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Anechoic measurement of the polar plots of a Soundfield MKV B-format microphone

This brief document contains the results of a verification test made on a Soundfield MK-V, connected to its own preamplifier / power supply.

The microphone control unit was preliminarily calibrated following the instructions of the manufacturer, so that the relative gains of the WXYZ channels were properly set.

The measurements were made in an anechoic chamber (m 4 x 3 x 2.5), with a cutoff frequency of 185 Hz. The sound source was a Quested F11P studio monitor, powered with a Crown K1 amplifier.

Figure 1 show the microphone in the anechoic chamber.

The measuring system was a Notebook PC (Dell Inspiron 8000, Pentium III 1 GHz) equipped with a professional sound board (Digigram VX-pocket 2), working at 48 kHz, 24 bit resolution. The rotating table was an Outline ST-1, driven directly from the "right" analog output of the VXpocket board.

The measurement software was Aurora v. 3.2 (www.ramsete.com/aurora). The test signal was MLS, order 15. Each measured impulse response was truncated at 4096 samples. An average of 8 sequences was computed at each angular step. The angular resolution was 5°.

After the measurements were made, for each microphone output pair (WX, WY, WZ) a 24-bit, stereo WAV file was saved, containing the sequence of measured IRs. These files were later post-processed by means of the software Spectra Lab. V.4.32.16 (www.soundtechnology.com), by means of a sliding window of 4096 point, and re-computation of the octave-band spectra from each FFT block. The sequence of 72 spectra were automatically saved in an ASCII text file, from which they were read and imported in Microsoft Excel, which was employed for plotting the directivity patterns.

The amplitude of channel W was re-aligned with that of channels XYZ, multiplying the measured pressure values by 1.414. Thus pressure and velocity are plotted on the same scale, and their values should be the same for the incidence of maximum sensitivity of each velocity pattern.

Furthermore, the scale of the three polar plots, at the same frequency, were held unvaried. This means that the polar plots can be superposed, at each frequency. Doing so reveals that the pressure (W) during measurements W and Y varied substantially, being larger during the second one. This was due, probably, to the fact that the first measurement (WX) was made after just 15 minutes of power-on, and the microphone was not yet heated completely. In practice, it seems that the MK-V requires approximately one hour for reaching a complete stability.

The last three pages contain the directivity plots, measured in 8 octave bands, for the three channel pairs (WX, WY and WZ), obtained by separate measurements. The WZ measurement required to remount the microphone on the rotating board, so that at O° position it was pointing toward the source.

Fig. 1 – The Soundfield MK-V and the loudspeaker, in the WX and WY mounting mode.

The measurement procedure is briefly documented by figures 2 and 3. Figure 2 show CoolEditPro during the phase of simultaneous playback and recording. The upper stereo waveform, which is being played during the measurement contains 72x8 repetitions of the MLS15 signal on its left channel. Its right channel contains instead the rectangular pulse, at the end of each group of 8 repetitions, which is employed for giving the TTL pulse to the rotating table.

The lower stereo waveform is instead the recorded signal coming from the microphone outputs (W and X, in this case). It is quite evident how the W signal was constant, while the table was rotating, and instead X is changing significantly, although it never goes to zero as in theory it should be.

The measured raw data sequence is then subjected to deconvolution, and this way a sequence of 72 impulse responses are obtained, as shown in fig. 3. It is quite evident, in this figure, that W always stays very similar, whilst X changes amplitude and polarity during the rotation.

After the deconvoled set of impulse responses was obtained and saved to disk, it was re-processed through SpectraLab, producing the multiple spectrum, in octave bands, which was employed for drawing the polar plots.

