



Fig 7: Distance map of 32 (pairs) x 16 (layers) received signals; each mark shows a detected distance, white mark shows discarded measurement

Finally, results for the complete dataset are represented on fig. 7, where the determined distances for all transducer pairs are shown. The distances based on detection with 40 MHz sampling rate ranges from 18.114 cm to 18.845 cm, i.e. in difference range of 0.726 mm. The figure may be considered to show locally consistent values, corresponding to the imperfect shape of the cylinder and/or imperfect mounting of the transducers.

4 Conclusions

The presented approach enables more accurate detection of time of impulse arrival and consequently determination of time-of-flight for the USCT system, based on chirp based matched-filtering detection method with 4 times up-sampling of the received data. The detection of time of arrival is realized via computing in the frequency domain which greatly shortens the processing time. The comparison of detected distances, computed with the sampling rates of 10 MHz and 40 MHz clearly shows, that the detection method is more accurate if the dataset is resampled to 40 MHz, this way introducing a certain degree of temporal superresolution. The upsampling also increases the rate of successful detections, because the increased temporal resolution generally increases the correlation coefficient. These results are important for the following computational USCT calibration process that has been shown to be very sensitive to errors in the geometry of the transducer spatial arrangement.

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