

HPC SOLUTIONS - MADE FOR YOU.

# Continuous Benchmarking

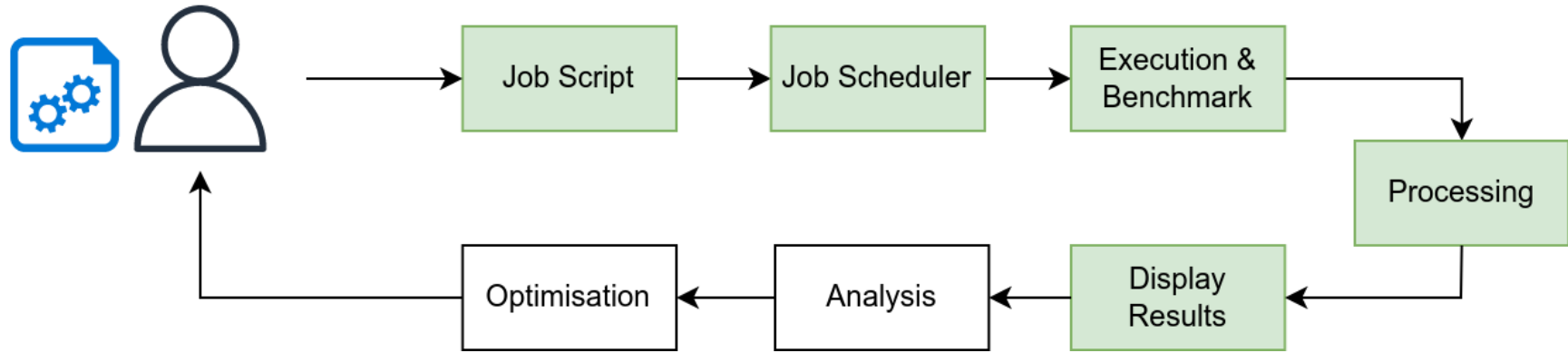
19/07/2022 | Nico Tippmann



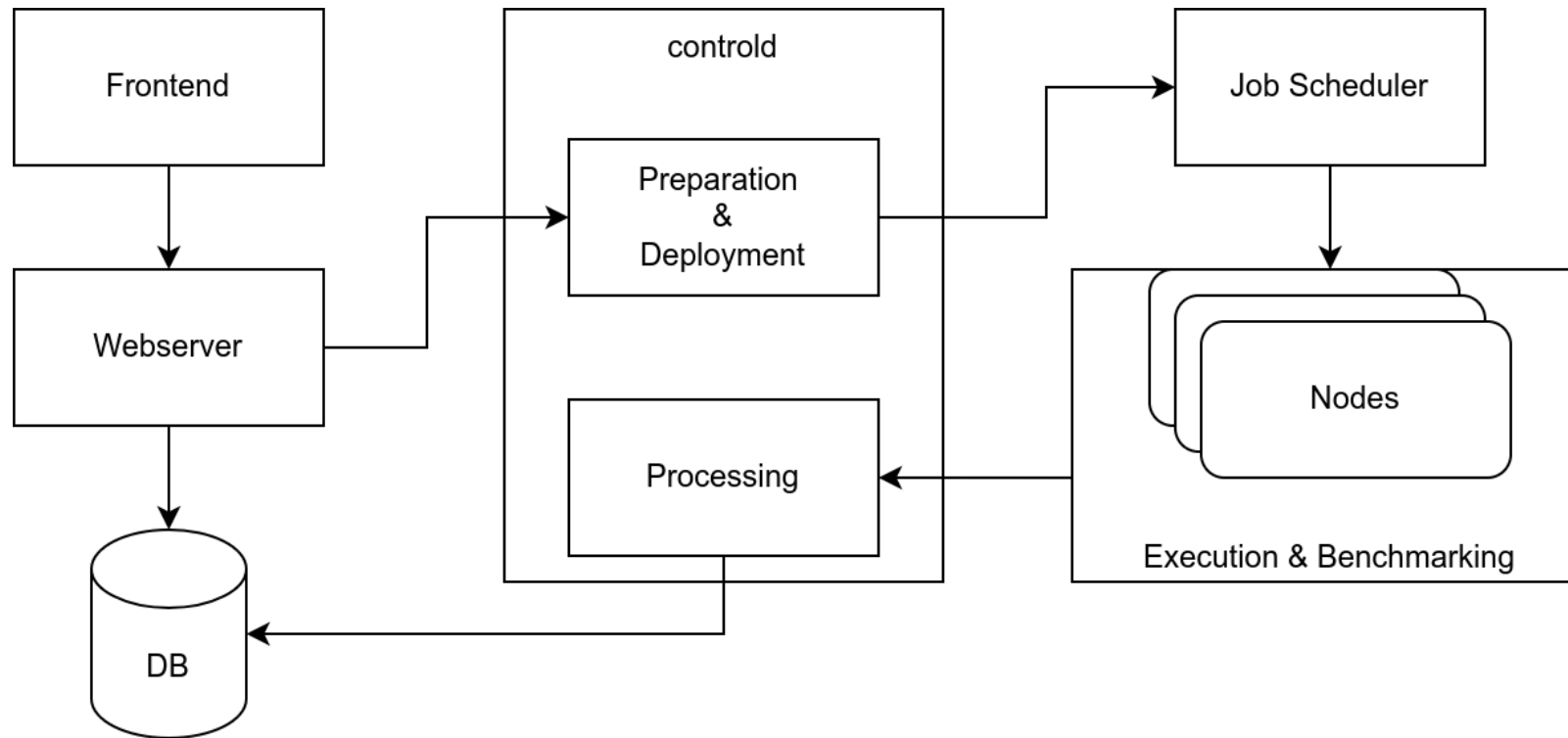
## Motivation

- Extending established process of Continuous Integration/Delivery by including non-functional properties like performance, efficiency and scalability
    - Concept and prototype developed during Master's Thesis @TUChemnitz (29.01.2021)  
*"Automation of Continuous Benchmarking for High-Performance Computing"*
  - High degree of automation to reduce time-consuming and error-prone benchmarking process
  - Ability to automatically deploy, execute and benchmark any application directly on the cluster
- Foundation for performance analysis and optimization

# Automation



# Architecture



## Current Status

- Target for beta-release end of Q3 2022
- Actively used in different two research projects
- Emphasis on CI extension, parameter studies and software regression testing
- Collection of ~130 different metrics
  - Usage of CPU, Memory, I/O and Network
  - GPU-Accelerators (currently only NVIDIA)
  - Hardware Performance Counters (via LIKWID) for low-level CPU/Memory-related metrics
  - Power Consumption
- Monitoring overhead < 1.5% with 5 second intervals

# Web Interface – Configuration

BENCHMARKS   CONFIGURATIONS
PROJECT MAST

JOB SCRIPT

[+ ADD VARIANT](#)

Job Name	Partition	Nodes
AutoPas_UniformCube	ALL	ibp03
Number of Tasks	Walltime	Variant Name
1	02:00:00	Variant 0

```

1 # preparation phase
2 module load comp/gcc/11.2.0
3 module list
4
5 # Project dir
6 cd /beegfs/MaST/AutoPas
7 # Build dir
8 cd cmake-build-manually-gcc
9
10 # execution/benchmarking phase
11 examples/md-flexible/md-flexible \
12 --no-end-config \
13 --no-progress-bar \
14 --particle-generator grid \
15 --particles-per-dimension 50 \
16 --particle-spacing 1 \
17 --cutoff 2.5 \
18 --deltaT 0 \
19 --tuning-phases 1
20 # postprocessing phase
                
```

only this section of the jobscript is benchmarked!

