Guidelines for Student Reports

Progettazione Di Array Per Imaging A Ultrasuoni Mediante Algoritmi Genetici

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Abstract

La realizzazione di sistemi per imaging a ultrasuoni ha diverse applicazioni per apparati biomedicali e sonar. Tali sistemi si basano sull'utilizzo di array di trasduttori a ultrasuoni (piezoelettrici) che effettuano una trasmissione e ricezione di impulsi acustici. In generale esistono differenti strategie per la progettazione dell'array a ultrasuoni:
(a) utilizzo di singolo array in trasmissione e ricezione: in tal caso l'array da progettare è uno, ma ogni elemento radiante deve essere predisposto per agire sia in trasmissione che in ricezione, con conseguenti costi e complessità realizzativa superiore; (b) utilizzo di due differenti array, uno in trasmissione ed uno in ricezione: in tal caso gli array sono separati (possono avere alcuni elementi in comune, che devono agire in trasmissione e in ricezione)
Al fine di progettare un sistema di questo tipo, occorre stabilire il numero e la posizione dei trasduttori (elementi radianti), tenendo presenti i vincoli esistenti in termini di complessità realizzativa (numero elementi che effettuano trasmissione e/o ricezione) e di risoluzione desiderata (contrasto, dimensione pixel). Le tecniche più comunemente usate in tal senso si basano su algoritmi di ottimizzazione globale, metodi randomici e approcci analitici. Il limite di tali tecniche è però legato al fatto che la caratterizzazione dell'array utilizzata per stabilire il design "ottimo" si basa sul comportamento del sistema di imaging a ultrasuoni in far field, mentre il loro utilizzo è solitamente in near field.
Un approccio alternativo al fine di realizzare sistemi di imaging a ultrasuoni ad elevate prestazioni può essere basato sull'utilizzo della loro caratterizzazione in near field nella fase di design, attraverso la Point Spread Function (PSF) dell'array (risposta all'impulso del sistema di imaging in near field). Obiettivo dell'attività sarà quello di valutare le prestazioni di una metodologia di progettazione innovativa che ottimizzi la PSF dell'array (in termini di larghezza di lobo, energia nella regione di lobo secondario, e contrasto di immagine) mediante l'utilizzo di un approccio ibrido che integri tecniche analitiche (basate su sequenze ADS) e stocastiche (algoritmi genetici). In particolare, saranno considerati design di tipo (b), al fine di minimizzare i costi realizzativi dell'apparato considerato e pur mantenendo elevate capacità di design.

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