3D Ultrasonic Imaging for Sheet Metal Hydroforming

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Abstract. With fluid forming processes getting more and more common in industrial application a lot of research is carried out to analyze the forming behavior of sheet metal within these processes.

In order to gather experimental information about the forming behavior of the workpiece, an imaging system is presented, that will allow determining the actual shape within the forming process. The system has to be functional in liquid media as well as in a high pressure environment. Therefore an ultrasonic based system has been chosen, consisting of a small number of transducers which are alternately used as transmitter and receiver. It is possible to cover 100 by 100 mm² with only 10 by 10 transducers by the use of special algorithms.

The reconstruction of the echographic images from the recorded data is done by a SAFT-algorithm (synthetic aperture focusing technique) followed by an analysis with special contour-detection algorithms, which are able to scan the image for contour data.

It can be shown that the accuracy of the reconstruction is quite good in the 2.5-dimensional domain, if appropriate contour models for the description are used. Because of the small number of transducers and the specular reflection of the signals, the quality of the image can be improved significantly by the extension of the SAFT algorithm with an angle-weighted factor. The three dimensional reconstruction is also possible and will be demonstrated for simple geometries. The ability for sampling more complex geometries and enhancing the accuracy will be achieved by the integration of three dimensional contour models and three dimensional angle-weighting.