[SAVE](#)   [CANCEL](#)

CONFIGURATIONS

AutoPas UniformCube
✎ 📄 🗑

mamico
✎ 📄 🗑

[+](#)

alpha v0.6.1

# Web Interface – Starting a benchmark

BENCHMARKS CONFIGURATIONS PROJECT MICROCARD

START BENCHMARK

Search

<input type="checkbox"/>	#	Name	Configuration	Date	Status
<input type="checkbox"/>	634	openCARP noground_bidom master 4c0d4572	noground_bidom_master	2022-07-14 07:41:49	Done
<input type="checkbox"/>	633	openCARP noground_bidom master 4aee136a	noground_bidom_master	2022-07-13 14:17:59	Done
<input type="checkbox"/>	632	openCARP noground_bidom master 4c0d4572	noground_bidom_master	2022-07-13 13:47:06	Done
<input type="checkbox"/>	631	openCARP noground_bidom master fc8a40	noground_bidom_master	2022-07-13 11:44:22	Done
<input type="checkbox"/>	630	openCARP noground_bidom master 0268fd12	noground_bidom_master	2022-07-13 09:10:37	Done
<input type="checkbox"/>	629	openCARP noground_bidom master 0268fd12	noground_bidom_master	2022-07-13 07:46:17	Done
<input type="checkbox"/>	628	openCARP noground_bidom master 0268fd12	noground_bidom_master	2022-07-12 07:43:36	Done
<input type="checkbox"/>	627	test	noground_bidom_master	2022-07-11 10:02:39	Done
<input type="checkbox"/>	624	openCARP noground_bidom master 0268fd12	noground_bidom_master	2022-07-11 07:41:39	Done
<input type="checkbox"/>	622	openCARP noground_bidom master 0268fd12	noground_bidom_master	2022-07-10 07:49:13	Done

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alpha v0.6.1

### Start Benchmark


Benchmark Name  
test

Configuration  
noground\_bidom\_master

CANCEL SUBMIT

# Web Interface – Benchmark Overview

START BENCHMARK

Search  

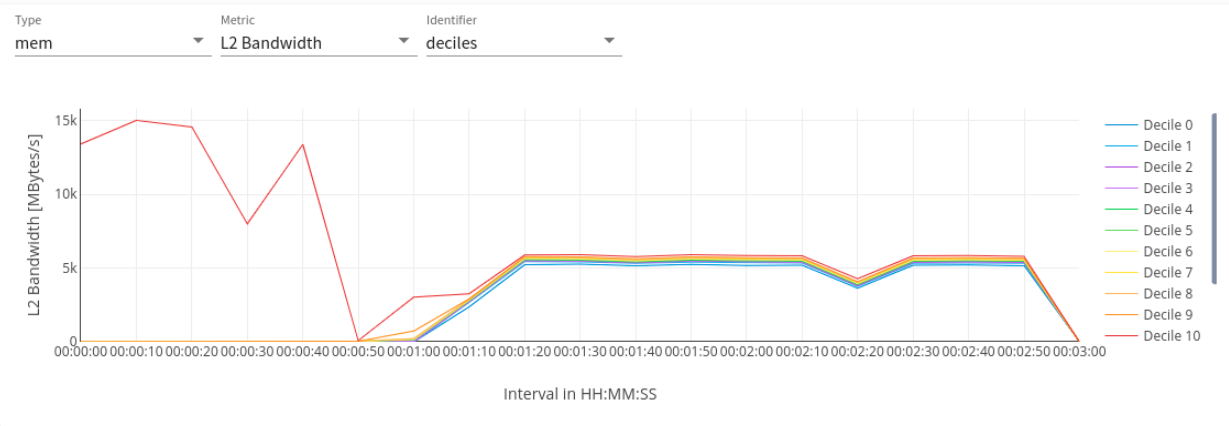
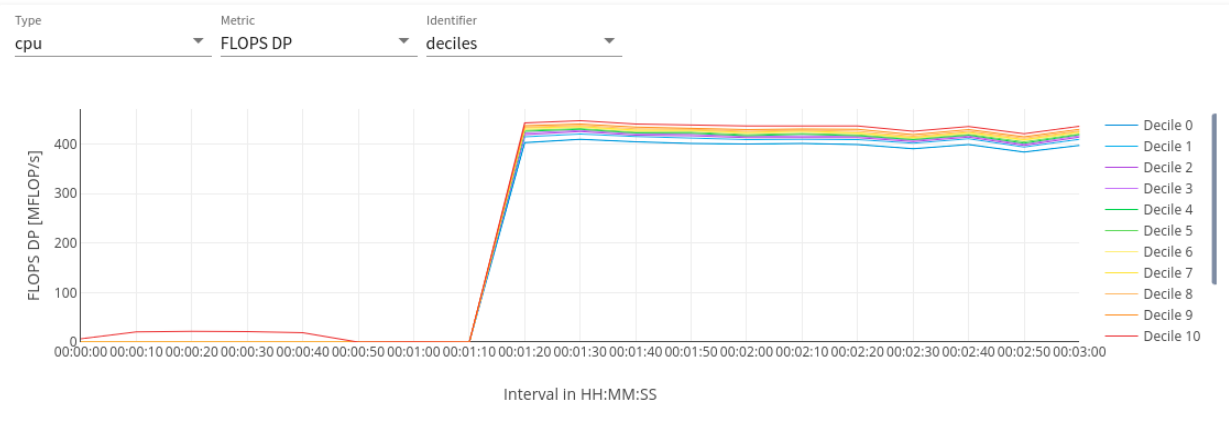
<input type="checkbox"/>	#	Name	Configuration	Date	Status
<input type="checkbox"/>	635	test	noground_bidom_master	2022-07-14 06:19:39	Submitted
<input type="checkbox"/>	634	openCARP noground_bidom master 4c0d4572	noground_bidom_master	2022-07-14 07:41:49	Done
<input type="checkbox"/>	633	openCARP noground_bidom master 4aee136a	noground_bidom_master	2022-07-13 14:17:59	Done
<input type="checkbox"/>	632	openCARP noground_bidom master 4c0d4572	noground_bidom_master	2022-07-13 13:47:06	Done
<input type="checkbox"/>	631	openCARP noground_bidom master fc8a402b	noground_bidom_master	2022-07-13 11:44:22	Done
<input type="checkbox"/>	630	openCARP noground_bidom master 0268fd12	noground_bidom_master	2022-07-13 09:10:37	Done
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# Web Interface – Benchmark Results

