ABSolution instructions
System constant and DC offset evaluation from test data

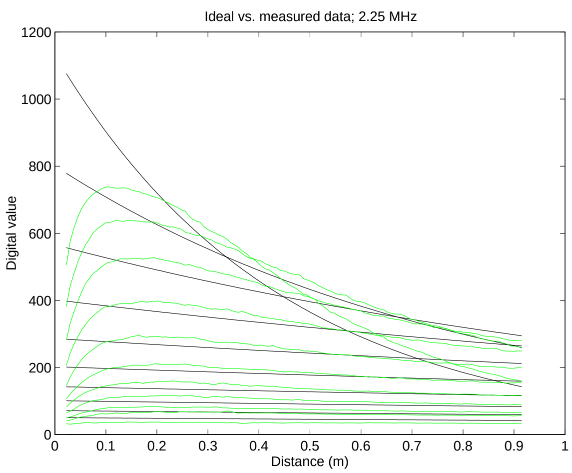
Two decisions must be made prior to calibration based on the experimental configuration.

- Nearfield limit
- Maximum test concentration

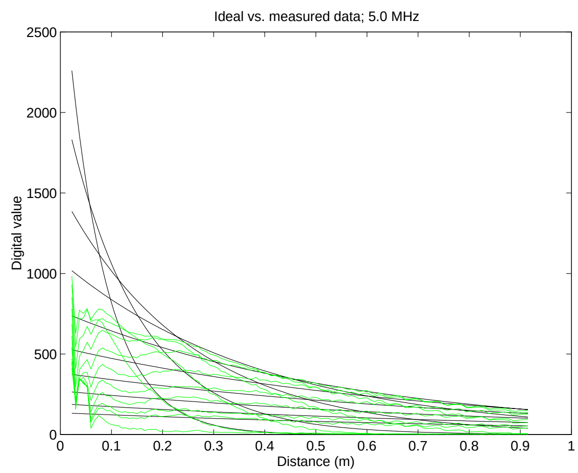
Nearfield limit distance is determined by the following:

- Physical characteristics of the piezoelectric crystal
- Saturation levels of receiver electronics and acquisition system

The nearfield region is apparent when comparing the ideal voltage curves to the actual measured curves.

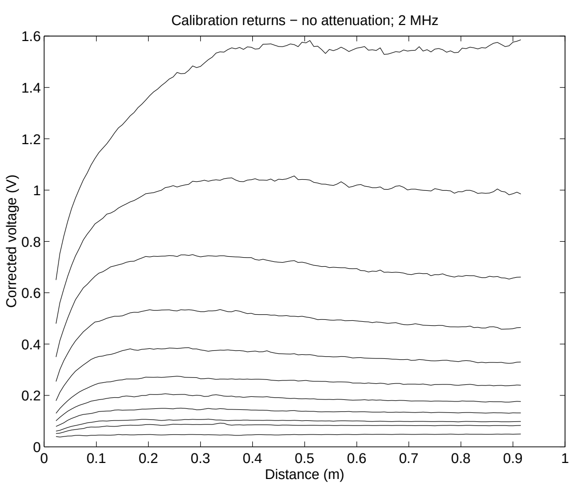


Ideal vs. data – 2 MHz

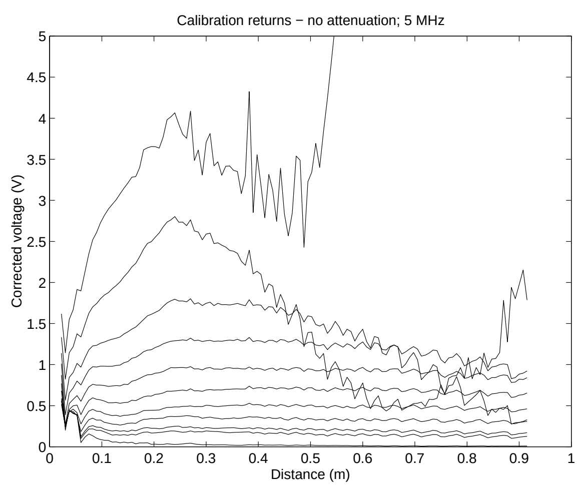


Ideal vs. data – 5 MHz

Unfortunately, the ideal voltage curve can only be generated after the system constant is known. But, since the actual concentration and size distribution are known during calibration, the measured results can be adjusted to approximate the signal level in absence of attenuation. Once this is done, saturation and the appropriate nearfield limit are more obvious.



