



Green Flash

High performance computing for real-time science

Contribution from Observatoire de Paris on WP7
Final Design Review, April 6th 2018



Project #671662 funded by European Commission under program H2020-EU.1.2.2 coordinated in H2020-FETHPC-2014



Contribution to WP 7: SW stack

OdP team responsible for SW stack development

- Covers HRTC, SRTC and simulator
- Based on standard, free and as much as possible open source SW
- Rely on external collaborations (KAUST, Subaru)

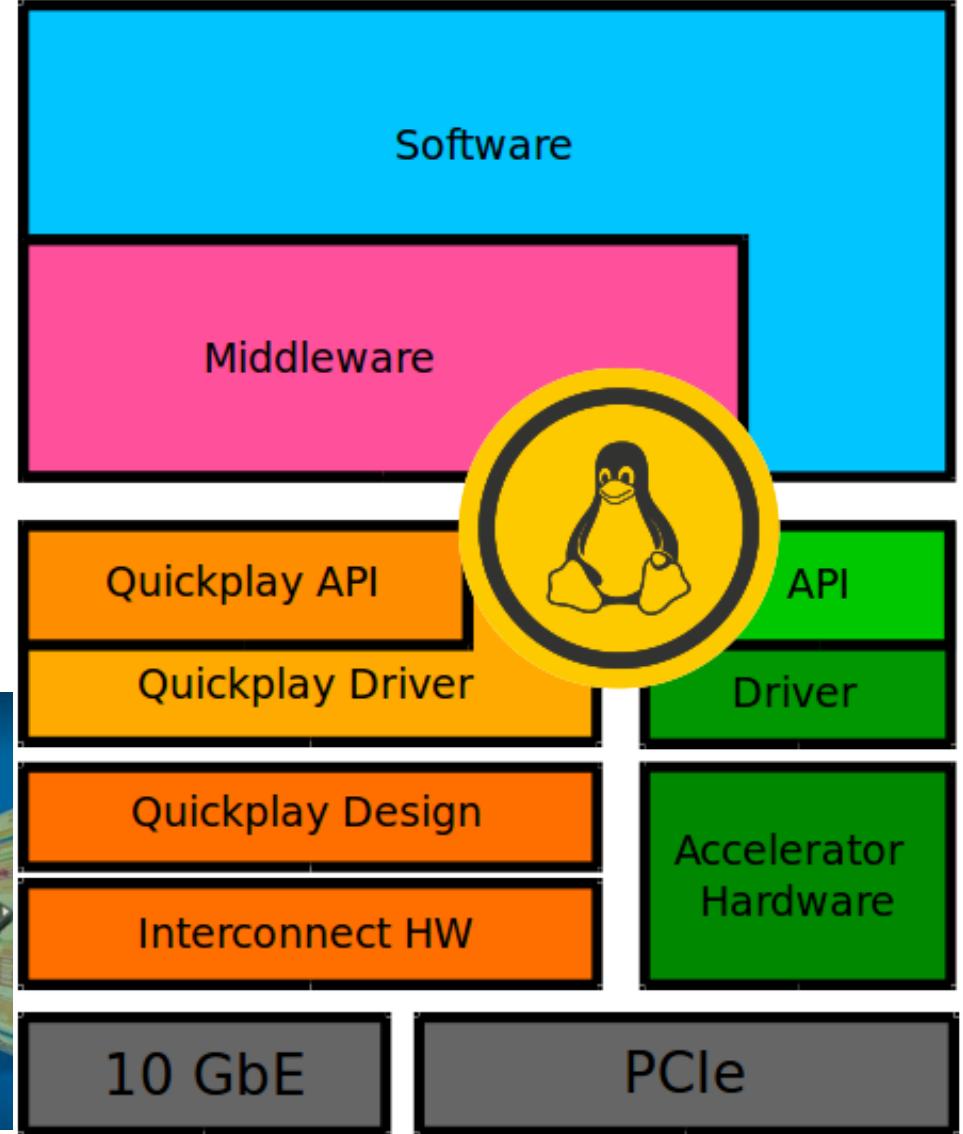
Main contributions

- Consistent stack architecture across subsystems
- Identify and use optimized libraries in dedicated pipelines
- Optimized SW blocks for HRTC and SRTC



Green Flash SW stack

HW landscape





Building blocks

- CACAO: <https://github.com/cacao-org/cacao>
- Open source
- Multi-platform
CPU or CPU+GPU
- Used on SCExAO
- Relying on
shared memory
and tmux for
processes sync and
management

cacao Alpha Release 0.1.0
Compute And Control For Adaptive Optics

Main Page Related Pages Modules Data Structures Files

cacao Outline

- Change Log
- top
- Bug List
- Modules
- Data Structures
- Files

Outline

Compute And Control For Adaptive Optics (cacao)

Source Code

cacao is under development - this is a Alpha release

What is an alpha release ?

cacao on github

cacao User's Guide

Getting started :

- Installation : Downloading and Installing cacao
- News : Major upgrades and new features
- Command Line Interface : Using cacao's command line interface (CLI)
 - CLI Overview
 - Readline Input Keys
 - Command Line Interface Syntax

Configuring and running cacao :

Step-by-step instructions:



Building blocks

- MOAO:
- <https://github.com/ecrc/moao>
- Open source
- Multi-platform
CPU or CPU+GPU
or CPU+Xeon Phi
- Relying on
standard
numerical libraries
- Used for supervisor

