This calculation sheet will show the data for a single driver with no EQ.

line := "analysis"   product := "abbey"   date := "7_6_10"

infile := "sys02"

Change these for product lines

This is the file name

____ Do NOT CHANGE anything below this line

directory := "C:\Documents and Settings\ERG\My Documents\"

READ imp files

concat(directory, line, "\", product, "\", date, "\", infile, ".txt") = ▮

imps := READPRN(concat(directory, line, "\", product, "\", date, "\", infile, ".txt"))

cols(imps) = ▮

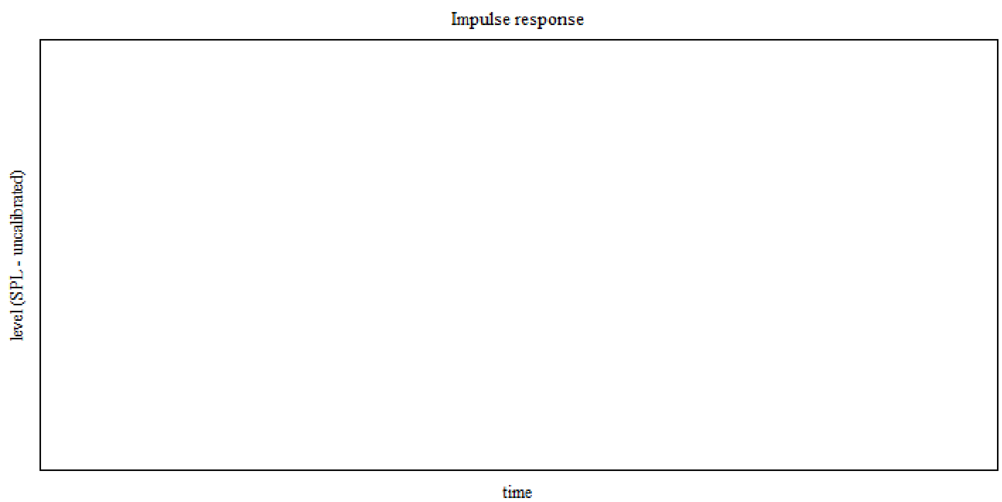
$\text{sample} := (48000)^{-1}$ num_pts := 4096

the sample rate of the wave file from SpectraPlus
num_pts is kind of arbitrary

$\text{last}\left(\text{imps}^{\langle 0 \rangle}\right) =$ ▮

$\text{sample}^{-1} =$ ▮

$j := 0 .. \text{num\_pts} - 1$



Now we want to remove the ideal and window the data to remove the reflections
These values can be found from the above plot, they are in sample numbers

delay_time := 0.004   window_time := 0.0085

$$\text{delay} := \text{trunc}\left(\frac{\text{delay\_time}}{\text{sample}}\right) \qquad \text{window} := \text{trunc}\left(\frac{\text{window\_time} - \text{delay\_time}}{\text{sample}}\right)$$

