ChaNGa usage quickstart

Outline

- Genealogy
- Compiling/running
- Parameters
- Analyzing
- Test problems

Genealogy

- Pkdgrav
  - Joachim Stadel, TRQ
  - N-body only, cosmology, planetesimals (Derek Richardson, Rory Barnes)
- Gasoline: Pkdgrav + SPH
  - James Wadsley, Joachim Stadel, TRQ
- Pkdgrav2: FMM (public)
  - Joachim Stadel, Doug Potter
- ChaNGa: rewrite of Gasoline in Charm++ (public)
  - PPL, Graeme Lufkin, Stadel, Wadsley, TRQ

Installing Charm: compile the compiler

- Download charm
  - git clone git://charm.cs.illinois.edu/charm.git
- Build Charm for ChaNGa
  - ./build <TARGET> <TARGET ARCHITECTURE> [OPTIONS]
  - Net with 64 bit Linux, intel Compiler:
    - ./build ChaNGa net-linux-x86_64 icc
  - Ibverbs with 64 bit Linux and SMP:
    - ./build ChaNGa net-linux-x86_64 smp ibverbs
  - MPI with 64 bit Linux, optimized:
    - ./build ChaNGa mpi-linux-x86_64 --with-production

Compiling/Running ChaNGa

- Download/Compile
  - git clone git://charm.cs.illinois.edu/cosmo/changa.git
  - git clone git://charm.cs.illinois.edu/cosmo/utility.git
  - cd changa
  - ./configure CHARM_DIR=<path to charm>
  - make
- Run
  - ./charmrun +p 4 ./ChaNGa adiabat.param +balancer Orb3dLB_notopo
  - (For MPI) mpirun -np 128 ./ChaNGa ...

Running Charm on IB network

In the qsub file:

- Locate allocated nodes:
  - echo 'group main ++shell /usr/bin/ssh' > nodelist

    for i in `cat $PBS_NODEFILE | uniq` ; do

      echo host $i >> nodelist

    done
- Run:
  - charmrun +p 32 ++nodelist nodelist ChaNGa -wall 60 adiabat.param +balancer Orb3dLB_notopo >& DIAG
- SMP Run:
  - charmrun +p 30 ++ppn 15 ++nodelist nodelist ChaNGa ...

Necessary Files

- Parameter file
- Initial condition file (“Tipsy” format)
- Output files
  - Output snapshots (also “Tipsy”)
  - Log file: (text with energy diagnostics)
  - Screen output (redirect to file, text diagnostics)

Parameter file

See: http://librarian.phys.washington.edu/astro/index.php/Research:ChaNGaOptions

General format: “keyword = value”

achInFile : The filename of the initial conditions
achOutfile: base name of output files.
iOutInterval: timesteps between outputs
iLogInterval: timesteps between log entries
iCheckInterval: timesteps between checkpoints
iWallRunTime: wall clock time in minutes in the queue

Parameter file: timestepping

See: http://librarian.phys.washington.edu/astro/index.php/Research:ChaNGaOptions

dDelta: (Base) Timestep
nSteps: number of timesteps
dEta: timestep accuracy criterion
bEpsAccStep: dt ~ sqrt(eps/acc)
bGravStep: dt ~ sqrt($r_{ij}^3/(m_i + m_j)$)
dEtaCourant: Courant timestep parameter
dEtauDot: limit changes in thermal energy during adiabatic cooling

Parameter file: gravity

See: http://librarian.phys.washington.edu/astro/index.php/Research:ChaNGaOptions

bDoGravity: enable gravity (on by default)
dTheta: Opening angle: small => higher accuracy
dSoft: set softening (usually already set in IC)

Parameter file: SPH

See: http://librarian.phys.washington.edu/astro/index.php/Research:ChaNGaOptions

nSmooth: number of neighbors (default 32)
bDoGas: do SPH
bGasAdiabatic: adiabatic equation of state
bGasIsothermal: isothermal equation of state
bGasCooling: use the cooling function (set at configure time)
dMsolUnit: Solar masses per system mass unit
dKpcUnit: Kiloparsecs per system mass unit
dConstGamma: adiabatic index of gas
dMeanMolWeight: mean molecular weight of gas
dConstAlpha: linear term of artificial viscosity
dConstBeta: quadradic term of artificial viscosity

Note: **G = 1 for time/velocity units**

Parameter file: Performance

See: http://librarian.phys.washington.edu/astro/index.php/Research:ChaNGaOptions

nBucket: number of particles in tree leaves
bConcurrentSph: overlap gravity and SPH computation
nPieces: number of pieces to divide tree
nDomainDecompose: 1) Oct 3) Hilbert SFC
nCacheDepth: depth of tree to fetch on a cache miss
nYield: the number of buckets to calculate before yielding to other work

Parameter file: Visualization

See: http://librarian.phys.washington.edu/astro/index.php/Research:ChaNGaOptions

dDumpFrameStep: number of timesteps between image outputs (can be a fraction)

iDirector: number of camera angles

See movie/director.README for camera options

Analysis: Quick visualization

- http://www-hpcc.astro.washington.edu/tools/tipsy/tipsy.html
- ~trq/bin/tipsy

```
>openb adibat.001000
>loads 0
>zall
>zgas logrho -1 0
```

Analysis: pynbody

- See http://pynbody.github.io/pynbody/
- Based on numpy: “module load python”
- export PYTHONPATH="/home/trq/python"

```
>>> import pylab
>>> import pynbody
>>> import pynbody.plot.sph as sph
>>> s = pynbody.load('adiabat.001000')
>>> s.physical_units(distance='au')
>>> sph.image(s.g, qty="rho", width=60)
>>> pylab.show()
```

Test problems

- changa/teststep
  - King model; collisionless dynamics
- changa/testshock
  - Sod shock tube
- changa/testcollapse
  - Everard collapse of spherical cloud with accretion shock

Larger tests

- Wengen fragmenting disk

  ~trq/pfs/wengen

- “Blob” test

  ~trq/pfs/blob

  See me for new version of SPH

- Kelvin-Helmholtz
  - Ask