| 1.0	Example Design

Description

A beamformer performs a spatial signal filtering focusing on a target angle. It gathers a set of signals from an antenna array and linearly combines them to strengthen a signal from a designed direction in a constructive way.

An adaptive beamformer achieves an advanced spatial filtering under an environment with interference signals. The conventional beamformer is limited by jamming signals at a main lobe and sidelobes of the array response, but the adaptive beamformer is capable of nulling unwanted jamming signals.

An adaptive beamformer basically observes a given environment regardless of interferences in prior and finds a weight coefficient vector for the linear combination of beamformer.

In this example design, we implement Minimum Variance Distortionless Response (MVDR) algorithm. The MVDR adaptive beamforming uses Sample-Matrix Inversion (SMI) methods, which determines the antenna array weights directly from observation. Other methods commonly find weights iteratively until converging to an optimal solution, for example, maximizing SNR, so their solution is indeterministic and not practical to implement for a real-time system.
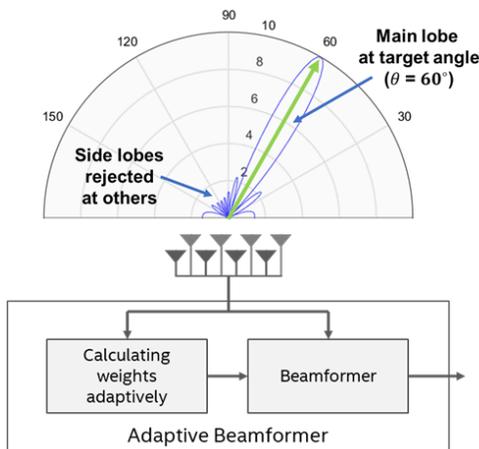
Our MVDR adaptive beamforming algorithm is a QR decomposition (QRD)-based method. To get weights directly, it needs to calculate an inverse of input matrix in the process, and the QRD substitutes the complex matrix inverse operation into a simpler form of the solution.

Features

- MVDR adaptive beamforming algorithm
- Implemented on Arria-10 FPGA devkit
- Intel FPGA OpenCL Flow
- Supporting 8 or 64 array elements
- Supporting 25 independent beam
- Maximum throughput 3.03M/0.365MHz adaptive beams for 8/16 elements respectively

Applications

- Military applications of sonar and radar
- Wireless communication
- Commercial networks
- Radio applications
- Acoustic noise canceling
- Microphone array speech processing

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