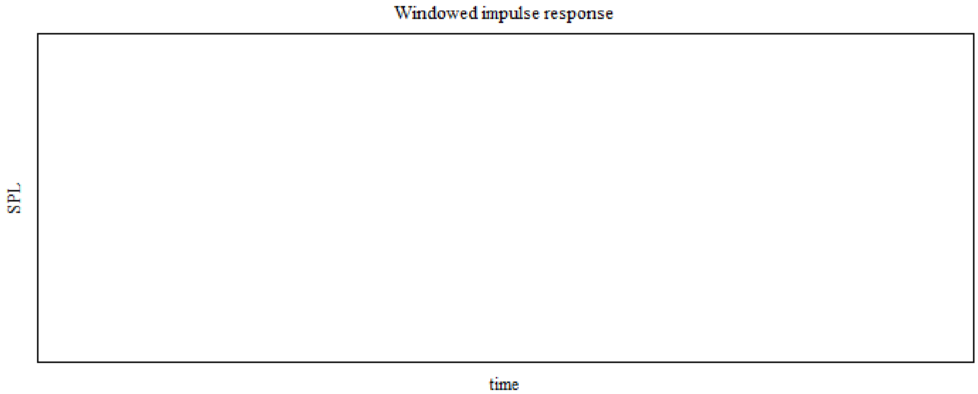
delay = ▮   window = ▮

$$\text{wind}(\text{value}, \text{ii}, \text{win\_num}) := \begin{cases} \text{value} & \text{if } \text{ii} < \text{win\_num} \\ \text{value} \cdot e^{\frac{\text{window} - \text{ii}}{32}} & \text{otherwise} \end{cases}$$

window function

$i := 0 .. 12$

$$\text{imp\_w}_{j,i} := \begin{cases} 50 \cdot \text{wind}\left(\text{imps}_{j+\text{delay},i}, j, \text{window}\right) & \text{if } j < (\text{num\_pts} - \text{delay}) \\ 0 & \text{otherwise} \end{cases}$$



FREQUENCY RESPONSE

Find the frequency response from the windowed data.

FFT length is num_pts

define the spherical Hankel functions

$$fft\_\_^{\langle i\rangle} := 2\cdot\pi\cdot fft\left(imp\_w^{\langle i\rangle}\right)$$

$$if := 0 .. \frac{num\_pts}{2}$$

$$freq_{if} := \frac{if}{sample\cdot num\_pts}$$

$$freq_0 := .01$$

$$h(n,kr) := js(n,kr) + i\cdot ys(n,kr)$$

define the spherical Hankel function of the first kind

$$hp(n,kr) := \begin{cases} (-h(1,kr)) & \text{if } n = 0 \\ \dfrac{n\cdot h(n-1,kr) - (n+1)\cdot h(n+1,kr)}{2\cdot n + 1} & \text{otherwise} \end{cases}$$

and its derivative

Define x

$$i := 0 .. 24$$

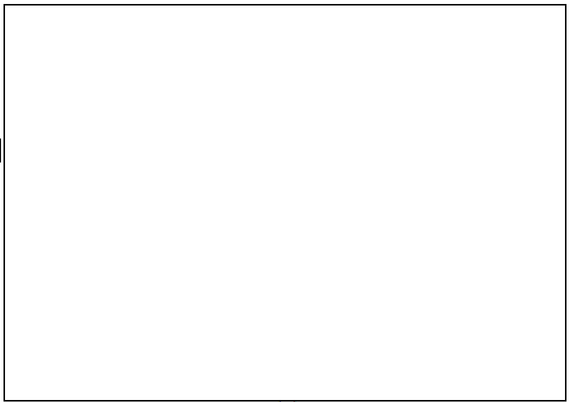
$$\theta_i := i\cdot 7.5$$

$$x_i := \cos\left(\theta_i\cdot\frac{\pi}{180}\right)$$

$$mm := 450$$

$$freq_{mm} = \blacksquare$$

$$example_{if,i} := \begin{cases} \left|fft\_\__{if,i}\right| & \text{if } i < 13 \\ \left[\left(\dfrac{12}{i}\right)\cdot\left|fft\_\__{if,12}\right|\right] & \text{otherwise} \end{cases}$$



$\overrightarrow{example} = ▪$

$\overrightarrow{arg(example)} \cdot \frac{180}{\pi} = ▪$

$angle\_coef := 18$

$$ans^{\langle if \rangle} := \left| \begin{array}{l} vReal \leftarrow \left(example^T\right)^{\langle if \rangle} \\ regress(\theta, vReal, angle\_coef) \end{array} \right.$$

$xy := 0..180$

$$Fexp(if, xy) := \sum_{ii=3}^{angle\_coef+3} \left[ans_{ii,if} \cdot (xy)^{ii-3}\right]$$

