COSMIC SRTC : review and future plans
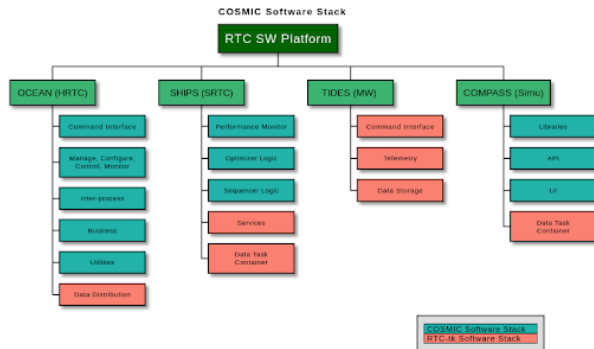## RTC4AO 6, ESO Garching

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SHIPS in COSMIC

- Part of MAVIS
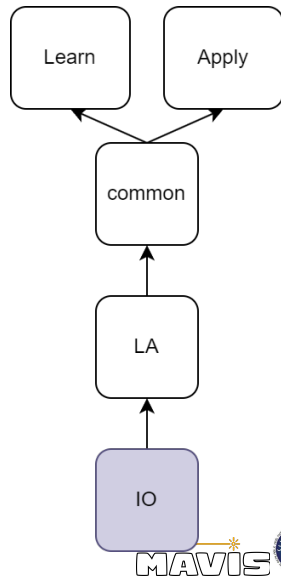- Supervisor module with HIgh Performance Software

- Tackles compute intensive tasks in the SRTC
- Use of accelerators

Composition of SHIPS:

- C++ / CUDA / OpenMP
- Data tasks core:
  - Input / Output
  - Linear Algebra
  - Specific needs
- ESO RTC Toolkit:
  - Wrap and expose the data tasks
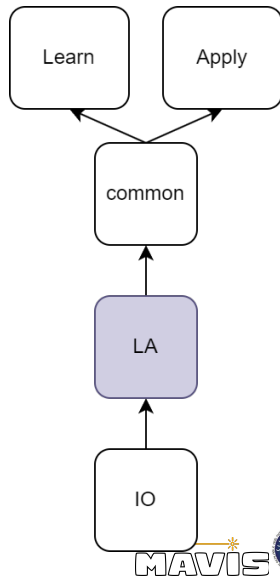 - Handles telemetry
- ICS gateway
- HRTC gateway

TAO : Tomography for AO:

- IO
  - Command line
  - FITS
  - json

TAO : Tomography for AO:

- LA : provides a uniform interface to linear algebra libraries
  - Hardware selection
  - Management of matrices
  - LAPACK, cuBLAS
  - Possibly more advanced libraries to enhance performance (Chameleon)
    - Not required for MAVIS
   - Problem of the licencing (LGPL)

TAO : Tomography for AO:

- Common : common to data task
  - Phase structure function
  - Instrument modelisation :
    - WFS : position of the subapertures, pointing direction
    - DM : position of the actuators, influence functions
  - Atmospheric profile
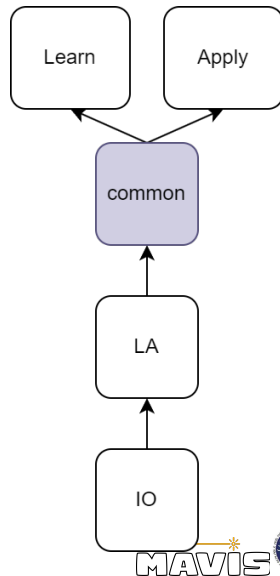
TAO : Tomography for AO:

