max}} = 1.738$

$CX_{\text{max}} = 3.872$

overall MAX from C and T displacements

$TY_{\text{max}} = 2.248$

$CY_{\text{max}} = 3.295$

$X_{\text{max}} = 3.872$

Select RPM for spectrum display

kk := 0

FRAME for movie

$N_{RPM} = 22$

Turbine and Compressor FFTs - X Direction at Proximator

Red Continuous = Turbine Side
Blue Dashed = Compressor Side

Select Speed (index)

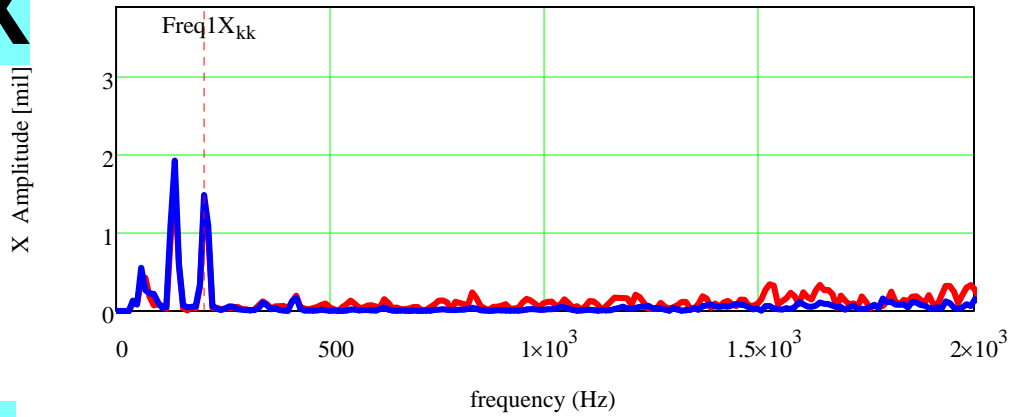
XPercent := 100 for scale

Zoom In to this percent max for X:

$kRPM_{kk} = 12.5$

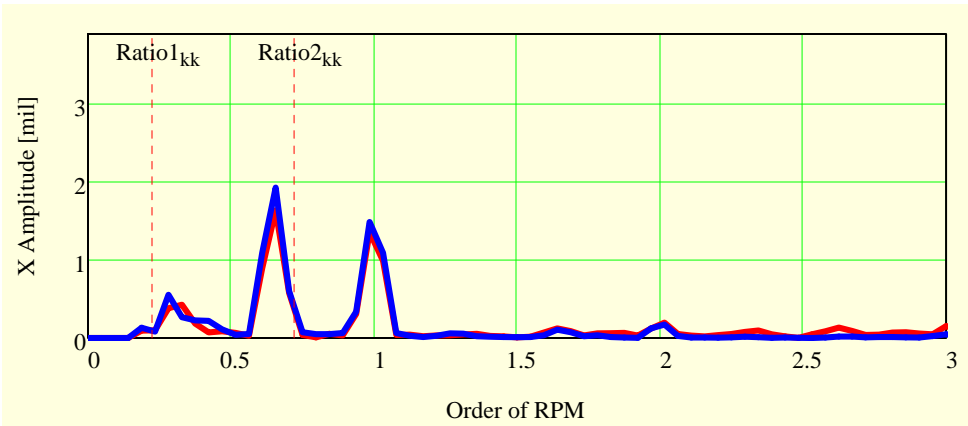
$Freq1X_{kk} = 208.333$

X



Red : Turbine
Blue : Compressor

X



Turbine and Compressor FFTs - Y Direction at Proximito

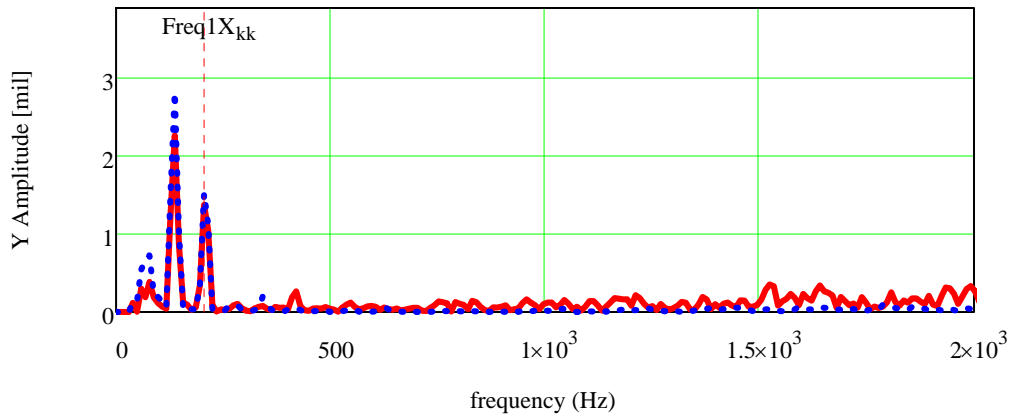
kRPM_{kk} = 12.5

Red Continuous = Turbine Side
Blue Dashed = Compressor Side

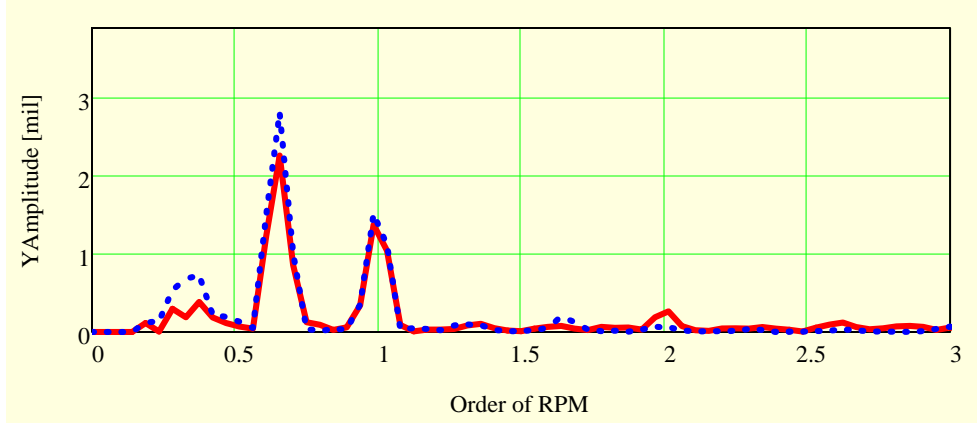
Zoom In to this percent max for Y:

YPercent := XPercent

Y



Y



Turbine and Compressor Orbits at Proximitors (Horizontal and Vertical)

Select Speed (index)

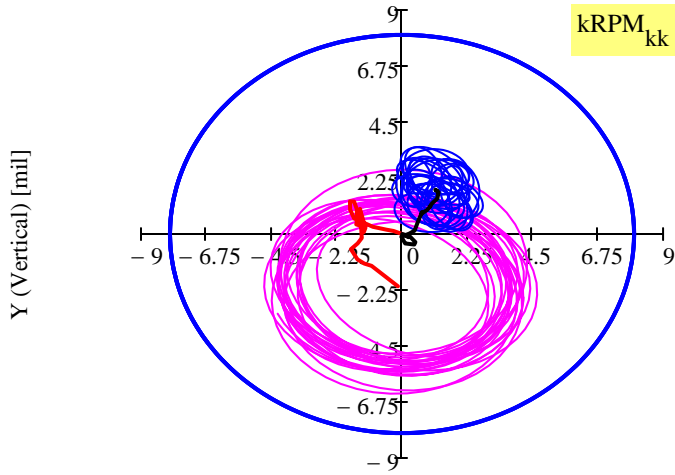
$kk := 22$

FRAME = 0 to... $N_{RPM} = 22$

PLOT RELATIVE TO ORIGIN: $kRPM_0 = 12.5$ $kRPM_{N_{RPM}} = 65.01$ $\theta_C = 0$

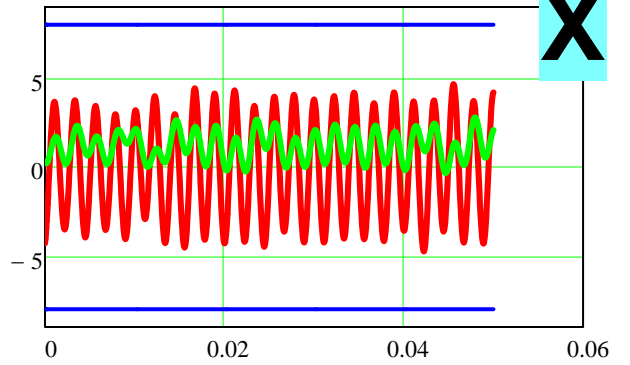
shaft speed

$kRPM_{kk} = 65.01$

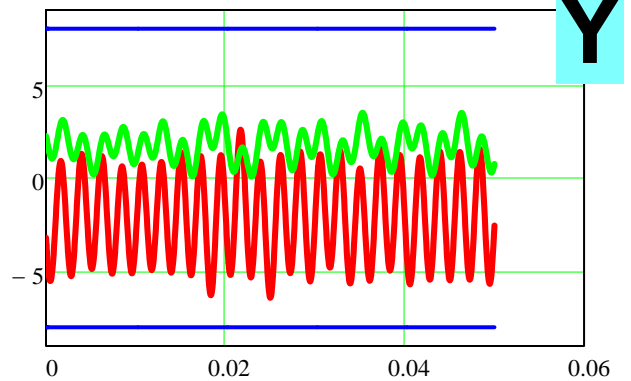


- Comp Orbit
- Turb Orbit
- Comp DC
- Turb DC
- Lowest Conical Limits @Proximitors

