ALUs

GPU-Accelerated
EO processing toolbox by CGI

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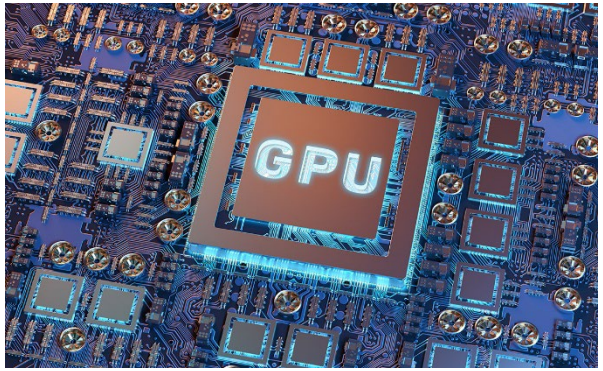
Living Planet Symposium 2022

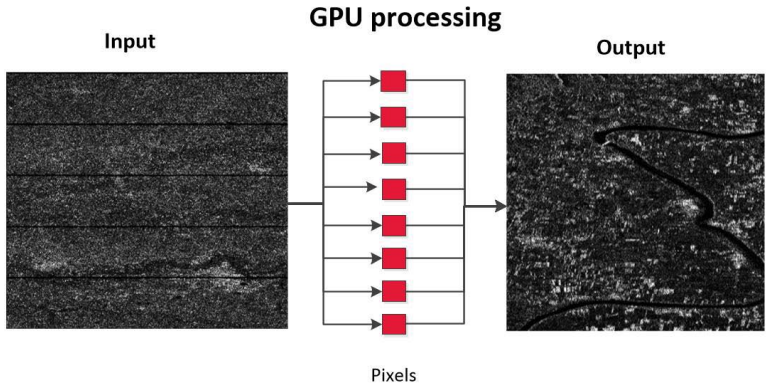
C1.08 Advanced Solutions for SAR processing and analytics

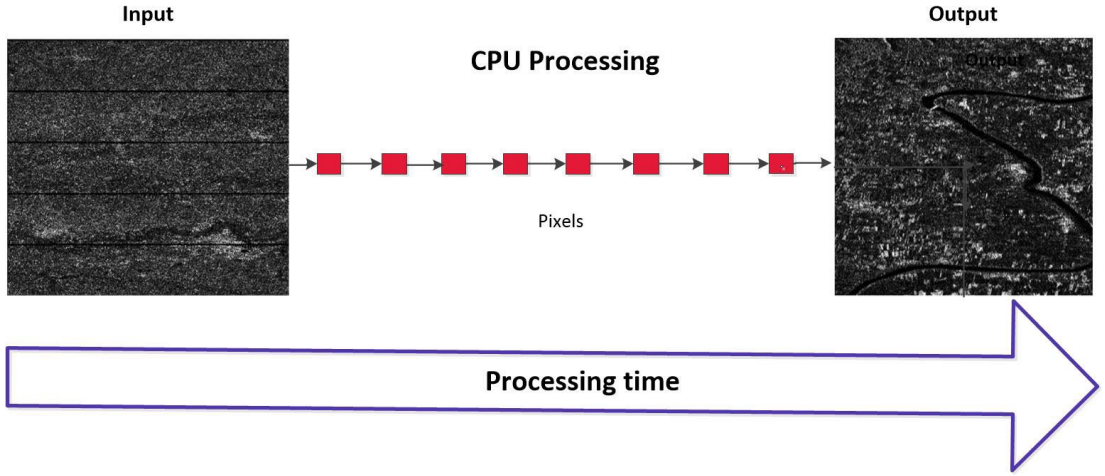
Introduction

Acceleration of EO data processing	SAR & Optical tools	Graphical Processing Units
Estonian GSTP activity	C++ and CUDA	Open Source Software