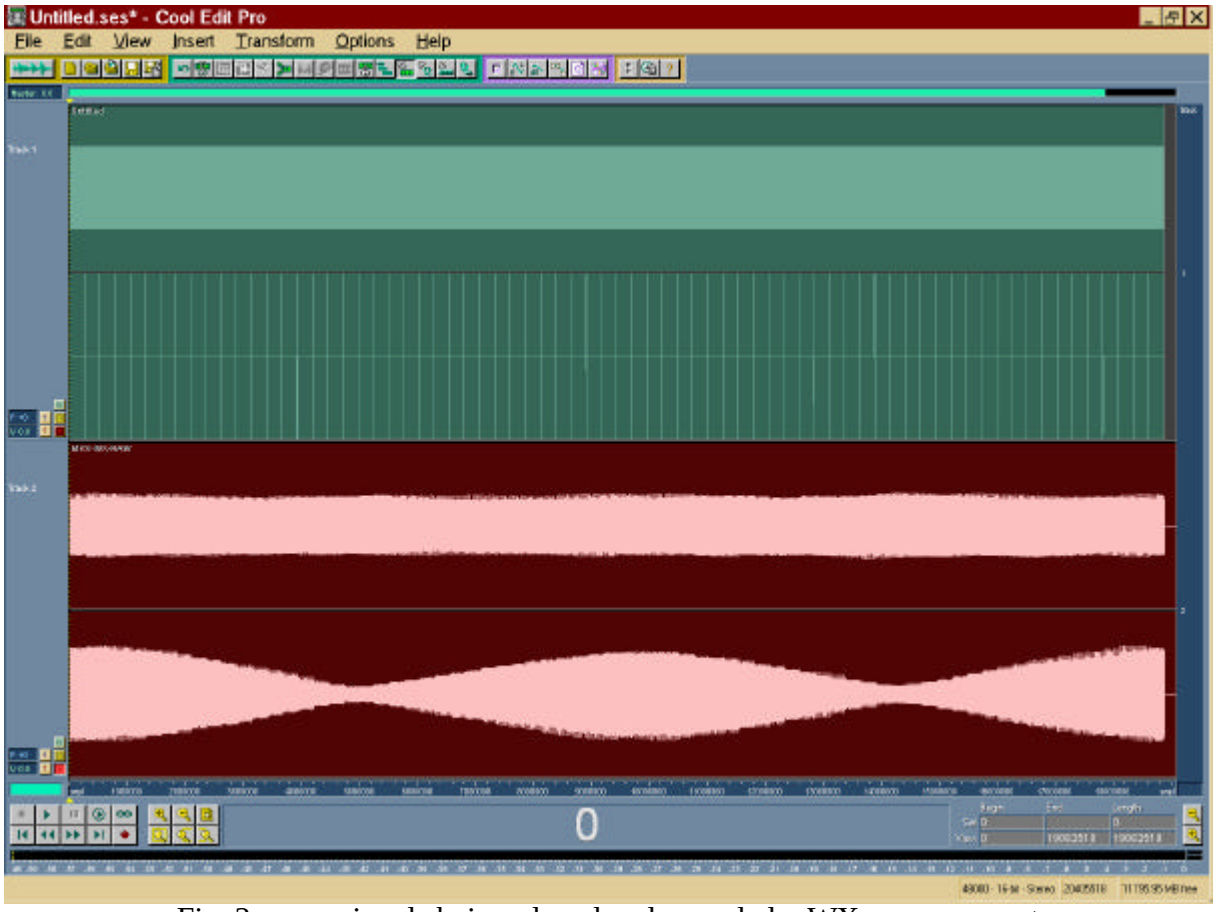


Fig. 2 – raw signals being played and recorded – WX measurement

