



PROGRAMME
DE RECHERCHE
NUMÉRIQUE
POUR L'EXASCALE

ExaDI - Working Group 4

Scaling inverse problem resolution

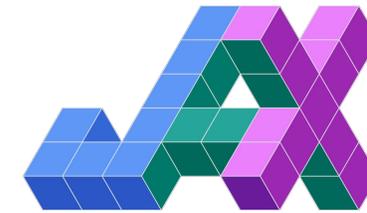
WG Leader:
Thomas Moreau (Inria Saclay)

Roadmap

WG4 – Scaling ML-based Analytics and inverse problems for Exascale

How to scale workflows based on IA technology on large HPC infrastructure?

Large data vs Large data stream



- Identify the algorithms which are relevant for such use cases
 - ⇒ Inverse problem resolution
- Identify/benchmark core ML building components to use these algorithms
 - ⇒ Distributed computation for inference/training
- Develop software bricks required to unlock / scale these use-cases
 - ⇒ Distributed processing for inference
 - ⇒ Coupled HPC and IA workflows
 - ⇒ Easy deployment of multi-GPU computation

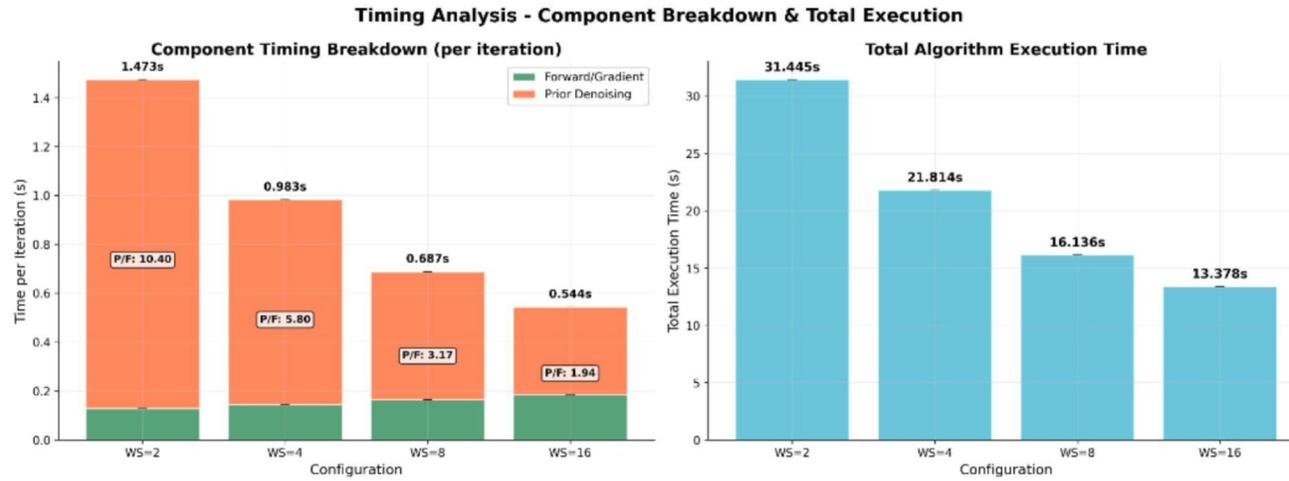
Deep-inverse: scaling inverse problem inference

- Distributed computation for linear inverse problem resolution:
PnP/Variational methods
- Develop an API in Deep-inverse to run distributed computation
- Develop a benchmark to evaluate the acceleration factor

Evaluation: benchmark/mini-app with realistic usage

- Large scale image deblurring (toy problem for easy development)
- Large scale CT reconstruction
- SKA: toward real use case with the OSKAR simulator
Extra challenge: how to buffer reconstruction?

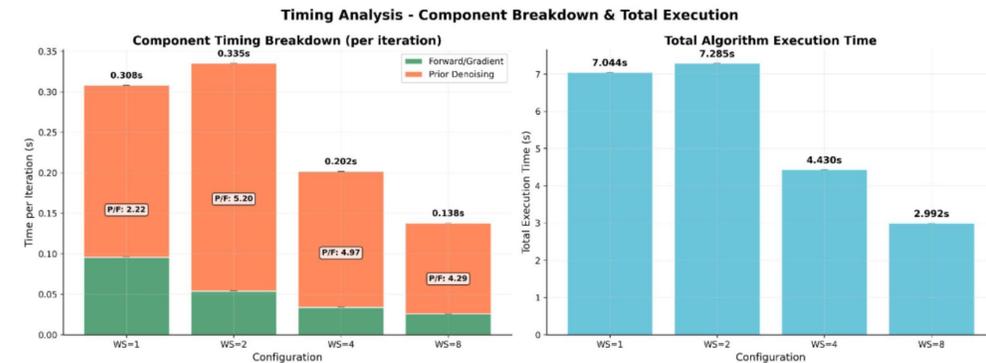
nufft (divided in worldsize splits) - image (1, 2048, 4096) - drunet



Radio astronomy

Tomography

Radon transform (divided in angle ranges) - image (1, 1024, 1024) - drunet



Roadmap: next steps

Linear inverse problems with ML

- Increase workflow complexity with OSKAR, Snake-fMRI
- Target stream of inverse problems: consider batching/latency trade-off
- Train on large scale data - distributed infrastructure for Trainers

Bayesian inverse problems with SBI

- Online learning with large simulation - distributed dataloaders with simulators
- Distributed API for large scale observations - joint with deepinv?
- Build a large scale mini-app