

SOP Discussion with Domain Expert

State of the Practice for Lattice Boltzmann Solvers

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Overview

- Goals
 - ▶ Understand the state of the software development practices for LBM Software
 - ▶ Make recommendations for improvements
 - ▶ A publication that is useful to the community
- We have developed a standard methodology for assessing SOP for Domain X
- The methodology requires a **domain expert** to:
 - ▶ Vet the preliminary results
 - ▶ Assess the feasibility of the recommendations
 - ▶ Navigate the publication process
 - ▶ Answer **developer** interview questions on pain points
- Today's meeting
 - ▶ Informal
 - ▶ Questions do not have to be answered in real time, or by domain expert

Overall Process

1. *Domain Expert*: Create a top ten list
2. Brief *Domain Expert*
3. Initial list of candidate software packages
4. *Domain Expert*: Vet domain software list
5. Domain Analysis
6. *Domain Expert*: Vet domain analysis
7. Collect empirical measures
8. Measure using measurement template
9. Interview developers
10. Use AHP process to rank the software packages
11. *Domain Expert*: Vet AHP ranking
12. *Domain Expert*: Review recommendations

Vet Software List

- How does our list compare to the domain expert's list?
- Is any software missing?
- Is there software that should be included?
- Any other questions/comments or concerns?

Software List

- Ludwig
- ESPResSo
- Palabos
- OpenLB
- LUMA
- pyLBM
- DL_MESO (LBE)
- waLBerla
- Sailfish
- laboetie
- TCLB
- MechSys
- lettuce
- ESPResSo++
- MP-LABS
- SunlightLB
- LB3D - paper
- LIMBES
- LB2D-Prime
- HemeLB
- lbmpy
- LB3D-Prime
- LatBo.jl

Domain Expert Software List

Domain Analysis

- So users can pick the right software for their task
- Think of the software as a family of related software products, like:
 - ▶ Family of automobiles
 - ▶ Computer hardware
 - ▶ ...
- Commonalities
- Variabilities
- Parameters of variation
- Do the following slides capture the commonalities and variabilities?
- We can follow up over e-mail, if that is easier

Commonalities

- Lattice - discretized domain within a boundary
- Collision operator (The Bhatnagar-Gross-Krook Collision Operator is common)
- Probability density function
- Equilibrium distribution function
- Boltzmann transport equation

Variabilities

- May use parallel processing (May use varied tools for this - MPI, CUDA..)
- Different equilibrium distribution functions (compressible and incompressible)
- Coefficients for equilibrium distribution function (based on velocity directions - 2,3,5,9,13,15,19,27)
- Lattice dimensions (1D, 2D, 3D)
- Varied velocity directions, partially based on dimensions (2,3,5,9,13,15,19,27)
- Collision operators (SRT, TRT, MRT, BGK)
- Collision vs collision-free transport equations
- Number of fluids that can be modeled simultaneously
- Fluid parameters (Reynolds Num., density, viscosity, etc.)
- Lattice boundary (reflective or non-reflective)

Summary of Measures

- Empirical measures
 - ▶ Examples
- Measurement template
 - ▶ qualities
- Interview questions
 - ▶ Examples
- AHP Process with pairwise comparisons

Thoughts on Overall Ranking?

[Peter and Ao, give the overall ranking graphic for your domain]

Ranking Follow-Up

- We would like feedback on the ranking for each of the qualities
- Is it feasible to review all 10 graphs, and the associated write-up?
- Maybe there is a grad student that can review the rankings?

Discuss Recommendations



Publication

- Where should we publish this paper?
- Who do you see as the targeted readers?

Developer Questions (for next time)