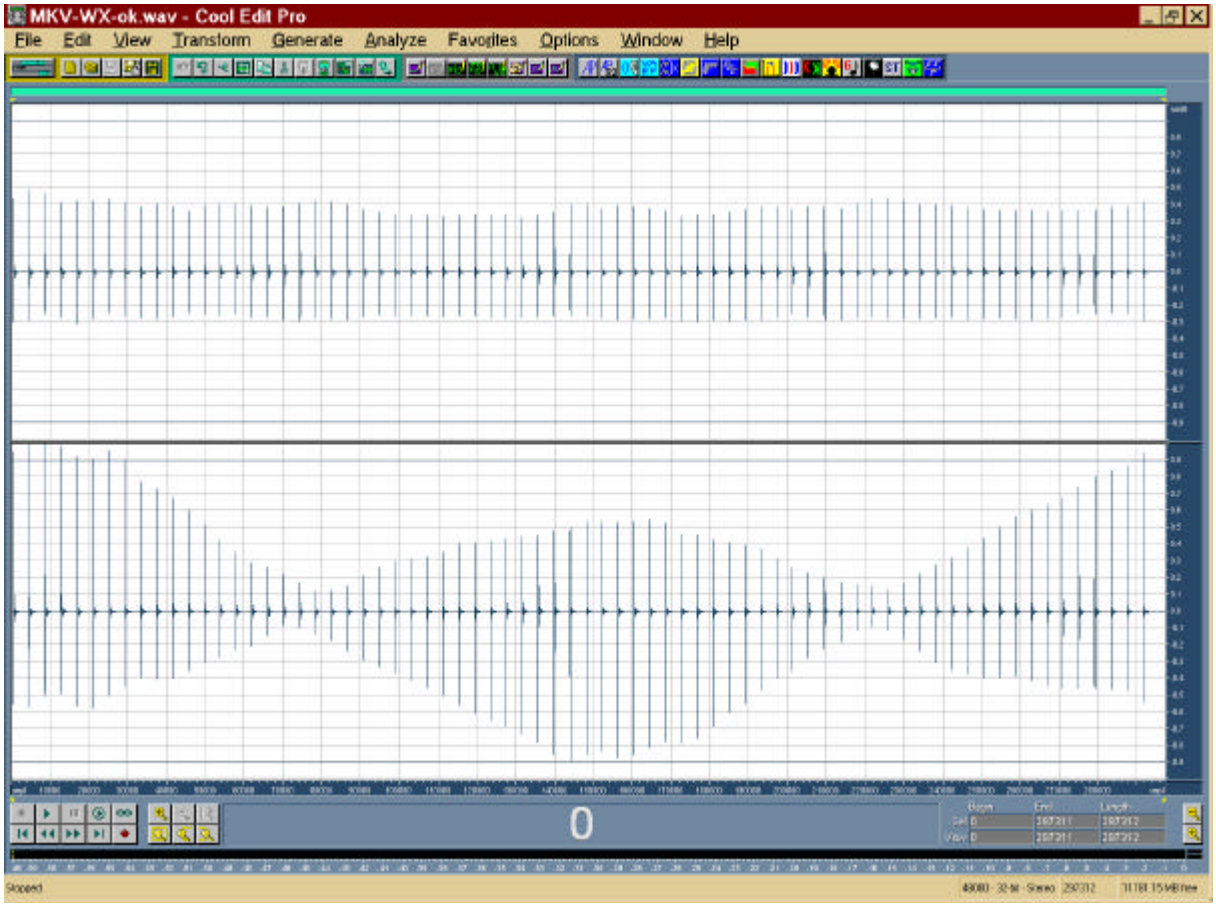
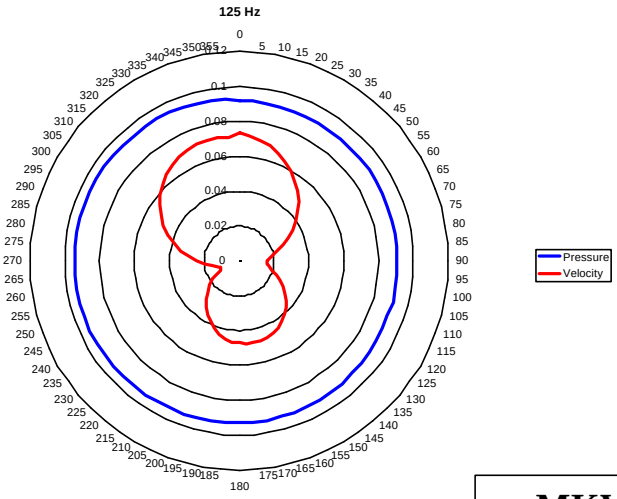


