Contribution ID: **35** Type: **Poster**

Object Classification and Localization with an Airborne Ultrasound Imaging System

Thursday, November 2, 2017 3:00 PM (1 hour)

An airborne ultrasound imaging system (ABUS) was developed at KIT for reflection tomography. The prototype system consists of sixteen ultrasonic transducers surrounding a region of interest (ROI) of defined shape with a diameter of 50 cm. The transducers have a center frequency of 200 kHz and a bandwidth of 20 kHz. The prototype aims to demonstrate possible industrial applications for object classification and localization with airborne ultrasound.

(2) Material and Methods

ABUS can image multiple objects from multiple angles around the ROI in a single acquisition using synthetic aperture focusing technique (SAFT). Grating-lobe reduction is achieved with a sliding median filter. Challenges for automatic object segmentation are varying intensities of depicted object edges and acoustic shadowing, which causes incomplete objects in reconstructed images. A workflow for automatic object segmentation was developed, consisting of a multi-parameter SAFT reconstruction, object segmentation with local maxima detection, feature extraction, classification with a neural network and object localization using Generalized Hough Transform (GHT).

(4) Discussion and Conclusion

The evaluation results showed a classification accuracy at 95.4% and a localization accuracy of 5 mm, which is smaller than the measured full width at half maximum of the point spread function of 1.5 cm. Further improvement by adding more transducers or applying a higher bandwidth could improve detection of object features smaller than 2 cm.

(3) Results

The workflow was evaluated with six 3D printed objects of different sizes and shapes. Forty measurements were performed at discrete positions for each object in the ROI. The neural network was trained using Bayesian Regularization Backpropagation and achieved an accuracy of 95.4%. The localization accuracy was evaluated with a cylinder with an asymmetrical feature. A total of 60 measurements at discrete positions and angles were made. The localization with GHT achieved a position accuracy of 5 mm with a standard deviation of 2.7 mm. The angle accuracy was 2.8° with a standard deviation of 5.4°.

Author: Mr TAN, Wei Yap (KIT-IPE)

Co-authors: Mr ERBACHER, Grischan (KIT-IPE); Dr RUITER, Nicole (Karlsruhe Institute of Technology); Dr STEINER, Till (Pepperl+Fuchs GmbH)

Session Classification: Poster session

Track Classification: Main Track