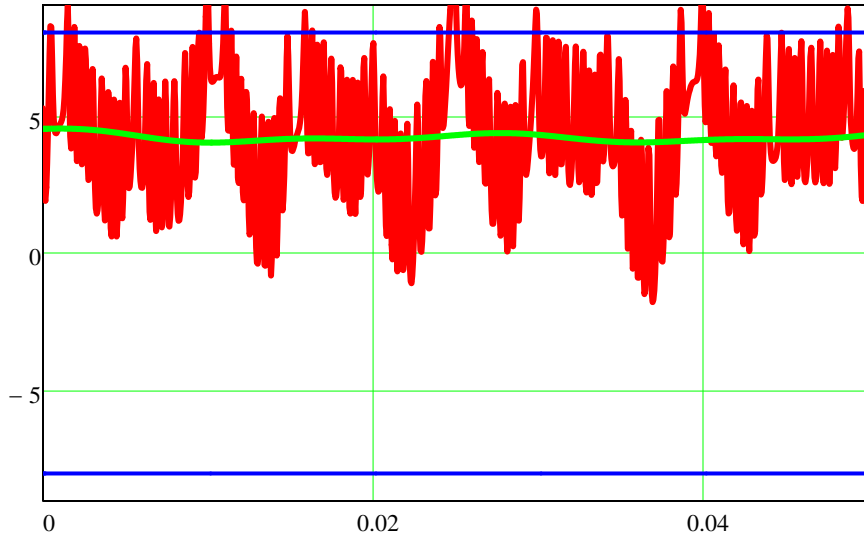
X (Horizontal) - Comp=Red, Turb=Green



Y (Vertical) Comp=Red, Turb=Green



X (Horizontal) - Comp=Red, Turb=Green

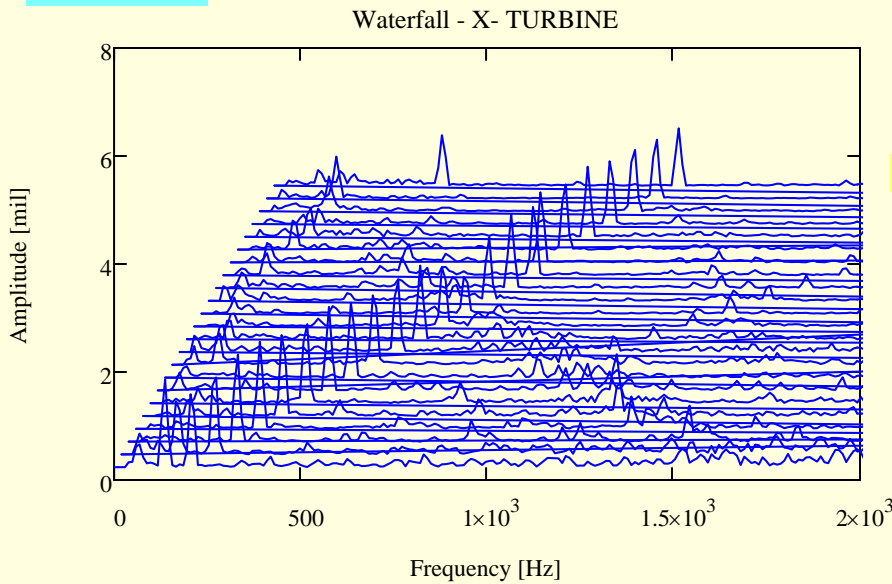


Time signals w ad w/o filter

Turbine Waterfalls - X Direction at Proximator

$TX_{max} = 1.738$

X



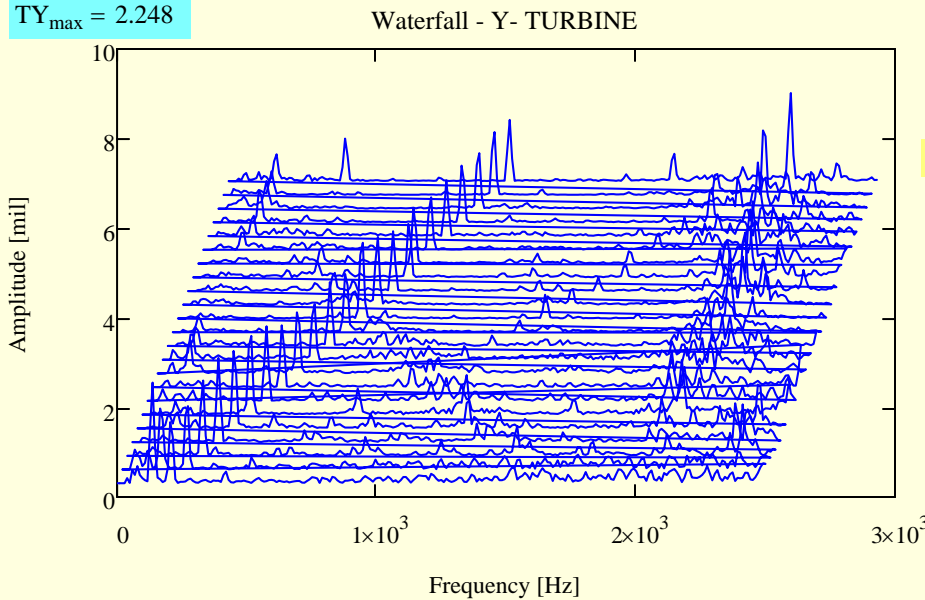
maxkRPM = 65.01

minkRPM = 12.5

Turbine Waterfalls - Y Direction at Proximator

$TY_{max} = 2.248$

Y



maxkRPM = 65.01

minkRPM = 12.5

▶ calculate peak values

SYNCHRONOUS or SUB SYNCHRONOUS COMPONENTS AT specified WHIRL RATIO

Specify a Whirl Ratio: ratio := 1

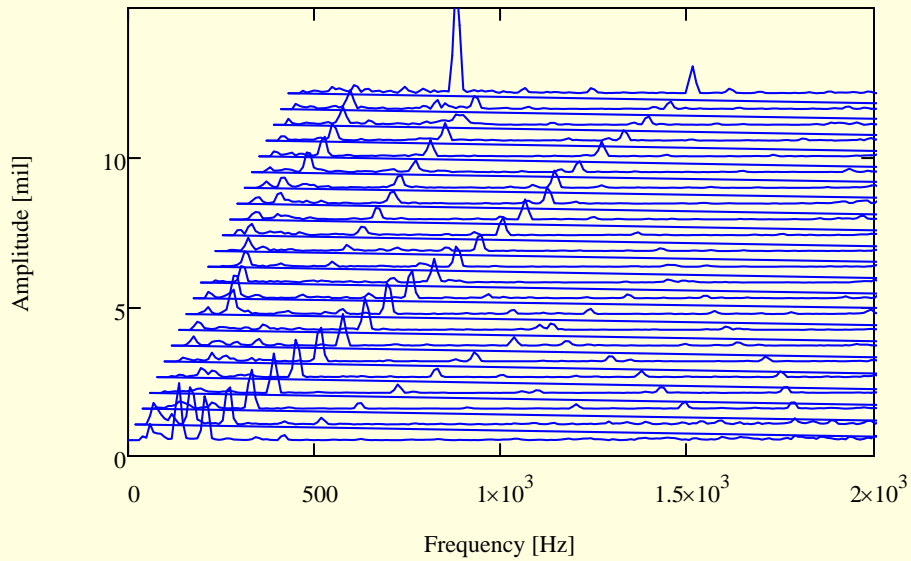
$$\frac{\text{ratio} \cdot \text{maxkRPM} \cdot 1000}{\text{freq}_{i_{max}} \cdot 60} = 0.433$$

If this result is > 1, findratio will fail since spectrum does not contain frequencies for desired ratio (increase imax above)

