
gevolution
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gevolution

- First cosmological relativistic n-body code based on general relativity.
- gevolution is developed on top of the LATfield2 library.

LATfield2

- LATfield2 handle particles and fields, the parallelization, FFTs, and I/O.
- LATfield2 basics, 3 classes:
  - Lattice: store the metadata describing the lattice geometry (rectilinear grid).
  - Site: n-dimensional index, methods to loop over the lattice, access neighbors of lattice points,...
  - Field: Store a pointer to the data, method to update the ghost cells and I/O.

gevolution: some numbers

- Typical run on lattice between 4k^3 and 8k^3 lattice points and particles.
- Last week production run on Piz Daint:
  - Problem size: 7680^3 (0.5×10^{12}) points and particles.
  - Per cycle 30TB are Fourier transform. (15 3d transforms of 2TB), over the run 10PB are Fourier transform. (Take around 4 hours on 2400 nodes, 28800 MPI processes (on Piz Daint)).

Evolution and Strategy

- Goals: Porting field operations of LATfield2 and gevolution.
- Strategy:
  - Fields can exist on the CPU only or on the CPU and the GPU.
  - Looping operation rewritten to allow parallelization while keeping the same semantic inside the loops.
  - Update of ghost cell can be done either on the device or on the host.

Results

- What were you able to accomplish:
  - gevolution FFTs on GPU.
  - LATfield2 fields operations ported to GPU: it works for all small examples.
  - We had not yet time to profile the new version.

What problems you encountered

- How to port C++ class:

  do not forget to:

  - Copyin/create each dynamical members of the class.
  - delete(this) in the class destructor!

Then last issue is still under investigation:

Different behavior depending on the scope: main or in a function. It works in the main but crashes in functions.

Wishlist

- What do you wish existed to make your life easier?
  - Tools: cout or printf would be great! Especially for debbuging.

Was it worth it?

- We manage to port the relevant part of LATfield2, this would have not been possible without the support of the experts present in the EuroHack17.
- Next step of development is to port all loops of gevolution.
- Now gevolution can use the GPU of Piz Daint (at least for the FFTs). We will use this version of gevolution for future production on Piz Daint.
- We all learn a lot about openacc/C++