$a := .5$

$modes := 12$

$n := 0..modes$

$$k_{if} := \frac{2 \cdot \pi \cdot freq_{if}}{343}$$

$|hp(n, k_{if} \cdot a)|$

$$coef_{if,n} := (n + .5)\cdot\frac{1}{1}\left(\int_{-1}^{1} Leg(n,xx)\cdot Fexp\left(if, acos(xx)\cdot\frac{180}{\pi}\right) dxx\right)$$

This is the central integration step that defines the modal coefficients. From here the data is smoothed and then stored as smoothed modal FRs

$coef = ▮$

$num\_plot := 200$

$iplot := 0 .. num\_plot$

redefine the frequency range and resolution

Convert from linear frequency spacing to log

$$freq\_plot_{iplot} := 2\cdot 10^{\frac{3\cdot iplot}{num\_plot}+1} \qquad nm := 4$$

$$intrp_{iplot,n} := \left| \begin{array}{l} iff \leftarrow trunc(freq\_plot_{iplot}\cdot sample\cdot num\_pts + .5) \\ \text{for } i \in 0..\,nm \\ \quad \left| \begin{array}{l} vy_i \leftarrow coef_{iff-i+\frac{nm}{2},n} \\ vx_i \leftarrow freq_{iff-i+\frac{nm}{2}} \end{array} \right. \\ vs \leftarrow regress(vx, vy, nm) \\ value\_out \leftarrow interp(vs, vx, vy, freq\_plot_{iplot}) \\ \text{return } value\_out \end{array} \right.$$

$$HP1(f, f_{ss}) := \frac{f}{f + i\cdot f_{ss}} \qquad B := 12$$

$f_{ss} := 5$

$$Filt(f, f_0, B) := e^{-B\cdot\left|\log\left(\frac{f}{f_0}, 2\right)\right|}$$

$$smooth_{iplot,n} := \frac{1}{B}\cdot\left[\sum_{j=0}^{num\_plot}\left(Filt(freq\_plot_j, freq\_plot_{iplot}, B)\cdot intrp_{j,n}\right)\right]$$

This step just smoothes the data with a bandpass filter.
smooth is still an array of modal coefficients vs. frequency,
but now its log and smoothed.

$freq\_plot_{iplot}$

$$Power_{iplot} := \sum_{n=0}^{modes}\frac{\left(smooth_{iplot,n}\cdot smooth_{iplot,n}\right)}{2n+1}$$

The power response is the sum of the coefficients squared, normalized.

$$\left(smooth_{iplot,0}\right)$$
$$\left(smooth_{iplot,1}\right)$$
$$\left(smooth_{iplot,2}\right)$$
$$\left(smooth_{iplot,3}\right)$$
$$\left(smooth_{iplot,4}\right)$$
$$\left(smooth_{iplot,5}\right)$$
$$smooth_{iplot,6}$$

$$freq\_plot_{iplot}$$

$$it := 0..45$$

$$\theta_{it} := 2 \cdot it$$

$$xx_{it} := \cos\left(\theta_{it} \cdot \frac{\pi}{180}\right)$$

$$polar\_map_{iplot,it} := 5 \cdot \left[\sum_{nn=0}^{modes} \left(smooth_{iplot,nn} \cdot Leg\left(nn, xx_{it}\right)\right)\right]$$

The pressure response is a simple reconstruction.

$$polar\_map_{iplot,46} := Power_{iplot}$$

filename := concat("C:\Documents and Settings\ERG\My Documents\" , "analysis\" , infile , ".txt")

WRITEPRN(filename) := polar_map

filename = ▮

$$20 \cdot \log\left(\left|polar\_map_{iplot,0}\right|\right) - 6$$

$$20 \cdot \log\left[\frac{\left(freq\_plot_{iplot}\right)^2}{100^2}\right]$$

$$10 \cdot \log\left(\frac{\left|polar\_map_{iplot,10}\right| \cdot \left|polar\_map_{iplot,10}\right|}{Power_{iplot}}\right) - 20$$

$$freq\_plot_{iplot}$$

v = ▮