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Design of an Acoustic Imaging Sensor Array for Mobile Robots

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Abstract : Imaging of underwater objects is primarily conducted by acoustic imagery due to the severe attenuation of electromagnetic waves in water. Acoustic imagery underwater has varied range of significant applications such as side-scan sonar, mine hunting sonar. It also finds utility in other domains such as imaging of body tissues via ultrasonography and non-destructive testing of objects. In this paper, we explore the feasibility of using active acoustic imagery in air and simulate phased array beamforming techniques available in literature for various array designs to achieve a suitable acoustic sensor array design for a portable mobile robot which can be applied to detect the presence/absence of anomalous objects in a room. The multi-path reflection effects especially in enclosed rooms and environmental noise factors are currently not simulated and will be dealt with during the experimental phase. The related hardware is designed with the same feasibility criterion that the developed system needs to be deployed on a portable mobile robot. There is a trade of between image resolution and range with the array size, number of elements and the imaging frequency and has to be iteratively simulated to achieve the desired acoustic sensor array design. The designed acoustic imaging array system is to be mounted on a portable mobile robot and targeted for use in surveillance missions for intruder alerts and imaging objects during dark and smoky scenarios where conventional optic based systems do not function well.

Keywords : acoustic sensor array, acoustic imagery, anomaly detection, phased array beamforming
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