2 MHz data – attenuation removed

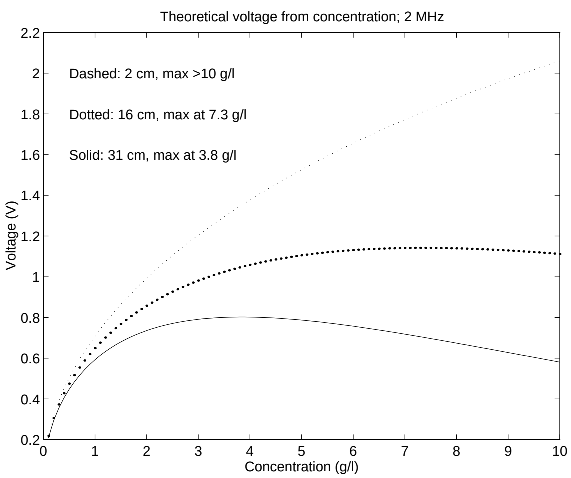


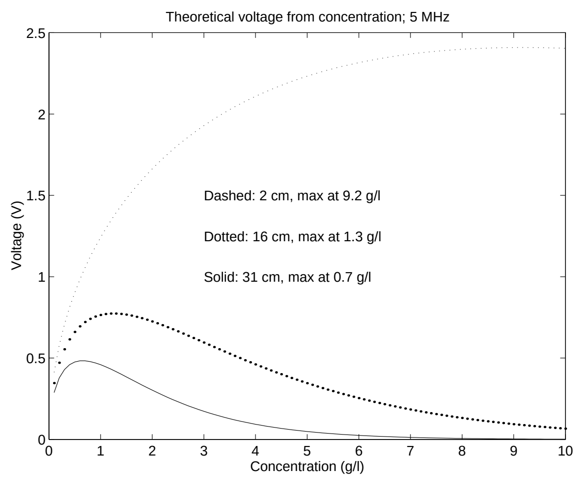
5 MHz data – attenuation removed

In the ideal case, after correcting for attenuation, the signals would be straight lines. Several factors together prevent this in reality. First, errors from not accurately knowing the concentration and distribution in the calibration tank result in an incorrect calculation of the sediment attenuation parameter. Also, poor measurement resolution of small signals will distort the curve.

The maximum test concentration must be determined for each frequency based on the chosen nearfield limit. The concentration at the first point in the profile (at the chosen nearfield limit) must be determined using an iterative technique. This iterative technique will produce two concentration solutions. We are interested in using only those concentrations lower than the maximum value of the first solution.

This is best understood by considering the return signal from a steadily increasing concentration. At low concentrations, as the concentration increases, the signal increases. At some critical concentration, the attenuation of the signal by the sediment in the region between the transducer and the first point becomes so large that as the concentration increases, the signal decreases. This critical concentration is the limiting concentration.





Signal level through constant concentration: 2 MHz   Signal level through constant concentration: 5 MHz

The signals resulting from concentrations below this limit are at a level corresponding to low sediment attenuation. Accumulated error in the profile is therefore minimal and instrument resolution is not typically a problem.

Once the nearfield limit and limiting concentration have been determined, ABSolution can be used to determine the best system constant and best DC offset. ABSolution expects input files in Matlab's mat-file format (all versions earlier than version 5 work fine. If using version 5+, be certain to save the file with the –v4 option from within Matlab). For system constant evaluation, the file should contain a matrix with one dimension corresponding to distance and one dimension corresponding to various tank concentrations. For example, if 5 constant concentration profiles of 120 points each were used for the tests, the matrix should be 5 x 120. Each of the 5 signals is an ensemble RMS of the profiles collected for the duration of each concentration test. In addition, a single vector of the known concentrations (1 x 5 in the previous example) should be included in the file.

Start ABSolution. The initial dialog asks whether *concentration only* or *concentration and size* will be determined. For determination of the system constant, the grain size distribution must be known, so chose *concentration only*. Next, click *Choose Data Files*. Select the file containing the data matrix and known concentration vector. Click *OK* to proceed to the environmental variables dialog.

Next, you will be prompted for the environmental conditions during the tests. Enter the temperature (in degrees Celsius), the speed of sound, water density, the grain distribution parameters, and the sediment density in the appropriate edit boxes.

At this point, the transducer dialog appears. Enter the operational frequency, pulse width, crystal radius (radius not necessary if the near field limit will be over-ridden), and the gain correction parameter for the transducer used. Enter the sampling rate and sampling delay for the acquisition system. Check the box under the system constant edit box indicating that the system constant is to be determined. Leave the attenuation and backscattering values set to –1 such that theoretical values will be calculated. Ignore the system constant edit box and the DC offset edit box, as these values will be calculated based on the test data.

Next, click the down arrow next to the *ACP variable name* edit box to select the matrix variable. Be certain to indicate the matrix orientation. Click *OK* to proceed to the *known concentration* dialog.

Select the name of the known concentration vector and appropriate limits and divisions for the system constant and DC offset evaluations. It's best to start with wide limits and few divisions on each in an attempt to pin down the best solutions. Once an estimate has been determined, the procedure can be repeated with better resolution of the parameters. Selecting *OK* will bring the program to a summary screen, where parameter values can be checked. Any incorrect parameters can be re-entered by selecting the appropriate dialog from the *Action* menu. Once the values have been verified, choose *Calibrate* from the *Action* menu to start the evaluation. You will then be prompted to select a directory for the output data. The output data file will be the test data evaluated with the best system constant and DC offset. Again, the output file is in mat-file format, such that it can be immediately loaded into Matlab for inspection.

Select *OK* to proceed to the *Outfile Info* dialog. The output filename consists of the original test data file name plus the suffix you enter here. For example, if the test data file is called *test.mat* and the suffix is *cal*, then the output filename will be *testcal.mat*.

After the suffix has been entered, the evaluation procedure begins. In the end, you will be provided with two system constants, two DC offsets, and the minimum error achieved using all data. The first system constant and offset are determined using only the first point in the profile (that corresponding to the nearfield limit). The second constant and offset use all data from the nearfield limit onward.

Write down these results!! They are not yet saved in the data file.