Introduction: GPU Processing







Introduction: Expert user input to algorithm selection

Introduction: Processing algorithms

Sentinel-1 coherence estimation routine
- Apply Orbit file
- TOPSAR Split
- Back-geocoding
- Coherence Estimation
- TOPSAR Deburst
- TOPSAR Merge
- Range-doppler Terrain Correction

Sentinel-1 calibration routine
- TOPSAR Split
- Thermal Noise Removal
- Calibration
- TOPSAR Deburst
- Range-doppler Terrain Correction

Sentinel-2 and any other raster data resampling

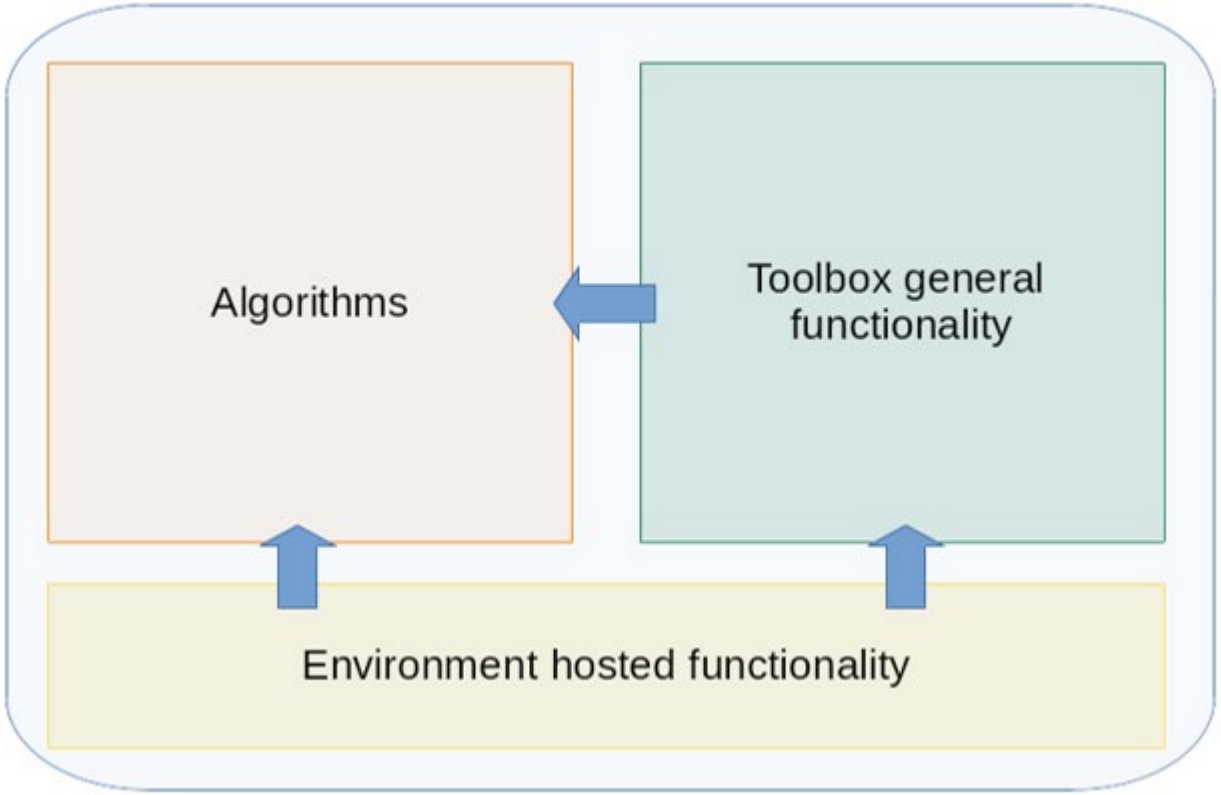
Gabor feature extraction (coming July 2022)

ALOS PALSAR Zero-Doppler focusing (coming July 2022)

ALUs Architecture

Designed to be as lightweight as possible:

- Command line tools
- Built on top of the standard tools and libraries, components “off the shelf”
- Easy to embed into different solutions
  - Jupyter notebooks and other frontends
  - Docker, kubernetes
  - Optimizations can be achieved on the platform level



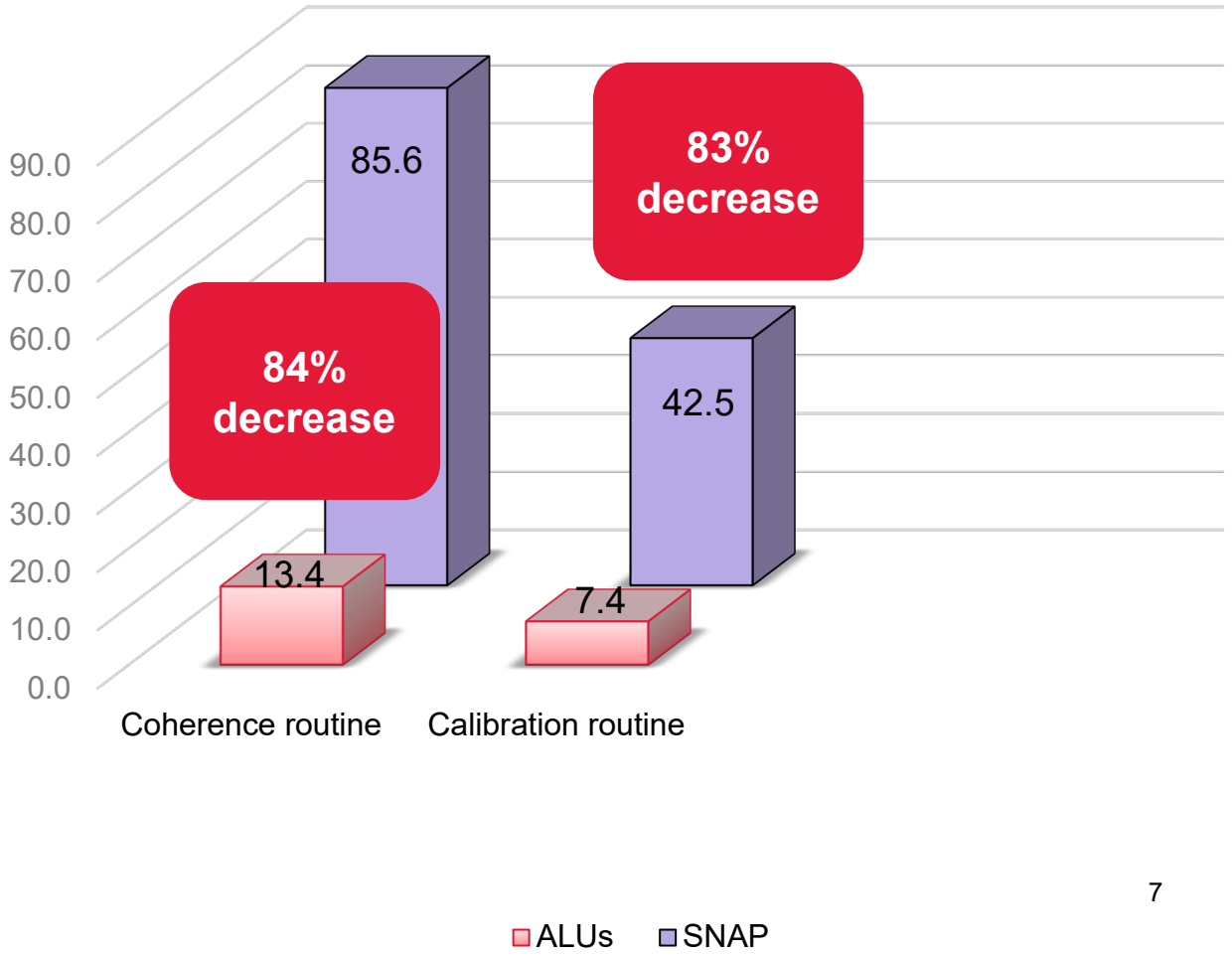
ALUs v.s. ESA SNAP - Speed

SNAP version 8.0.9 and ALUs version 1.0.0 were used for comparison.