Compressor Waterfalls - X Direction at Proximito

$CX_{max} = 3.872$

Waterfall - X - COMPRESSOR



X

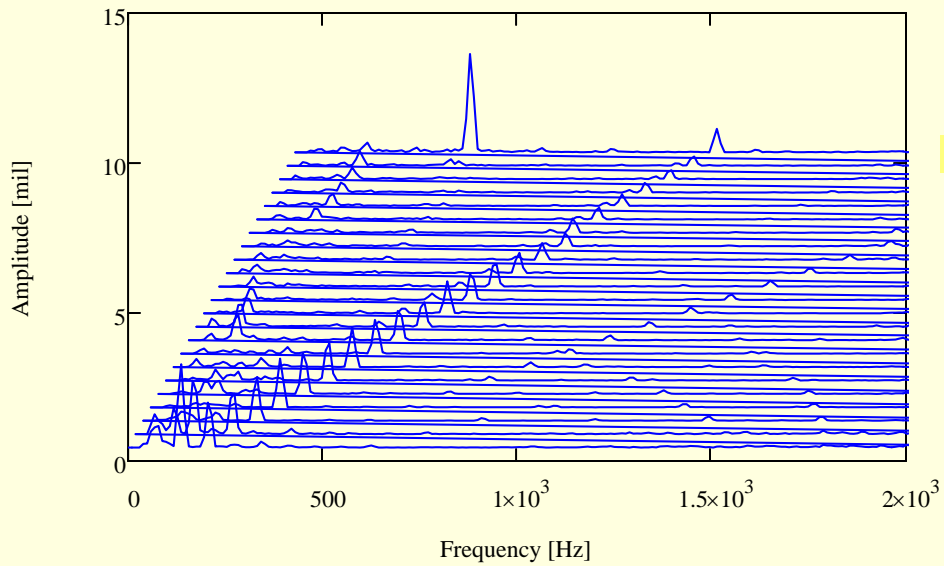
maxRPM = 65.01

minkRPM = 12.5

Compressor Waterfalls - Y Direction at Proximito

$CY_{max} = 3.295$

Waterfall - Y - COMPRESSOR



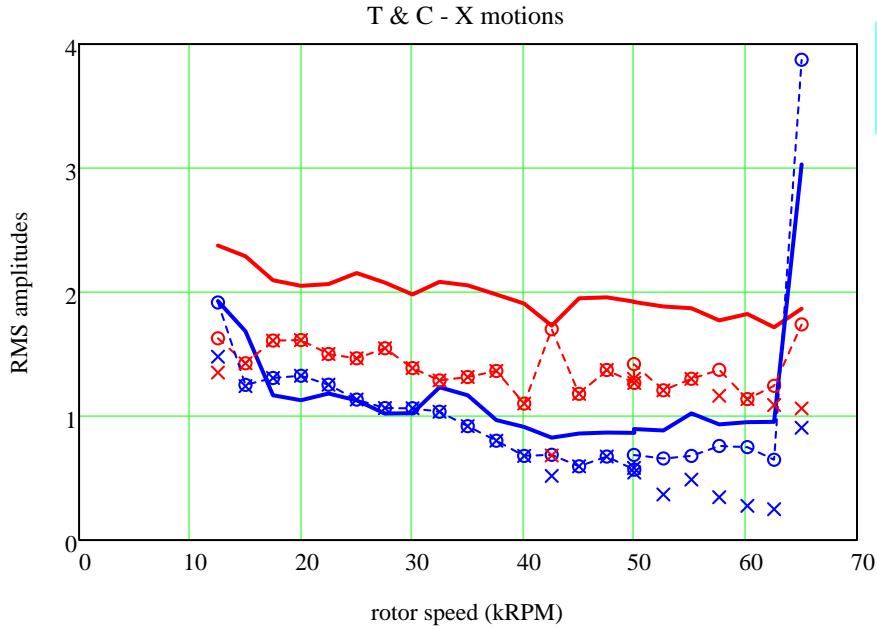
Y

maxRPM = 65.01

minkRPM = 12.5

Turbine and Compressor Specified WFR Analysis - X Direction at Proximator

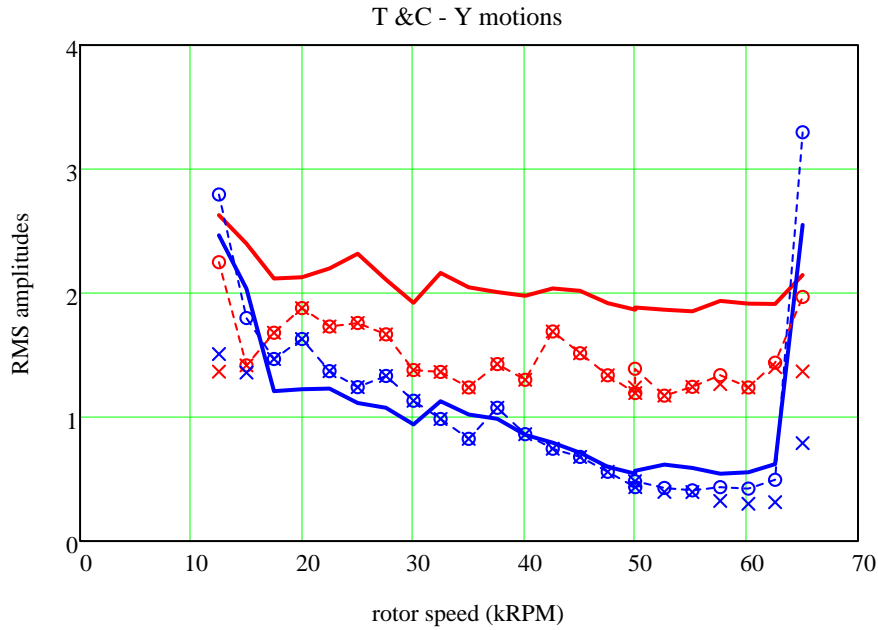
ratio = 1



- Turb Overall
- Comp Overall
- ⊙⊙⊙ Turb Peak
- ⊙⊙⊙ Comp Peak
- ××× Turb at specified WFR
- ××× Comp at Specified WFR