- Specific data tasks to which IO,LA and common are available:
  - Apply : nothing more required
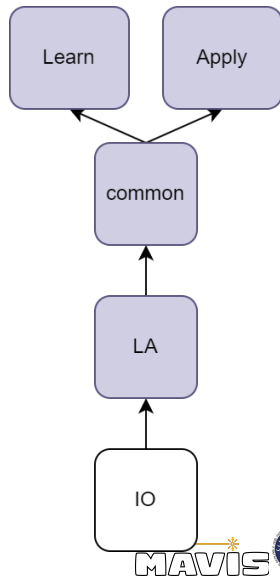 - Learn : also need specific kernels : score function, derivatives
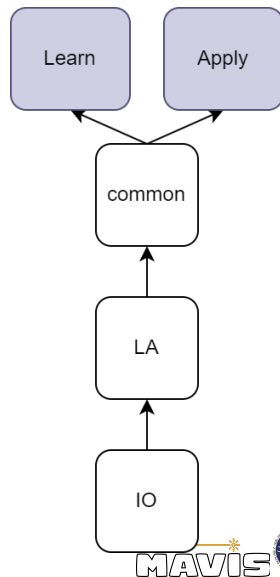
TAO : Tomography for AO:

- Python interface with pybind11
  - LA, common and data tasks
  - No computation involved
- Interface with COMPASS
  - Creates input data required

Three different uses
- In a standalone program
- As Python module
- As external library for the RTC tk

What does it do currently:

- Data tasks covariance matrix generation, Learn and Apply
  - MMSE and PLAA
  - GLAO, LTAO, MCAO, MOAO
- MAVIS scale test case
  - 8 WFSs, 19k measurements
  - 3 DMs, 1k actuators
  - 5 atmospheric layers
  - Hardware:
    - CPU : Intel(R) Xeon(R) Gold 6248 CPU @ 2.50GHz, 30 cores
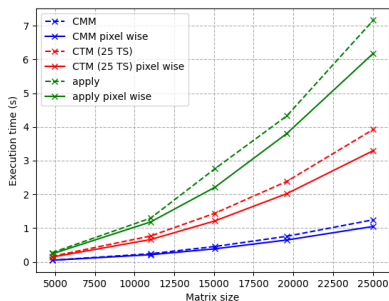   - GPU : Nvidia V100

Table 1: Task execution time in second

task / hardware	CPU	GPU
Learn 10 parameters	2143.6	38.50
Apply 25 TS	193.2	2.1

What does it do currently:

- Apply Benchmark
  - Nvidia V100
  - 10 atmospheric layers
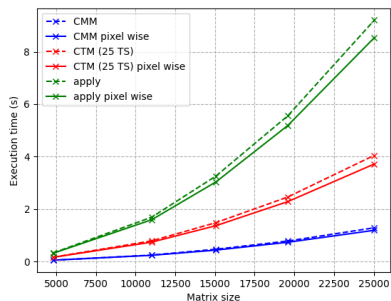
What does it do currently:

- Simulation with COMPASS:
  - Generates WFSs and DMs data
  - Runs SHIPS data tasks
  - Closes the COMPASS loop with SHIPS command matrix
- ESO RTC Tk:
  - SHIPS can be installed on ELT Linux Develepoment Environment
  - No GPU platform tested yet
  - Data tasks running in a file based configuration
  - Test pipeline from Telemetry Republisher to SHM reader
    - Timeout issues

Ongoing and future work:

- Data task:
  - Stochastic learn ([1] Y.Hong et al. 2021 https://doi.org/10.1007/978-3-030-85665-6_35)
  - LQG ([2] J. Cranney et al. AO4ELT 2019)
  - Other data tasks
- ESO RTC Tk:
  - Moving out of the file based to use the consul/nomad
  - Computation of a covariance matrix of slope for L&A
    - A good pretext to progress on the the interaction with the HRTC gateway
- ICS gateway

1. Outsmarting the Atmospheric Turbulence for Ground-Based Telescopes Using the Stochastic Levenberg-Marquardt Method
2. Document details - Zonal multi-layer predictive control for multi-conjugate adaptive optics: Mavis simulations

Thank You.