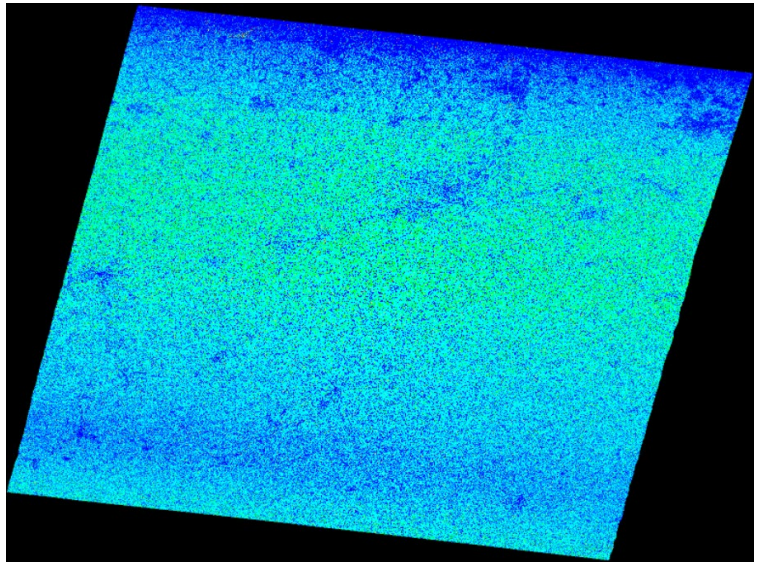
All the tests were performed on a laptop PC:

- CPU: Intel i7 10750h
- RAM: 32GB
- GPU: NVIDIA GeForce GTX 1660 Ti 6GB
- SSD (NVMe): SAMSUNG MZALQ512HALU-000L2

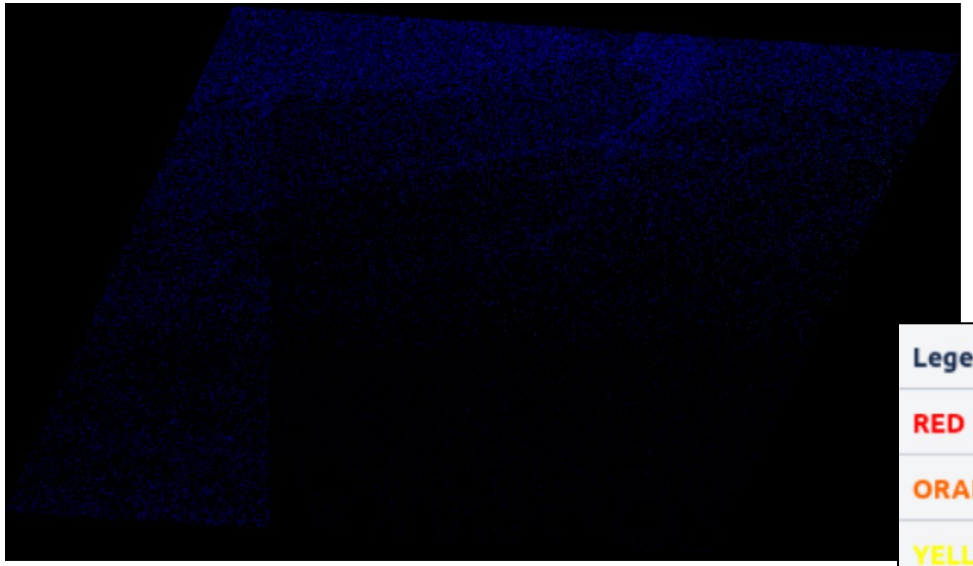
Processing speed in seconds – extracted inputs
(single S1 subswath)