WFR=1.0 (1X)

**Turbine and Compressor Specified WFR Analysis -
Y Direction at Proximator**



Y

Y

- Turb Overall
- Comp Overall
- ⊗⊗⊗ Turb Peak
- ⊗⊗⊗ Comp Peak
- ××× Turb at specified WFR
- ××× Comp at Specified WFR

WFR=1.0 (1X)

SHOW MOTION - ALL frequencies, ALL speeds: Determine importance of frequencies

Specify a Threshold Percent for Proximity:

XPercent := 4

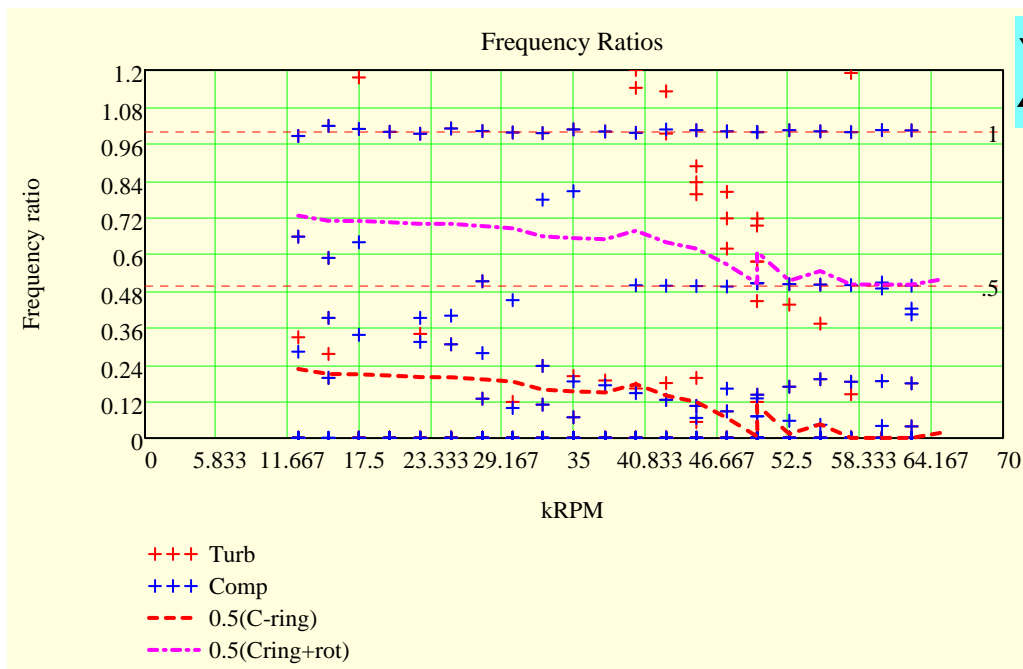
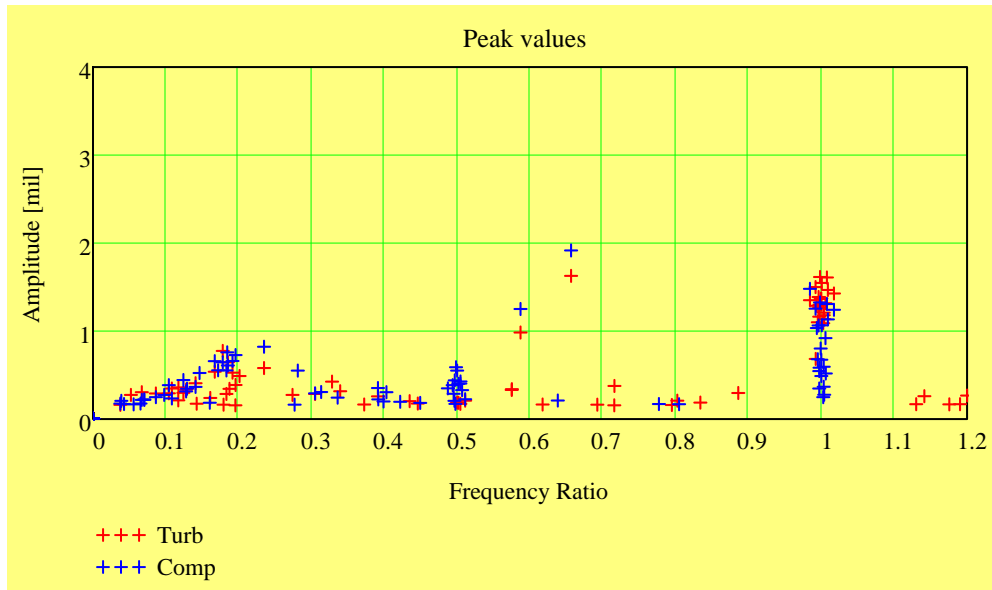
of maximum amp.

