

Artificial Intelligence (AI) includes techniques that enable computers to mimic human intelligence. Convolutional Neural Networks (CNNs) are prominent AI models for image recognition, excelling at tasks like classification and object detection. However, their high computational cost limits deployment on resource-constrained devices like smartphones.

To address this, we explored convolution methods based on the real-valued Discrete Fourier Transform (RV-DFT) and Discrete Hirschman Transform (DHT). Our analysis shows DHT-based convolution typically outperforms FFT- and RV-based methods due to lower complexity, especially since RV-DFT requires no length constraints and reduces real multiplications and memory usage. For input sizes that are powers of two, FFT remains the most efficient.

We developed a fast convolution algorithm called DHTConv, based on DHT, which reduces computational complexity and processing time. Hardware validation demonstrated its effectiveness, with FPGA implementation showing low latency and resource usage, and reductions of over 22% in real additions and multiplications.

Additionally, we created a software CNN, DHTCNN, using DHTConv, which outperformed SpatialCNN in speed for tumor detection. This success motivates further implementation of DHTConv in more complex networks such as YOLO.