ET computing needs

ET Annual meeting, Opatija, 12 Nov 2025

G. Merino

Introduction

Detailed, global computing needs for ET are not yet fully defined.

From the EIB we want to initiate a process for gathering current and future computing requirements from the various ET scientific boards/divisions.

Meeting held on the 20/06/2025 to kickstart this activity.

- ISB: Jan Harms
- SCB: Andreas Rietbrock
- OSB: Archisman Ghosh, Gianluca Guidi (Div10), Patricia Schmidt (Div8), Cristiano Palomba (Div7)
- EIB: Stefano Bagnasco, Paul Laycock, Gonzalo Merino

Acknowledged that detailed computing needs are not yet fully defined.

Agreed that divisions will survey the users to create a "bottom-up" estimate of requirements.

- Gather a first estimate of requirements for next year for this meeting.
- Produce a prioritized list of areas where R&D is expected.
  - how resource requirements could scale in the future
  - which types of sw & hw technologies are being explored as part of these R&D efforts.
- Establish a formal process to track these requirements in the future.

Comments from the kickstart meeting

Significant and varied needs across divisions:

- ISB: Newtonian Noise simulations. Currently mostly CPU-based (HPC resources) but there is R&D to use GPUs to accelerate them.
- SCB: Seismology studies (spectral element simulations). GPUs considered mandatory.
- OSB: Very heavy and diverse needs. Long-duration signal searches, Parameter Estimation and Waveform Development.

There is a clear trend moving from traditional CPU-based computing to GPU-based architectures.

A well-supported, stable software environment is critical to ensure adoption of common tools and collaborative efficiency.

- An open question is whether the current IGWN environment is sufficient for ET's needs.

Warning: We should avoid short-term solutions that are not sustainable.

- The LVK experience with siloed pipelines highlights the danger, making 24/7 operations difficult.

Future

We propose to establish a formal process, coordinated by the EIB, for tracking the computing needs from the various ET Boards.

- Two meetings per year
- Coordinated by the EIB (G. Merino)
- Members of the ET boards
  - ISB: Jan Harms
  - SCB: Andreas Rietbrock
  - OSB: Archisman Ghosh, Gianluca Guidi (Div10), Patricia Schmidt (Div8), Cristiano Palomba (Div7)

The date of the meetings should be set well in advance so that each group can prepare the input.

- Updated computing resource needs estimation for the next few (3?) years.
- Summary of the R&D activities in software and computing that can impact resource needs.
- Specific requests, identified issues, etc.

Instrument Science Board needs (J. Harms)

Newtonian Noise simulations are the main driver.

- A key source of low-frequency noise in ground-based gravitational wave detectors

Estimation of resource needs, based on extrapolations of realistic test runs (100 kCPUhrs).

- Total needs (during about three years):
  - 300 MCPUhrs for a CPU-only resource.
  - 50 MCPUhrs + 6.25 MGPUhrs (A100 equivalent) for a CPU+GPU resource (8 CPUcores/GPU).

R&D activities are ongoing, aimed to reducing these needs. Need to track requirements' evolution.

At least 3 groups where numerical simulations for Newtonian Noise have started:

- Germany, Belgium, Italy

Computationally very expensive.

- These are massively parallel tasks that require HPC allocations (low-latency interconnects)

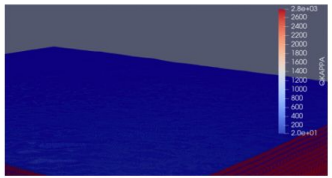
Site Characterization Board needs (A. Rietbrock)

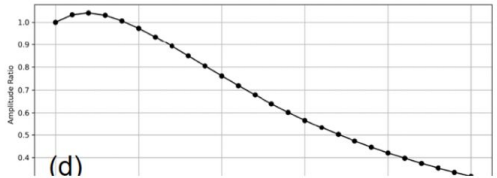
EINSTEIN TELESCOPE

PIC port d'informació científica

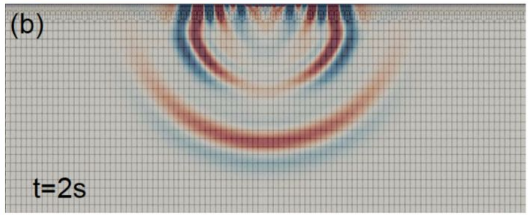
3D seismic simulations ➔ NN modelling

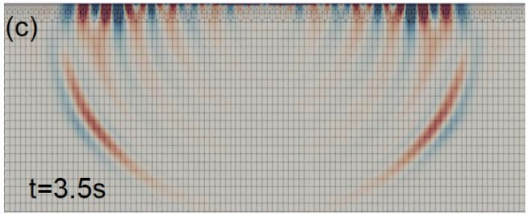
Comparisons between surface and buried stations

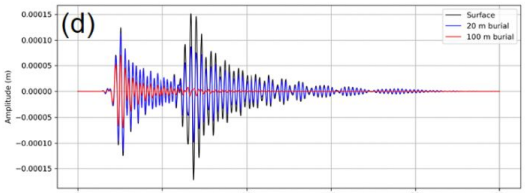


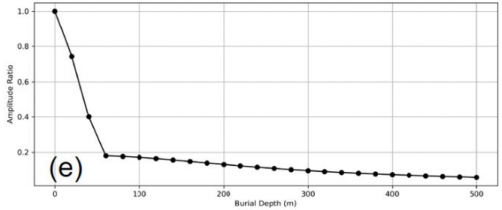


Homogeneous half space









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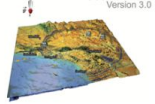
SALVUS IMAGE EVERYTHING

SPECFEM 3D Cartesian User Manual Version 3.0



Calculating displacement waveforms in complex 3D media at high frequency (10-20Hz) ==> 256 GPU cards plus

We will do a detailed estimate of compute needs in the next months

Poster by Yao, KIT