ALUs vs. ESA SNAP - Accuracy



S1 Coherence routine



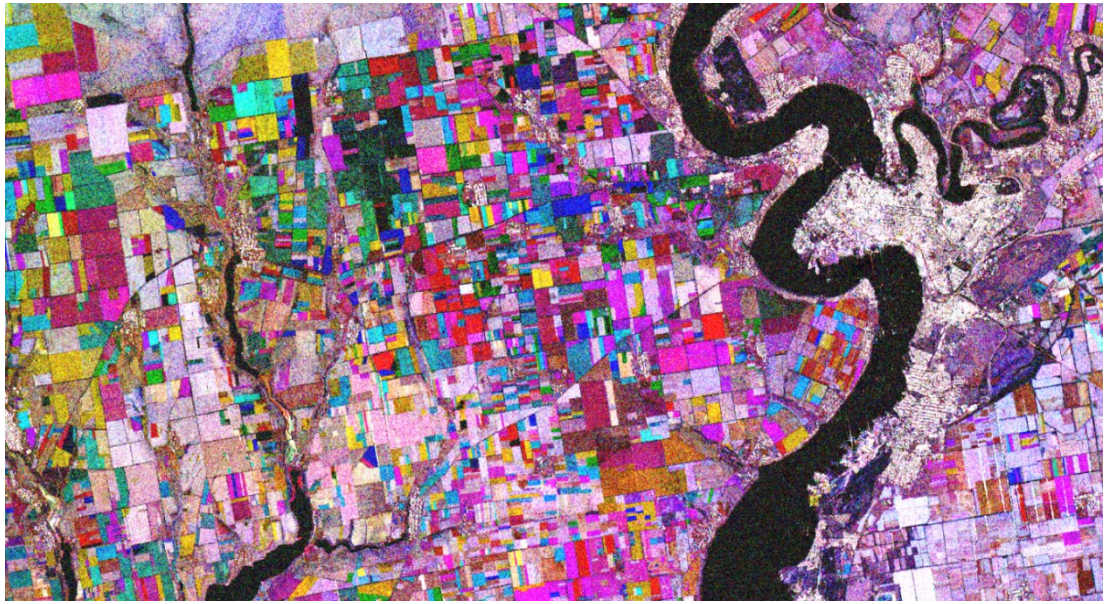
S1 Calibration routine

Legend	Relative error
RED	one pixel zero, second is not
ORANGE	>10%
YELLOW	> 1%
GREEN	> 0.1%
CYAN	> 100ppm
LIGHT BLUE	> 10ppm
BLUE	< 10ppm
BLACK	equal

Use Case: C-SCALE/EO4UA

- Copernicus eoSC AnaLytics Engine (C-SCALE) – a H2020 activity with the aim to federate European EO infrastructure services, such as the Copernicus DIAS and others

