Features of miluphcuda and their importance/priority

This overview should be the help to prioritize the order of implementations in the new code. The `#defines` are taken from

- miluphcuda devel version from timestamp *2021-03-26*

Sorted by priority

Prio0

- SOLID
- HYDRO

Prio1

Prio2

Prio4

Not needed

Random sorted with explanation

SOLID

- prio0

simulate solid body behaviour, i.e. stress tensor is given by $\sigma^{ab} = -p\delta^{ab} + S^{ab}$ particle specific values are: $\vec{x}$, $\vec{v}$, dim x dim matrix σ and S where one can save some memory since S is symmetric and traceless, so in 3 dim, one needs only 5 doubles instead of 9.

HYDRO

- prio0

solve the standard inviscid Euler equations, no shear forces

REAL_HYDRO

- not needed

allow only positive pressure

GRAVITATING_POINT_MASSES

- prio2

adds additional point masses to the simulation which interact gravitationally with themselves and with the sph particles imho

> we do not have more than 2 or 3 additional point masses, so no need for parallelization here, probably fastest to integrate them on all nodes individually

PARTICLE_ACCRETION

- prio2

requires gravitating point masses of boundary conditions. not needed from the very beginning. however, keep in mind that we need to be able to remove and add particles to the simulation.

UPDATE*SINK*VALUES

- prio2

depends on **PARTICLE ACCRETION**

INTEGRATE_ENERGY

- prio0

integrate energy equation, we need this from the very beginning

INTEGRATE_DENSITY

- prio0

integrate continuity equation, we need this from the very beginning

NAVIER_STOKES

- prio1

solve the Navier Stokes equation, viscous flows

SHAKURA_SUNYAEV_ALPHA

- prio1

depends on NAVIER_STOKES

CONSTANT_KINEMATIC_VISCOSITY

- prio1

depends on NAVIER_STOKES

KLEY_VISCOSITY

- prio1

depends on NAVIER_STOKES

FRAGMENTATION

- prio0

damage model following Benz & Asphaug 1994, essential to model rocks, depends on SOLID

DAMAGE_ACTS_ON_S

- prio0

depends on FRAGMENTATION

SPH_EQU_VERSION

- prio0

we've implemented two different versions of the SPH equations, ask cms for reference or lecture notes

ARTIFICIAL_STRESS

- prio0

artificial stress to overcome the tensile instability, required for fully elastic solids (rubber ring collision simulation)

ARTIFICIAL_VISCOSITY

- prio0

the one and only artificial viscosity by Monaghan (see review from 1992), we need this from the very beginning

BALSARA_SWITCH

- prio1

reduce artificial viscosity where not needed

INVISCID_SPH

- prio2

modern version of the balsara switch with shock capture and time dependent artificial viscosity coefficients

SHEPARD_CORRECTION & TENSORIAL_CORRECTION

- prio0

improve standard SPH to provide zeroth order and linear consistency. see standard sph textbooks or latest code paper

VON_MISES_PLASTICITY \ DRUCKER_PRAGER_PLASTICITY \ MOHR_COULOMB_PLASTICITY \ COLLINS_PLASTICITY \ COLLINS_PLASTICITY_INCLUDE_MELT_ENERGY \ COLLINS_PLASTICITY_SIMPLE

- prio0-1

these are all models for plasticity. Eventually we need all of them, for starters VON*MISES*PLASTICITY will do.

VISCOUS_REGOLITH \ PURE_REGOLITH \ JC_PLASTICITY

- prio4

these are all models for plasticity which we currently do not use

PALPHA_POROSITY \ STRESS_PALPHA_POROSITY \ EPSALPHA_POROSITY

- prio0-1

these are all models for porosity, p-alpha is *prio0*, epsilon alpha is *prio1* and

SIRONO_POROSITY

- prio4

Sirono is currently not needed.

VARIABLE_SML \ FIXED_NOI \ INTEGRATE_SML
READ*INITIAL_SML_FROM*PARTICLE_FILE

- prio0

SML_CORRECTION

- prio1

correction factors for variable smoothing length. documented in Evita's master thesis and references therein, or see PHANTOM paper

AVERAGE_KERNELS

- prio0

for varying smoothing length, the values of the kernels are averaged and not the smoothing lengths

XSPH

- prio1

additional smoothing of the velocity field. required for KLEY_VISCOSITY, nice to have but not prio0

BOUNDARY_PARTICLE_ID \ GHOST_BOUNDARIES

- prio3

boundary particles. a chapter on its own. leave it be for starters