A HIGH PERFORMANCE MULTI-OBJECT ADAPTIVE OPTICS FRAMEWORK FOR GROUND-BASED ASTRONOMY

MOAO

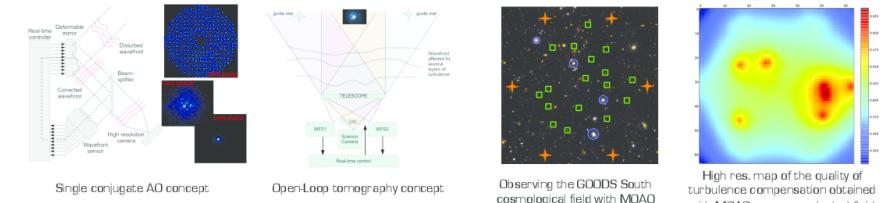
الجامعة الملكية المفتوحة
King Abdulaziz University of
Science and Technology

Extreme Computing
Research Center

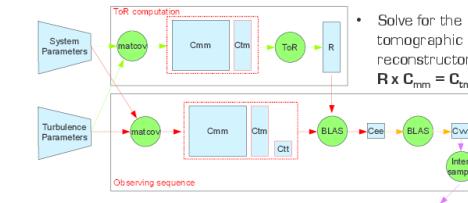
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The Multi-Object Adaptive Optics (MOAO) framework provides a comprehensive testbed for high performance computational astronomy. In particular, the European Extremely Large Telescope (E-ELT) is one of today's most challenging projects in ground-based astronomy and will make use of a MOAO instrument based on turbulence tomography. The MOAO framework uses a novel compute-intensive pseudo-analytical approach to achieve close to real-time data processing on manycore architectures. The scientific goal of the MOAO simulation package is to dimension future E-ELT instruments and to assess the qualitative performance of tomographic reconstruction of the atmospheric turbulence on real datasets.

THE MULTI-OBJECT ADAPTIVE OPTICS TECHNIQUE



THE PSEUDO-ANALYTICAL APPROACH



- Compute the tomographic error:

$$\mathbf{C}_{\text{ee}} = \mathbf{C}_{\text{ts}} - \mathbf{C}_{\text{tm}} \mathbf{R}^T - \mathbf{R} \mathbf{C}_{\text{tm}}^T + \mathbf{R} \mathbf{C}_{\text{mm}} \mathbf{R}^T$$
- Compute the equivalent phase map:

$$\mathbf{C}_{\text{eq}} = \mathbf{D} \mathbf{C}_{\text{ee}} \mathbf{D}^T$$
- Generate the point spread function image

PERFORMANCE RESULTS TOMOGRAPHIC RECONSTRUCTOR COMPUTATION – DOUBLE PRECISION



A collaboration of

PARIS
DIDER INRIA

With support from

intel

NVIDIA

CRAY THE SUPERCOMPUTER COMPANY

Sponsored by

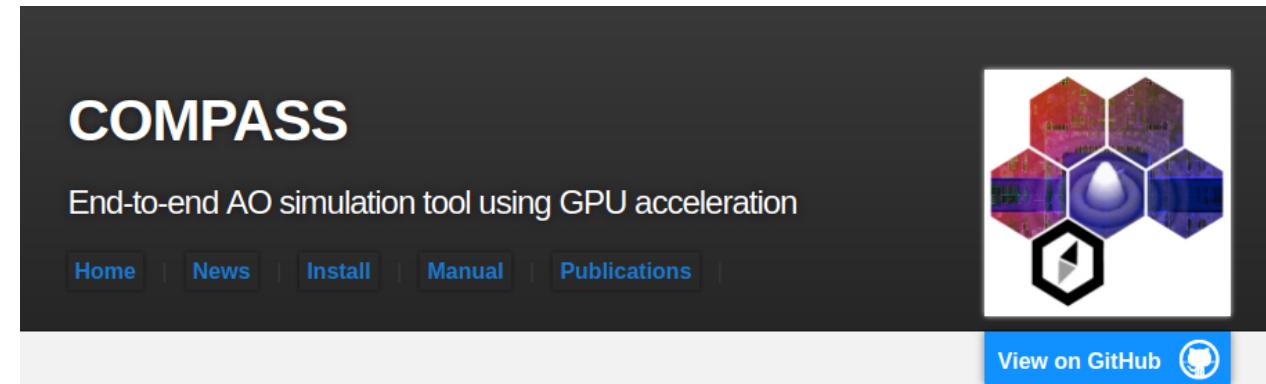
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Building blocks

- COMPASS: <https://github.com/ANR-COMPASS>
- Open source
- GPU only
- Versatile
- Supporting various system scales and concepts



What is COMPASS ?

The COMPASS platform was designed to meet the need of high-performance for the simulation of AO systems. The final product includes a software package for simulating all the critical subcomponents of AO, particularly in the context of the ELT and a real-time core based on several control approaches, with performances consistent with its integration into an instrument. Taking advantage of the specific hardware architecture of the GPU, the COMPASS tool allows to achieve adequate execution speeds to conduct large simulation campaigns caled to the ELT. The COMPASS platform can be used to carry a wide variety of simulations to both test specific components of AO of the E-ELT (such as wavefront analysis device with a pyramid or elongated Laser star), and various systems configurations such as multi-conjugate AO.

Get started

COMPASS is available on [GitHub](#) for Linux platform only, equiped with a Nvidia GPU card.

Follow the [installation instructions](#) to get all the dependencies. The [user manual](#) is available.

Please, check the [News](#) section to get informed of what's new on COMPASS and of important update.