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QR update applied to Beamforming filter

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Abstract

The Beamforming filter is an algorithm that processes frames comming from a signal that is periodically sampled. The most expensive operation to process a frame in this algorithm is the QR decomposition of a matrix which is updated, each time upon receiving a new frame, by deleting few rows at the top and appending new ones at the bottom. In this paper we present an implementation of a process called QR updating, *which is a procedure that allows to keep the Q and R factors of the QR decomposition of a given matriz A updated, avoiding thus to recalculate the whole QR decomposition. Our implementation has been carried out in an ARM processor architecture. The results show that we are more and more closer to the implementation of a real-time Beamforming algorithm on mobile devices.*

Keywords QR updating, Beamforming Filter, Heterogeneous Computing

I. Thesis idea

The thesis idea is around the development of digital sound applications with real-time constrains on low power consumption mobile devices that can be either heterogeneous, such as the NVIDIA Jetson TK1 and TX1 development kits, or asymmetric, like the ODROID-XU4 powered by the ARM big.LITTLE technology. In order to simplify programming and to get optimized codes for this hardware we will use HPC libraries like BLAS, LAPACK, CUBLAS, PLASMA, and MAGMA as much as possible.

The applications that can benefit from the work of this thesis are, e.g. applications of spatial sound (3D audio), filtering multichannel, echo cancellers of crosstalk, tracking and tracing of sources, classification and signal enhancement, etc. Among the applications, we will focus on processing distributed and collaborative of digital audio signals.

In this paper, we address the optimization of the Beamformer algorithm in these computing devices. This algorithm performs the same processing on each new sound frame. More than 70% of this processing falls into the computation of the QR decomposition of a given matrix which represents the sound signal that it is being sampled at the current time. For this reason we have introduced a technique called *QR update*, which allows to obtain the QR decomposition of a matrix departing from the QR decomposition of another one computed before. Avoiding to compute the QR decomposition of the current signal from scratch we can save computations.

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