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FRANCE 2030
PROGRAMME DE RECHERCHE
NUMÉRIQUE POUR L'EXASCALE

ExaDoST - Work Package 2
Breakout session with SKA

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Notes

Presentation of the WP2 tools (PDI, Damaris, Deisa) available here:

https://docs.google.com/presentation/d/1W9PPc45JO1qgU_75BhY6fdn9C-dM-ZCd/edit?usp=sharing&ouid=107253586576142123901&rtpof=true&sd=true

Question: which SKA scenarios could leverage the tools developed in WP2?

- In situ monitoring of the imaging pipeline
    - Compute assessment metrics to assess image quality at every iteration of the major & minor cycles
        - today you need to visualize to estimate if you need to continue to iterate or to stop or rely on an oversized fixed number of iterations
        - finding the correct parameters for running the pipeline is complex: today astronomers rely on trial & error with pipelines diverging rather often
    - In terms of execution & scheduling: optimise resource usage (eg. determine optimal nb nodes/cores/workers for the next iterations)
- Checkpointing
    - handle errors and node failures
    - save intermediate results to suspend execution (free computing resources)
- Later
    - extension to the self-calibration pipeline (adds an external loop on the quality of the calibration solutions) & simulation
    - extend resource usage to the management of a large number of pipelines operating simultaneously and accessing the same HW resources and share data

Integration of ExaDoST solutions with SKA demonstrator codebases - reminder of the conclusions of Deliverable D7

Damaris (WP2): could be used to optimize performance of the imaging pipeline (DDFacet / ddf-pipeline) and in particular streamline the asynchronous access patterns already implemented in the multi-node version. Integration with the OSKAR simulator could also be considered.

DEISA (WP2): could be used to monitor progress in iterative processes in calibration (Quartical), imaging (DDFacet) and maybe simulation as well (OSKAR) so as to offer offer an optimized solution for both in-situ analysis of intermediate results and checkpointing strategies.

PDI (WP2): could serve as the main integration instrument of the above mentioned solutions within the various components of the radio-interferometry pipeline. This still a hot topic at the time of writing this document.

DEISA + SKA ?

- Main goal: enable Quality Assessment of intermediate results during iterative imaging process:
  - Calculate quality assessment metrics (e.g. SNR, need to develop a catalogue of metrics)
  - Visualise intermediate results (image and residuals) typical size: 20k x 20k (x frequency channels)
  - Report to telescope operator & automate part of the decision-making: continue iterate or stop
  - Trigger data storage ("checkpointing" style, i.e. including workflow provenance)
- Concept proofing with a "simple" app: the prototype developed @ OCA with existing MPI port (has the same overall structure as other imaging pipelines)
- Could be generalized over the longer term to more complex workflows (DDF)

Damaris + SKA ?

- Need to define a more precise roadmap but in this case, complexity is the key aspect we want to tackle
- Difficult to come up with a mini-app / proxy app that will expose (in a representative way) the asynchronous access patterns we'd like to tackle
- Proposal 1: asynchronously execute multiple instances of the imaging pipeline (but does not include all the I/O refinements of DDF)
- Proposal 2: work on a subset of the DDF code for now (e.g. the KillMS calibration step could be a good candidate, with asynchronous read / write and compute)
- Proposal 3: work on simulator tool (OSKAR) to enable full pipelining and enable realistic observational scenarios (across frequency bands and time chunks)
- Need to consolidate this plan and start prototyping (team @ LAB could be available for this with help from CNRS / Obs. Paris)

PDI + SKA ?

- 2 possible directions:
    - “classical” approach: use PDI to abstract usage of DEISA & Damaris in 2 previous scenarios
    - concept proofing for transparent adaptation to new standard in radio-astronomy (MSv2 -> MSv4)
    - important to improve resource usage related to I/O contention within and between pipelines

Still preliminary (as of EoD 5/11/2025)

- Offline discussions with WP1 & 3 ongoing
- Need to refine the strategy to have a consistent approach (especially with work done in connection with WP1)