



Technische
Universität
Braunschweig



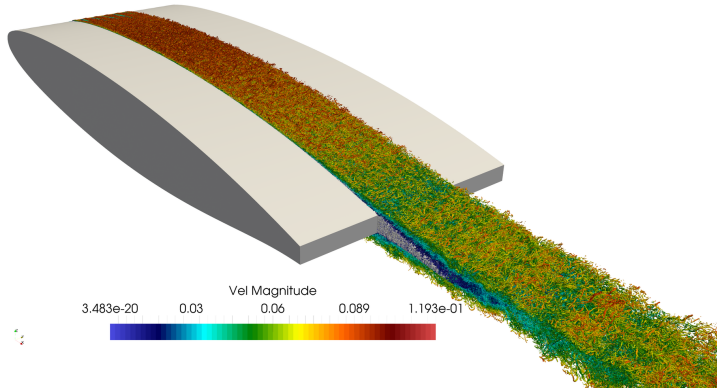
SURESOF

Showcase: VirtualFluids

Sören Peters, 16.05.2022

VirtualFluids

- CFD code based on the Lattice Boltzmann Method
- developed at the Institute for Computational Modeling in Civil Engineering (iRMB)
- under development for 15 years by various researchers





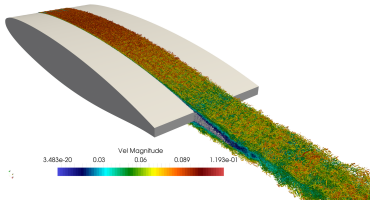
- Main Technologies: C++ 17, CMake, CUDA, Python
- ~125000 LOC
- Platforms: Linux, Windows (x64)
- Compiler: GCC, Clang, MSVC
- High Performance Computing on Shared- and Distributed Memory Architectures

Projects

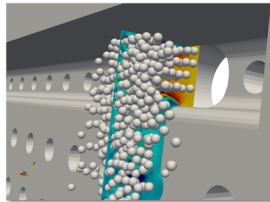
SFB880 Fundamentals of High Lift for Future



Civil Aircraft

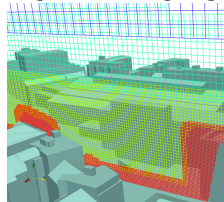


Termoplastische Partikelschäume NFF,



OHLF, VW

Non uniform LBM on GPGPUs



Challenges

■ Collaboration & Versioning

- Merging different diverging branches of the project
- switching to a central repository: GITZ Gitlab¹



¹<https://git.rz.tu-bs.de/irmb/virtuallfluids>

Challenges



■ Collaboration & Versioning And Availability & Accessibility

- Make use of Docker Container¹
 - while using GPUs and Shared Nodes on the cluster
 - while keeping the parallel efficiency
 - using the gitz gitlab container registry²

¹<https://git.rz.tu-bs.de/irmb/virtualfluids/-/wikis/Getting-Start-with-the-development-of-VirtualFluids>

²https://git.rz.tu-bs.de/irmb/virtualfluids/container_registry

Challenges

■ Software Quality & Design

- Enhance the test suite: how to help researchers to add tests?
- run tests also on HPC platforms like Phoenix
 - deploy from CI to Phoenix with HPC rocket¹
 - executing singularity containers on the cluster



¹<https://github.com/SvenMarcus/hpc-rocket>

Challenges

- **Software Quality & Design - Use your tools!**
 - utilizing static code analysis to track code quality
 - cppcheck¹
 - clang-tidy²
 - lizard³
 - gcov⁴



¹<http://cppcheck.net/>

²<https://clang.llvm.org/extra/clang-tidy/>

³<https://pypi.org/project/lizard/>

⁴<https://gcc.gnu.org/onlinedocs/gcc/Gcov.html>

Challenges

■ Software Quality & Design

- host a sonarqube¹ instance to visualise the code quality
- no central infrastructure available yet...



```
VirtualFluids src/gpu/GridGenerator/io/GridVTKWriter/GridVTKWriter.cpp
423 -- {
424     bool shouldSwap = false;
425     1 int tmp1 = 1;
426     2 unsigned char *tmp2 = (unsigned char *)&tmp1;
427     if (*tmp2 != 0)
```

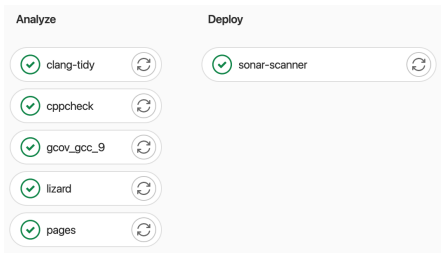
Condition '*tmp2!=0' is always true [See Rule](#)
Bug Minor Open Not assigned 5min effort

¹<https://github.com/SonarSource/sonarqube>

Challenges

■ Software Quality & Design

- static analysis are executed in the ci pipeline
- results are then transferd to sonarqube



Summary

- git and docker are very beneficial
- writing / adding tests is hard
- use your tools to track the code quality is easy

Future Development

- adding more tests
- enhance documentation
- using of docker on Phoenix
- Spread VirtualFluids and Suresoft to the world!