Model Based Defect Approximation in Ultrasonic Non Destructive Testing

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Ultrasonic non destructive testing methods have achieved rapidly gaining prominence as reliable techniques for tube inspection. Its use as inspection tool brings into light the challenge of developing fast and reliable data processing methods in order to be able to characterize flaws in the material. In particular, the determination of precise positions and dimensions of flaws is a complicated task due to the huge amount of data. Moreover, the obtained data contains strong noise caused e.g. by (multiple) reflections from mode converted signals.

In our group a new simplified physical model for the problem of tube inspection by ultrasound waves has been developed. Using this model we are able to solve the inverse problem of defect reconstruction in two steps. In particular, we use the sparsity of this problem: Normally the number and size of defects will be small compared to the tube size, i.e., a small number of reflections generates the measured data. In a first step we compute the position and amplitude of those reflections by solving a sparse representation problem with deconvolution methods (e.g. orthogonal matching pursuit (OMP)) [1]. Taking this information we can solve the inverse problem of our model.

In this talk, we will present the basic ideas of our inversion method and prove approximation properties. First numerical results will be shown. This is joined work with my supervisor Gerlind Plonka-Hoch (Göttingen).

References

[1] F. Boßmann, G. Plonka, T. Peter, O. Nemitz, T. Schmitte, Sparse deconvolution methods for ultrasonic NDT, Journal of Nondestructive Evaluation 31(3), 2012, (225–244)