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GPU acceleration of CCSDS Rice decoding

Bachelor's thesis
in **COMPUTER SCIENCE**

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Abstract

TBD

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11.3 Informatics, Computer Science

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D. Software

D.1.3. Concurrent Programming

I.4.2. Compression (Coding)

Tytuł pracy w języku polskim

Akcerleracja GPU dekodowania CCSDS Rice

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Introduction

Deep learning applications require complex, multi-stage data processing pipelines that include loading, decoding, cropping, resizing, and many other augmentations. These data processing pipelines, which are currently executed on the CPU, have become a bottleneck, limiting the performance and scalability of training and inference. To address this bottleneck, The NVIDIA Data Loading Library (DALI) was conceived with a goal of offloading data loading and preprocessing to the GPU.

Nevertheless, in the case of more unusual data formats such as FITS, which is a standard for space observation data, there are currently no solutions that would alleviate this bottleneck by harnessing GPU acceleration. One of the main problems that riddles FITS data format use case in machine learning is the widespread utilization of rather nonstandard RICE compression. This coding method became a standard as it well suited for running on FPGAs used onboard satellites, although less performant on more mainstream hardware architectures compared to alternative data compression methods.

That's why, motivated by a growing number of deep learning applications trained on images of space, our team approached the nontrivial problem of massive GPU parallelization of RICE coding and its implementation in the DALI library.

Chapter 1

Key terms

1.1. FITS

1.2. RICE

Chapter 2

GPU acceleration of CCSDS Rice decoding algorithm

2.1. Naive approach

Bibliography

- [Bea65] Juliusz Beaman, *Morbidity of the Jolly function*, *Mathematica Absurdica*, 117 (1965) 338–9.