Extract all frequency component

Turbine and Compressor Freq Analysis - X Direction at Proximator

thresholdX = 0.155

magnitude for filter



for plots

$$\text{RPM}_{\max} := \text{ceil}\left(\frac{\text{maxkRPM}}{10}\right) \cdot 10 = 70$$

Y-scale

$$D_{\max} := 4$$

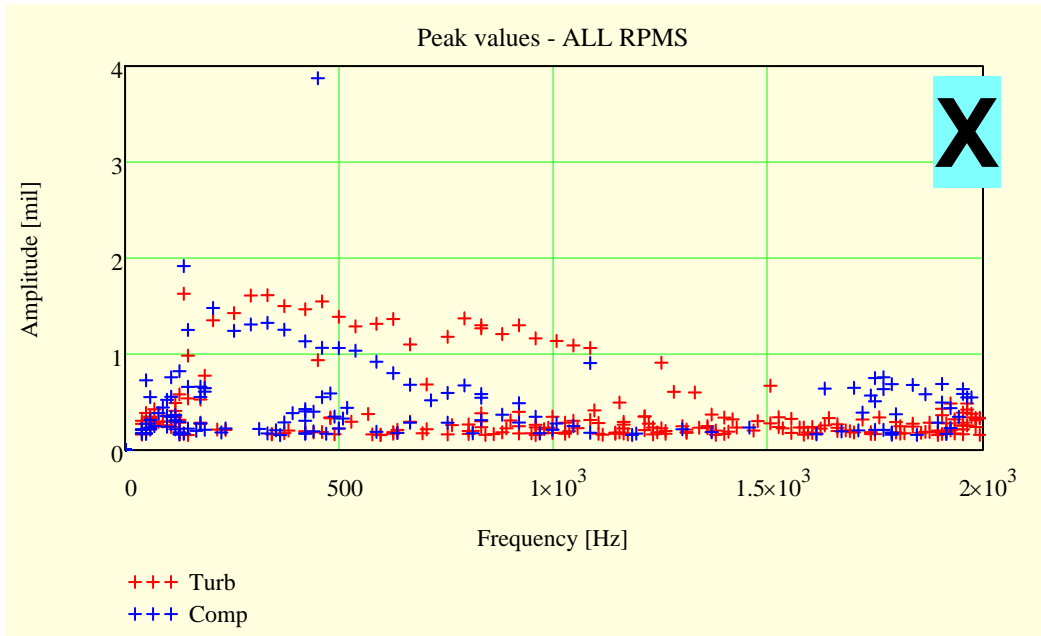
Max whirl frequency ratio

$$\text{wfr}_{\max} := \frac{2.4}{2}$$

Set for

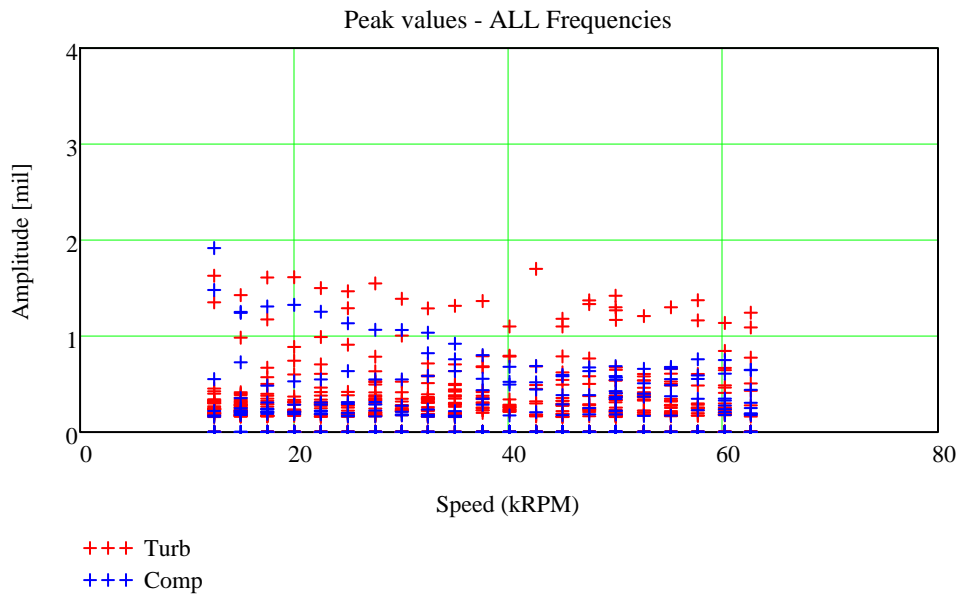
Turbine and Compressor Freq Analysis - X Direction at Proximator