Fig. 3 – set of 72 deconvolved impulse responses – WX measurement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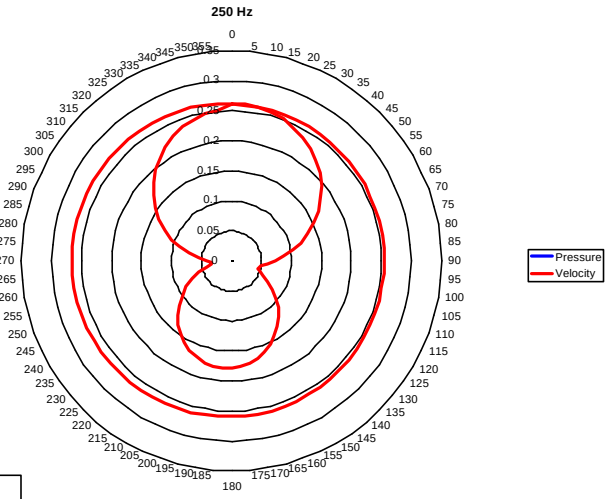
Velocity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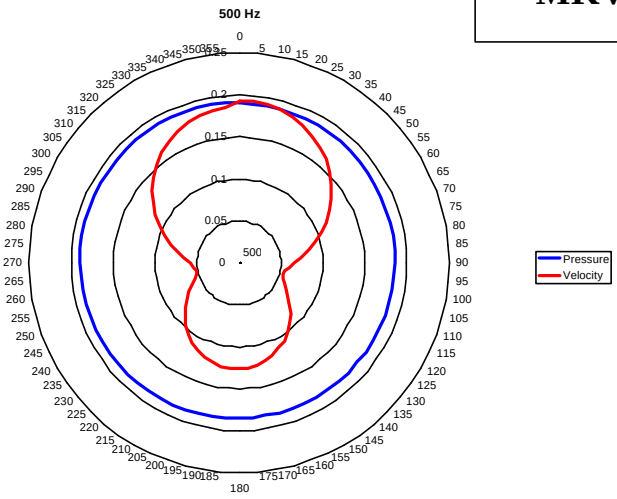
MKV - WX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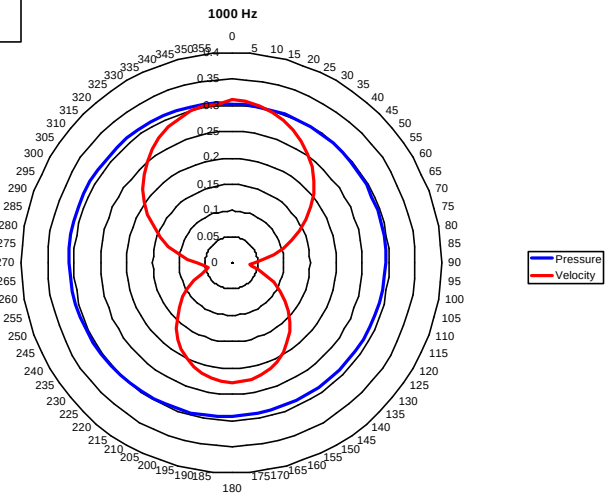
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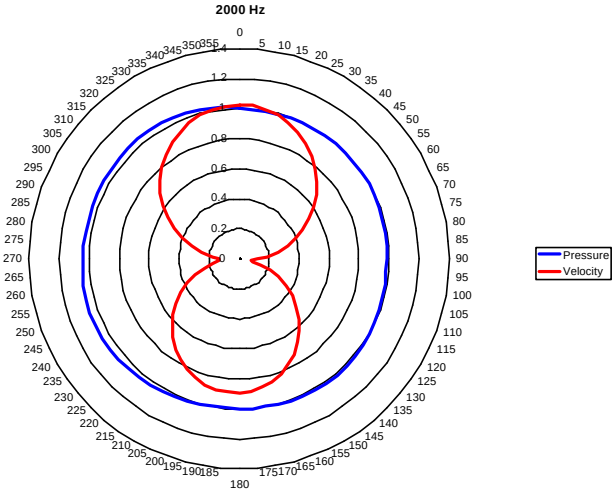
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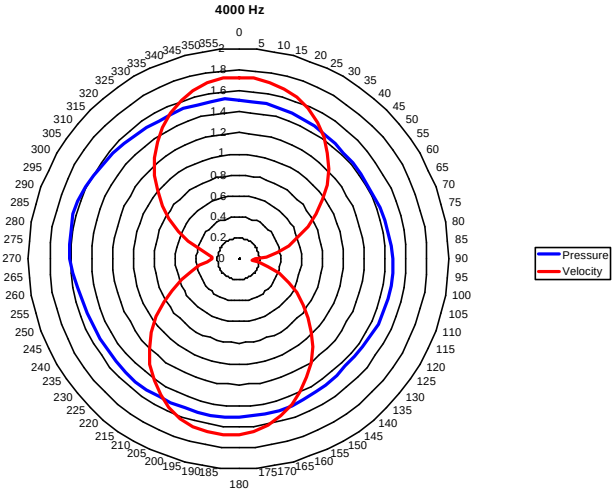
