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一种基于MATLAB的CMUT阵列设计与成像仿真方法

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摘　要：

为了分析阵列设计参数与成像效果的关系，提高微电容超声传感器（CMUT）阵列设计的可靠性，本文提出了一种仿真CMUT阵列水下成像方法。设计了一种CMUT结构，振膜厚3um，振动单元边长1.16mm， ANSYS仿真得出中心频率为464KHz。讨论了阵列参数与声束指向性关系，以空间脉冲响应理论为基础提出了一种可显示CMUT阵列成像效果图的仿真设计方法。通过MATLAB对该方法的仿真，模拟了不同结构的CMUT线阵在不同激励形式下的水下成像。仿真结果表明，64阵元且单元间距0.5λ的CMUT线阵在单脉冲激励下成像效果最好。该仿真方法的实验结果与理论一致，且相比单纯理论分析该方法结论更直观，考虑成像影响因素更全面。

关键词：电容式微加工超声传感器（CMUT）；阵列设计；空间脉冲响应理论；MATLAB；水下成像仿真

A method of the CMUT array Design and imaging simulation based on MATLAB

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Abstract:

In order to analyze the influence of design parameters on imaging results, and improve the reliability of design of the capacitance micromachined ultrasonic transducer (CMUT) linear array, a simulation method is proposed for underwater imaging of the CMUT array. A new structure of CMUT is designed with a diaphragm thickness of 3um and 1.16mm for the side length, and the center frequency is simulated with ANSYS as 464KHz. The relationship between parameters and the beam directivity is discussed. Based on the spatial impulse response theory, the simulation method which can display the imaging result of designed CMUT array is presented. Finally, the imaging simulation of this method is proceeded on MATLAB, and an optimal result is given by the CMUT linear array with 64 elements and 0.5λ for the spacing under monopulse excitation. For the CMUT linear array with different element number and element spacing, the imaging result of this method is in accordance with the conclusion of directivity theory, but more intuitive and comprehensive on imaging analysis.

Keywords: CMUTs; design of array; the spatial impulse response theory; MATLAB; underwater imaging simulation

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