World Academy of Science, Engineering and Technology
International Journal of Electrical and Information Engineering
Vol:10, No:05, 2016

Near Field Focusing Behaviour of Airborne Ultrasonic Phased Arrays Influenced by Airflows

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Abstract : This paper investigates the potential use of airborne ultrasonic phased arrays for imaging in outdoor environments as a means of overcoming the limitations experienced by kinect sensors, which may fail to work in the outdoor environments due to the oversaturation of the infrared photo diodes. Ultrasonic phased arrays have been well studied for static media, yet there appears to be no comparable examination in the literature of the impact of a flowing medium on the focusing behaviour of near field focused ultrasonic arrays. This paper presents a method for predicting the sound pressure fields produced by a single ultrasound element or an ultrasonic phased array influenced by airflows. The approach can be used to determine the actual focal point location of an array exposed in a known flow field. From the presented simulation results based upon this model, it can be concluded that uniform flows in the direction orthogonal to the acoustic propagation have a noticeable influence on the sound pressure field, which is reflected in the twisting of the steering angle of the array. Uniform flows in the same direction as the acoustic propagation have negligible influence on the array. For an array impacted by a turbulent flow, determining the location of the focused sound field becomes difficult due to the irregularity and continuously changing direction and the speed of the turbulent flow. In some circumstances, ultrasonic phased arrays impacted by turbulent flows may not be capable of producing a focused sound field.

Keywords : airborne, airflow, focused sound field, ultrasonic phased array
Conference Title : ICUA 2016 : International Conference on Ultrasonics and Applications
Conference Location : Amsterdam, Netherlands
Conference Dates : May 12-13, 2016