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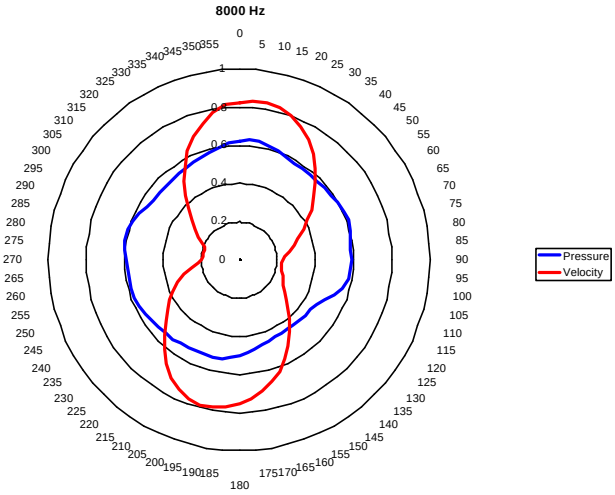
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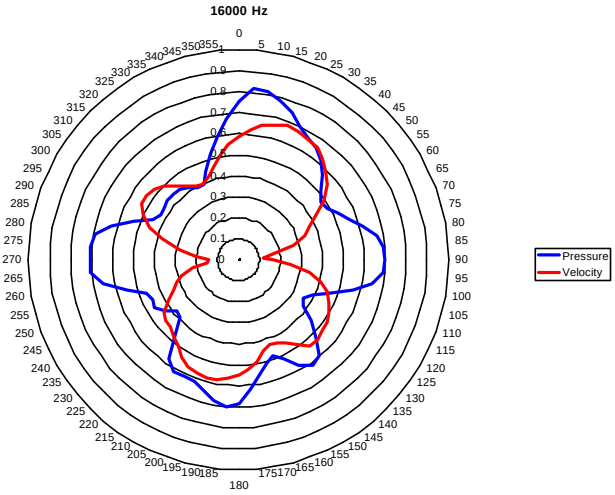
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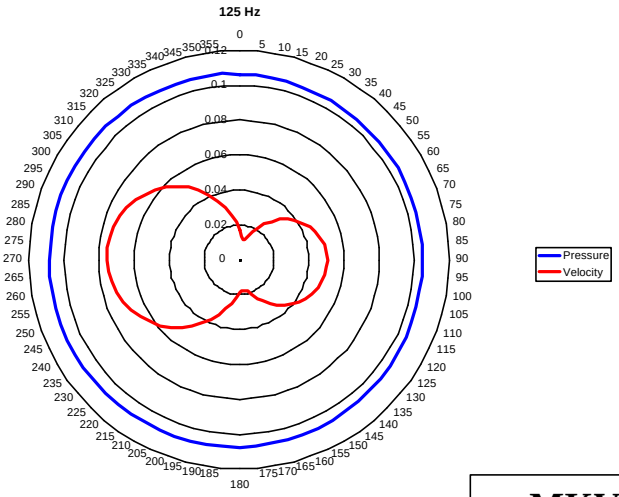
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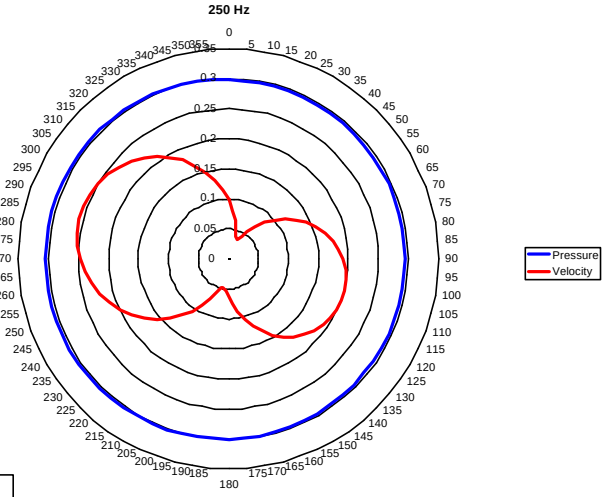
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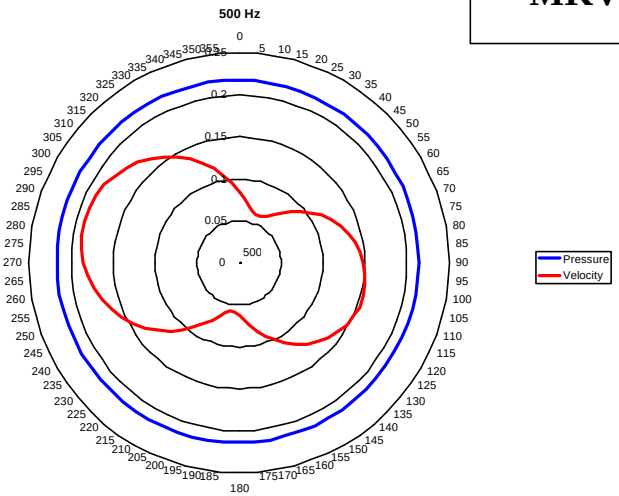
Velocity

