4. SOUND DATA ANALYSIS

To provide comparable sound data for analyzing, all recordings where done inside an anechoic chamber. The instrument sits on an optical table where also a heavy yet movable stand for carrying the AEM is also mounted (see Figure 4). The sound was captured using a ROGA™ RG50 instrumentation microphone positioned one meter in distance above the dulcimer center. A PCB™ signal conditioner and charge amplifier (Model 482A22) is directly connected to a PC-soundcard. The total recording time was limited to 15 seconds each strike.

Figure 4: Setup inside the anechoic chamber

4.1 Segmentation of sound data

For a consistent decay rate processing, the time domain signal has to be trimmed at a specific level of amplitude (red lines in Figure 5). The total length of the trimmed sound data becomes dependant on the decay rate, but will be independent of the total recording time and position of attack after recording start (see blue colored signal in Figure 5).

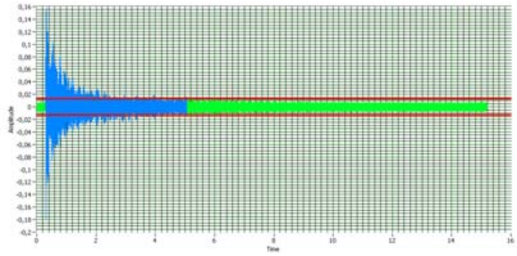

Figure 5: Captured time domain signal, red: trim levels, blue: trimmed signal, green: cut signal

4.2 Calculation of decay rate

Because the design of the hammered dulcimer, the strings are strongly coupled to the slotted bridge and soundboard. David Peterson assumed in his paper [3], that this may be one reason, why the double decay rate, which can normally be observed at instruments with more than one string per note (e.g. piano), can not be found in hammered dulcimers. This fact simplifies the calculation of the decay rate.

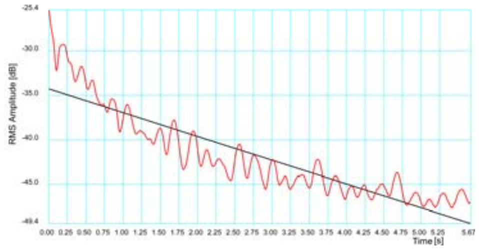

Figure 6: Decay graph, red: RMS amplitude, black: least square fitted linier approximation

After calculating the envelope of the time signal (see red curve in Figure 6) the method of least squares is used to fit the decay rate curve (black line in Figure 6). The gradient value can now be used to compare the decay rates of different notes of one instrument and also for a comparison of different models of dulcimers.

4.3 Conclusion

The artificial excitation mechanism proved to excite the instrument more consistently (therefore more reproducibly) than a musician. The standard deviation of the measured decay rates of 5 human excitations (1,23) in comparison to 5 computer controlled excitations (0,12) showed a factor of about 10 in difference (see Figure 7).

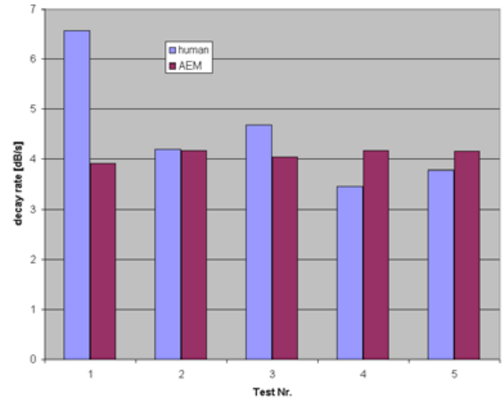

Figure 7: Comparison of decay rates of one note excited by a musician (blue) and the artificial excitation mechanism (red), 5 times each

Due to thermal effects inside the solenoids and electronics, some variances in the striking force are not negligible. The accuracy of the AEM could be improved by using the force sensor not only as a trigger, but also to normalize the recorded sound signal by the measured striking force.

5. REFERENCES

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