Karlsruhe Institute of Technology

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CEL

Efficient GPU Implementation of LDPC Decoder

Bachelor's Thesis

Project

The Sum-Product Algorithm (SPA) is a widely utilized decoding algorithm for Low-Density Parity-Check (LDPC) codes. This iterative decoding process involves updating nodes defined by the parity-check matrix of the code using specific update equations.

As the size of the parity-check matrix increases, the decoding duration on a CPU significantly increases. Therefore, implementing a GPU-based decoder can potentially reduce this duration due to the parallel processing capabilities of GPUs.

This thesis aims to efficiently implement the SPA in CUDA for GPU utilization. The objective is to fully leverage GPU resources to accelerate the decoding process. Various methods of employing GPUs for decoding codewords will be explored. Subsequently, the decoder implementation will be used to develop a simulation environment in C++ to benchmark the performance of existing codes. Additionally, Python binding files will be created to facilitate the use of the decoder. Finally, the extension of the decoder to a multi-GPU setting will be investigated.

This thesis can also be undertaken as a research practice or HiWi project.

Tasks

1. Efficiently implement the SPA in CUDA
2. Develop a simulation environment in C++ and Python bindings
3. Benchmark the performance of existing LDPC codes
4. Extend the implementation to support a multi-GPU configuration

Requirements

- ✔ Good skills in C++
- ✔ Interest in channel coding and communications

Institute

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