MKV - WY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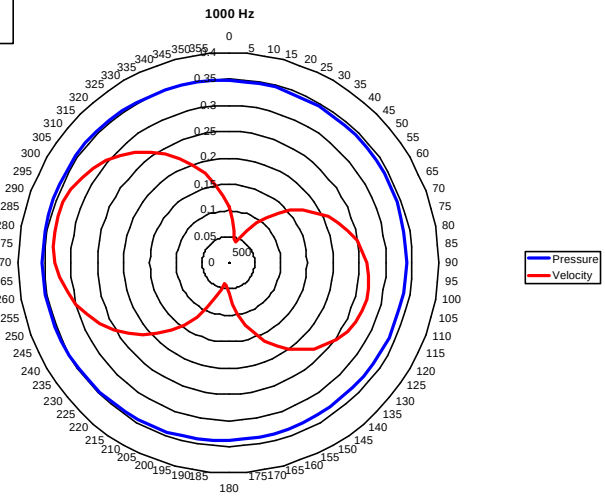
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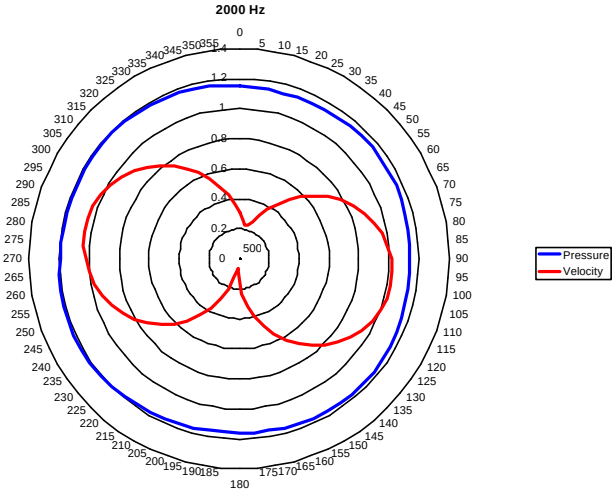
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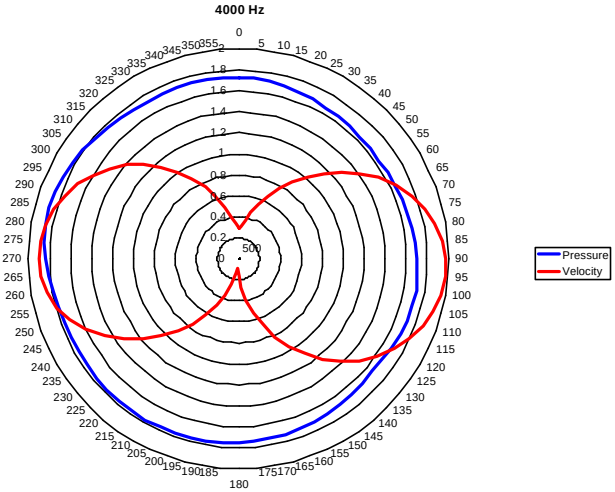
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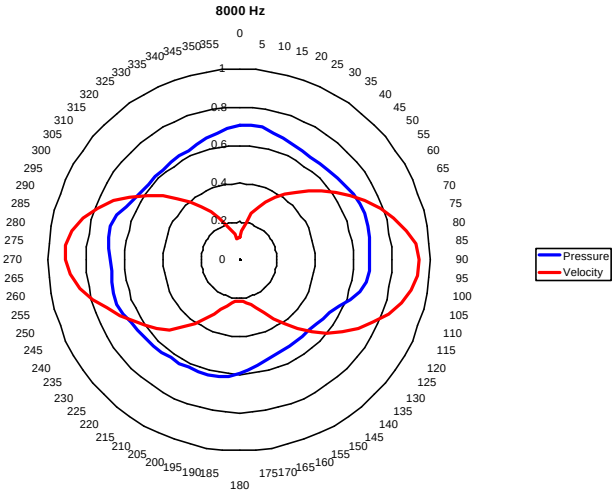