$$\frac{\text{thresholdX}}{\text{XPercent}} \cdot 100 = 3.872$$



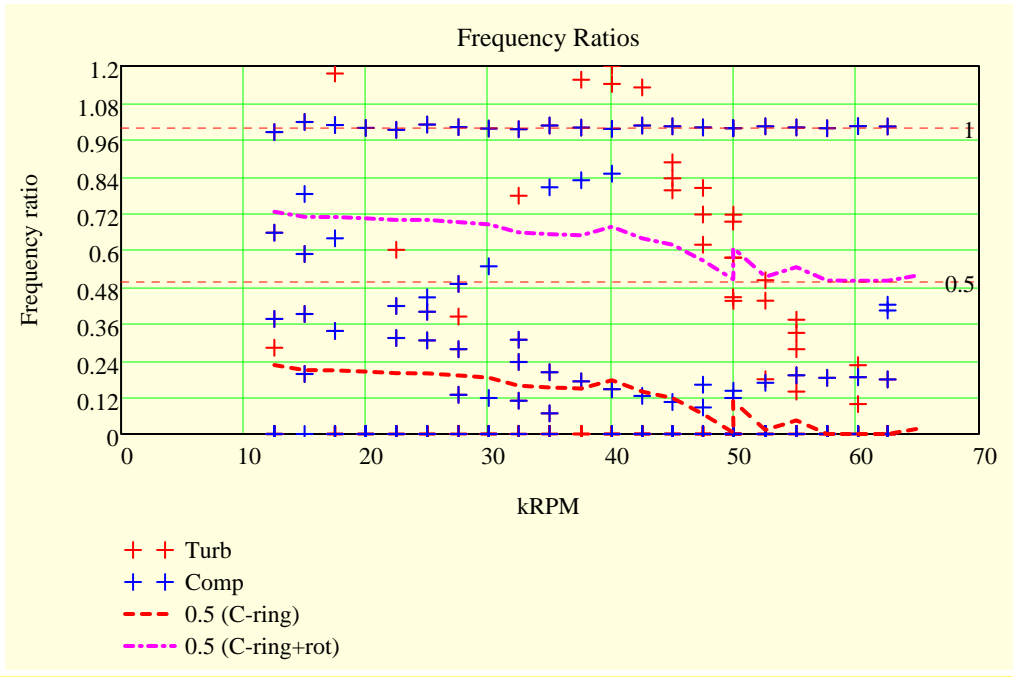
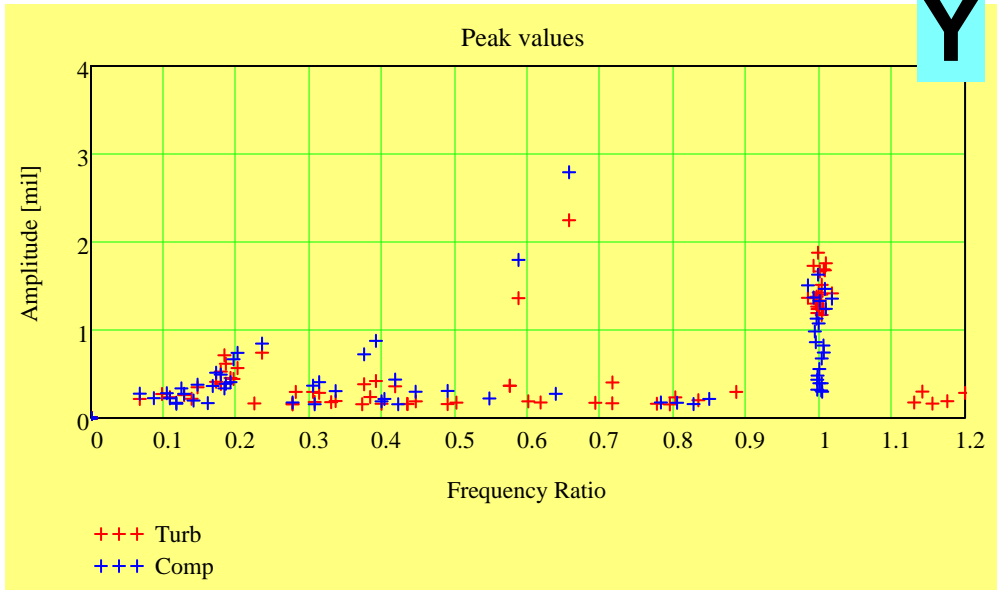
$$\text{max}(\text{CXpeak2}) = 3.872$$

$$\text{max}(\text{CXpeak}) = 1.915$$



Turbine and Compressor Peak Analysis - Y Direction at Proximitor

Y



Y

SELECT below to display amplitude and WFR for selected bandwidth: LOW & HIGH of RPM

Low := 0.2 High := .8

filter components

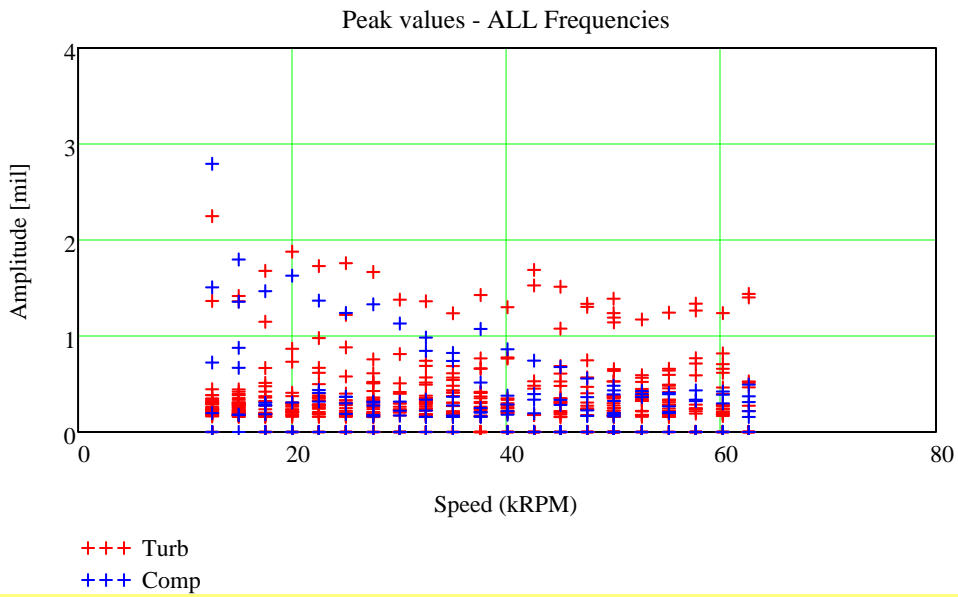
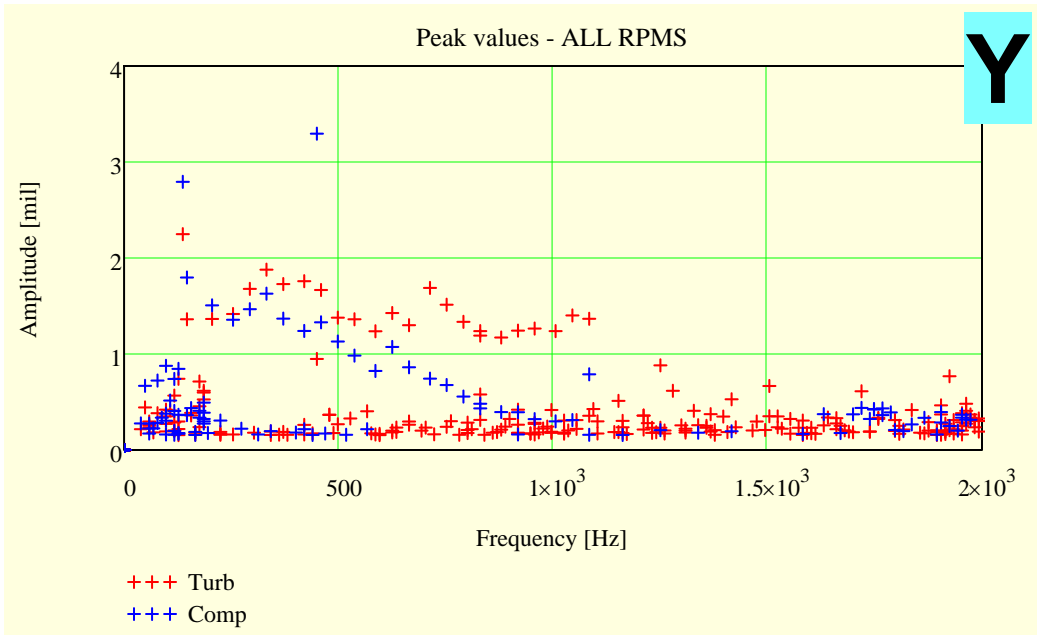
X_{max} := D_{max}