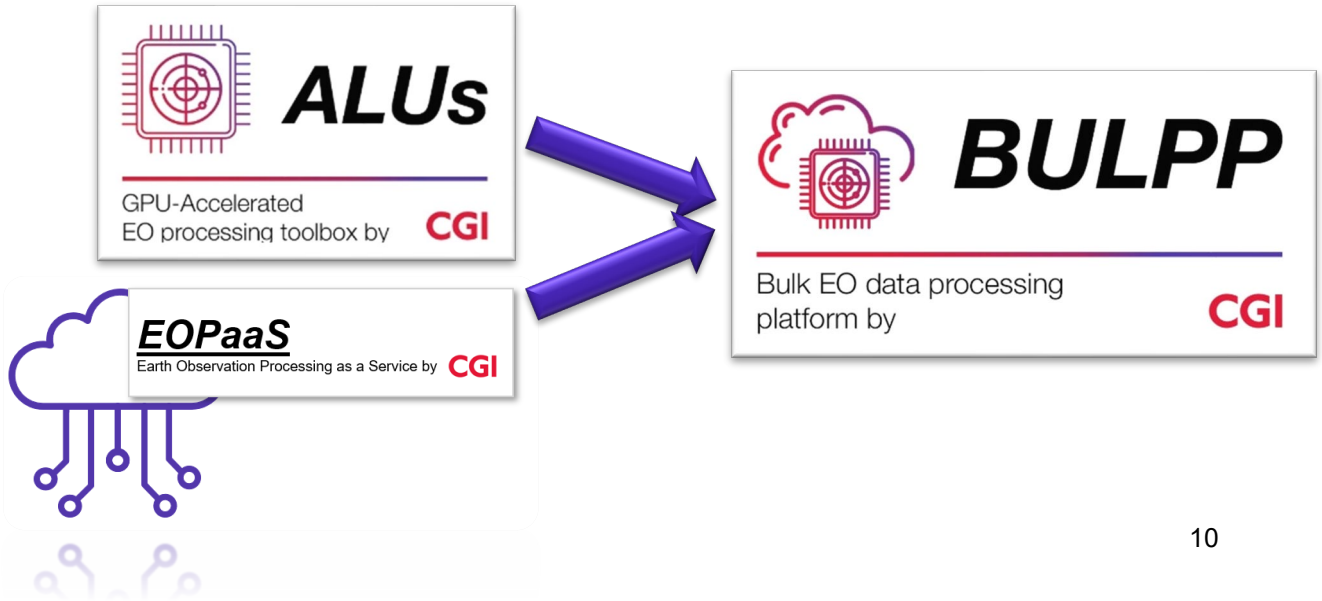
- ALUs is the basis for a C-SCALE use case named **SAROnTheFly**
  - Part of the EO4UA initiative
    - Production of ARD over Ukraine
    - Monitor agricultural activity
    - Year-long coherence time-series
  - Deployment in a cloud environment
  - Investigation of data transfer latencies
  - CREODIAS CARD S1 chains as benchmark
  - Coherence: **11 seconds per subswath**



RGB composite of three S1 coherence products produced by ALUs around Mykolaiv, UA
(c) European Commission, Joint Research Centre. Contains modified Copernicus Sentinel information 2022

Use Case: Bulk Processing via Parallel Computing (BULPP)

- BULPP – a modular, cloud-based bulk processing platform for EO data
- An ESA TDE activity by CGI, sarmap and University Polytechnica of Bucharest
  - Accelerate EO processing algorithms in the cloud with GPU-s
  - Create common, modular components to be reused for future use cases
  - Two reference algorithms in development:
    - ALOS PALSAR Zero-Doppler processing
    - Gabor feature extraction



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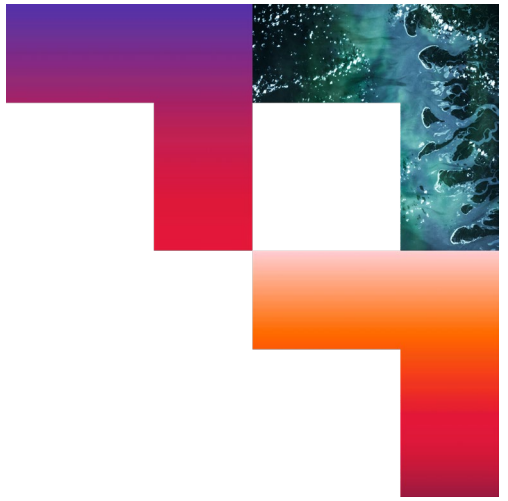
Future



Project close October 2022

Toolbox Validation Campaign

Wealth of Team GPU processing capability

Passion for GPU processing

Open to discuss new ideas and challenges

Insights you can act on

Sven Kautlenbach
Priit Pender
Anton Perepelenko
Martin Jüssi
Russell Gibson

CGI

cgi.com

https://bitbucket.org/cgi-ee-space/alus