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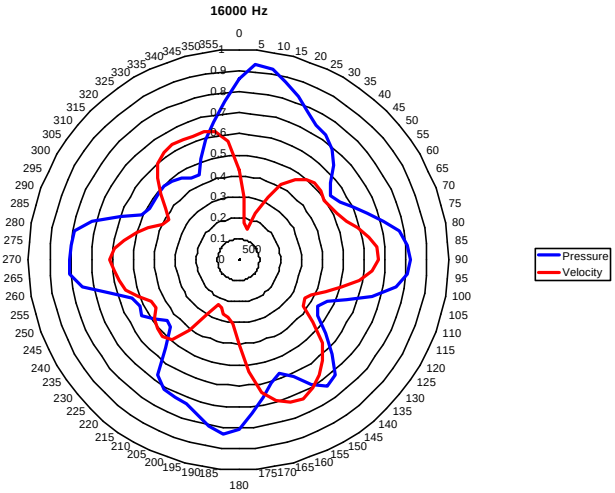
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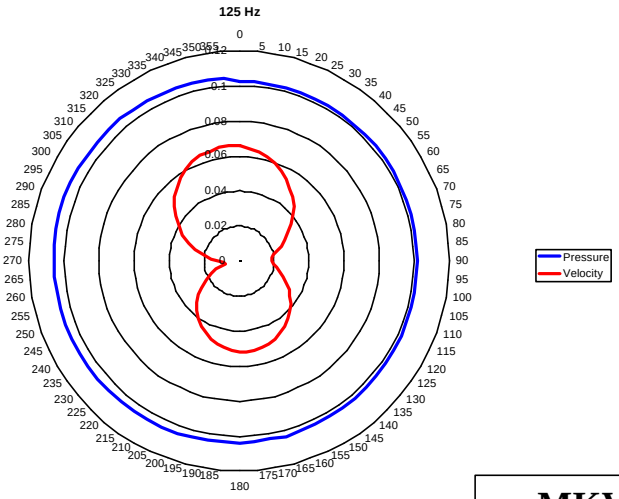
MKV - WZ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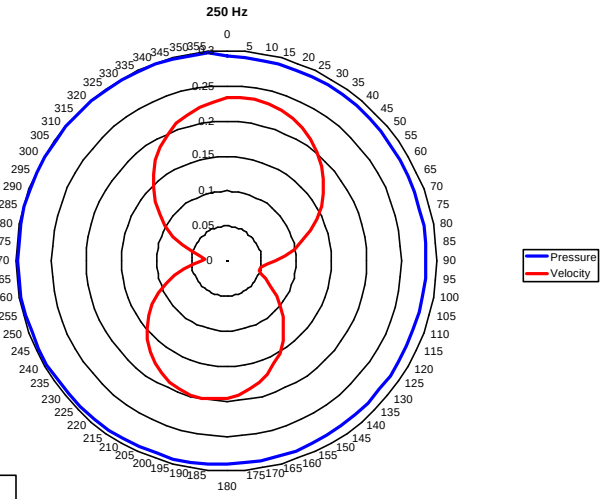
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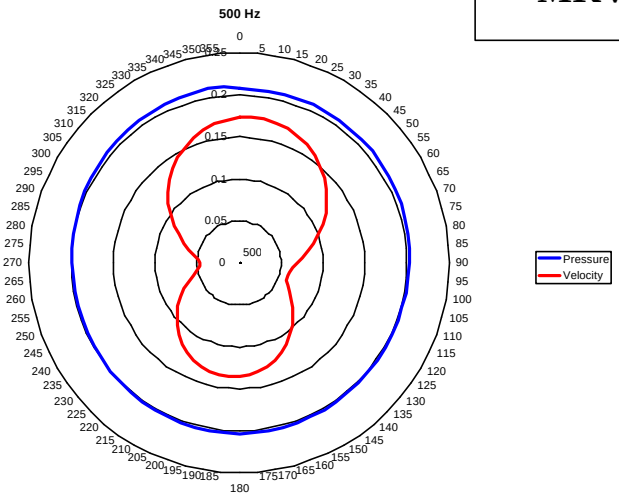
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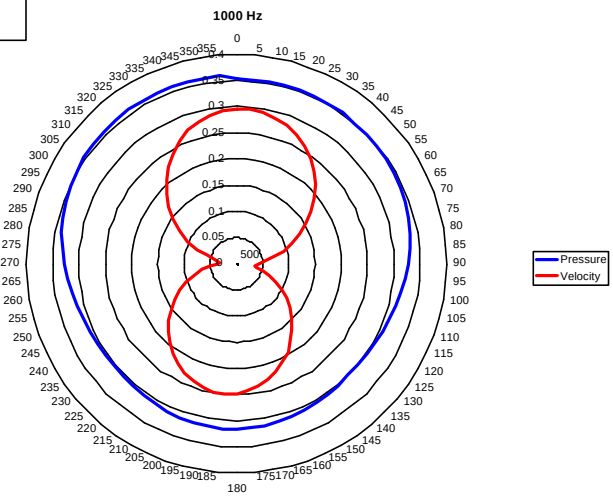