R_{max} := 1.2

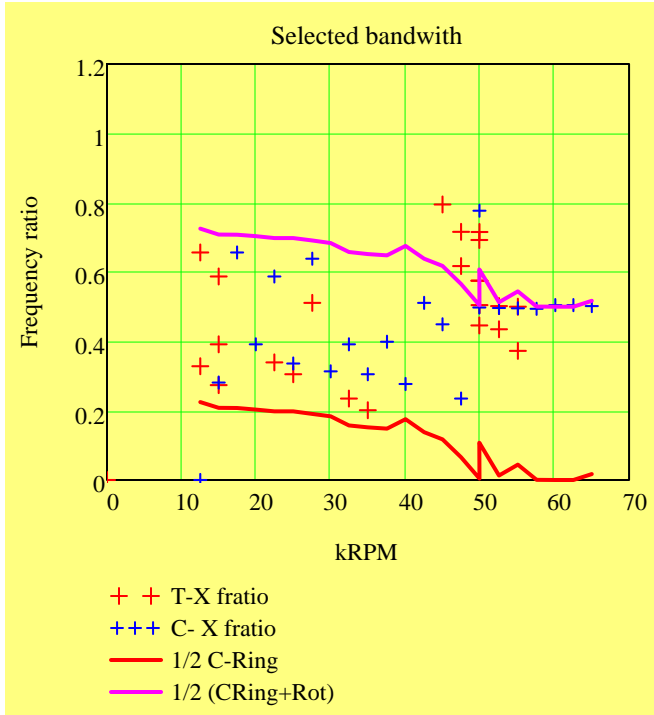
Low = 0.2

High = 0.8

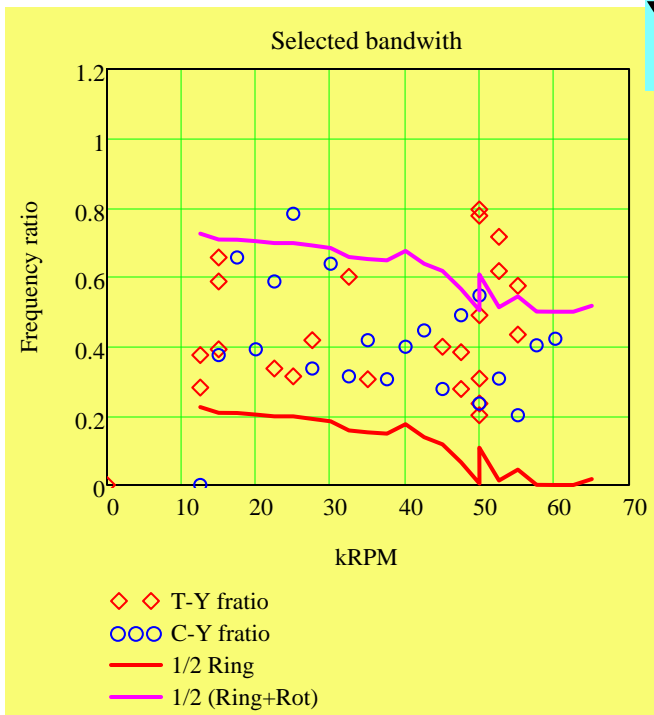
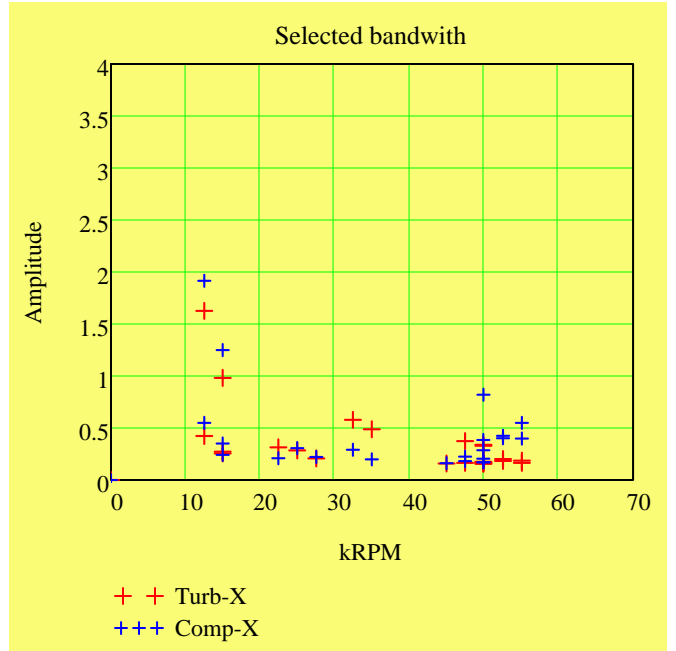
Turbine and Compressor Peak Analysis - Y Direction at Proximitors



Low=0.2, High=0.8 Components of frequency



X



Y