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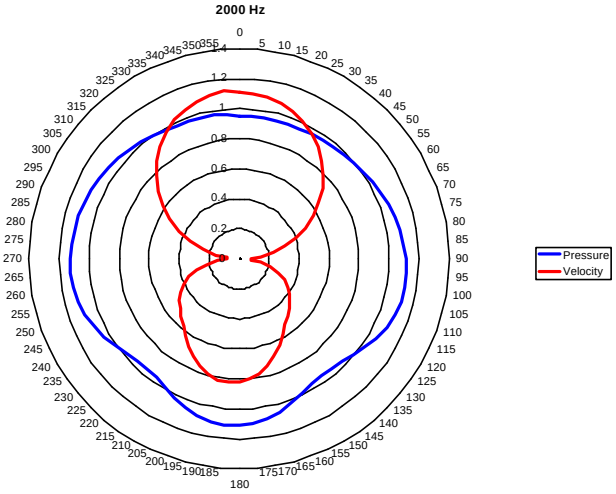
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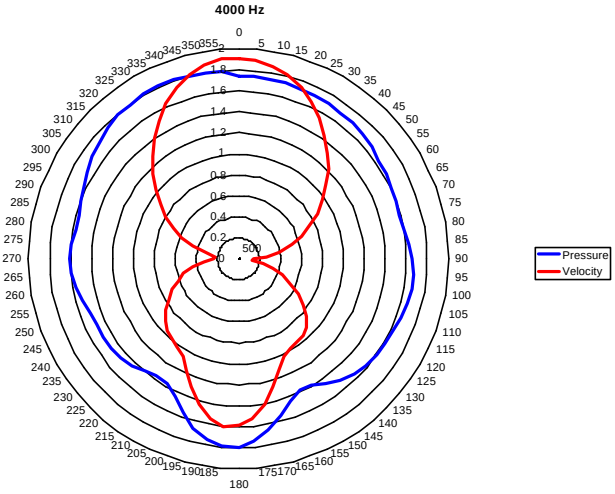
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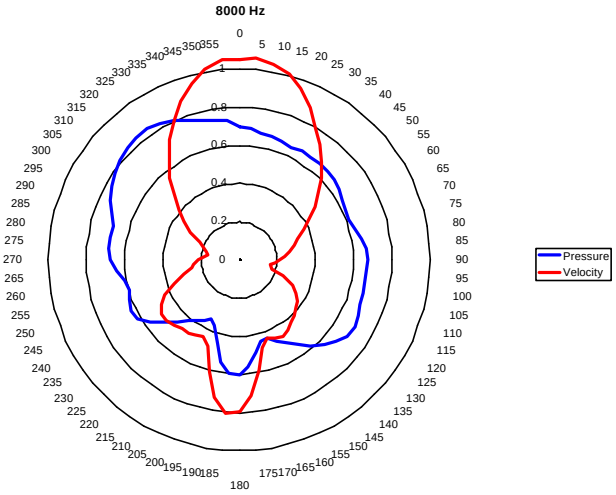
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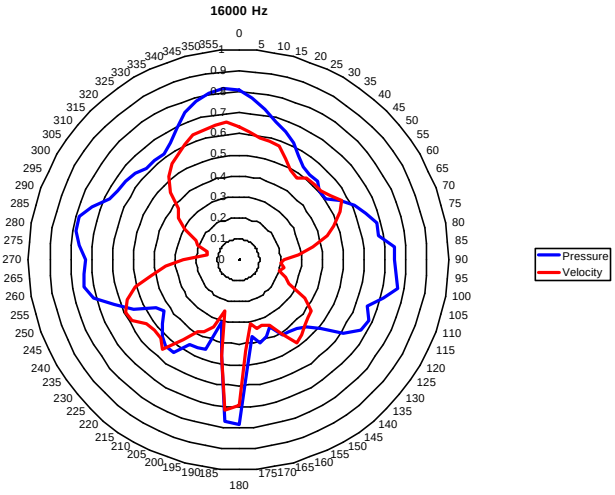
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