OUTPUT COMPARE EXPORT Synchronise Graphs



BENCHMARK

**Run Number** 618  
**Name** openCARP noground\_bidom master a99ce3f4  
**Status** Done  
**Configuration** noground\_bidom\_master  
**Runtime** 0:03:00 (180s)

HARDWARE

**Manufacturer System** Supermicro AS-4124GS-TNR  
**Processor** AMD EPYC 7713 64-Core Processor  
**Sockets** 2  
**Cores per Socket** 64  
**Threads per Core** 2  
**Max Speed** 3720.7029  
**Turbo Mode**  
**Cache L1d** 32K  
**Cache L1i** 32K  
**Cache L2** 512K  
**Cache L3** 32768K  
**Memory**  
**GPU**

CPU TOPOLOGY

SOFTWARE

**Hostname** gpu01sas.benchmarkcenter.megware.com  
**Operating System** AlmaLinux 8.5 (Arctic Sphynx)  
**Kernel** 4.18.0-348.2.1.el8\_5.x86\_64  
**BIOS Vendor** American Megatrends Inc.  
**BIOS Version** 2.3  
**BIOS Revision** 5.22

# Web Interface – Job Output

GRAPHS COMPARE EXPORT  Synchronise Graphs

SLURM JOBSRIPT

```

1 Loading mpi version 2021.5.0
2 Cloning into 'openCARP'...
3 -- The C compiler identification is GNU 8.5.0
4 -- The CXX compiler identification is GNU 8.5.0
5 -- Detecting C compiler ABI info
6 -- Detecting C compiler ABI info - done
7 -- Check for working C compiler: /usr/bin/cc - skipped
8 -- Detecting C compile features
9 -- Detecting C compile features - done
10 -- Detecting CXX compiler ABI info
11 -- Detecting CXX compiler ABI info - done
12 -- Check for working CXX compiler: /usr/bin/c++ - skipped
13 -- Detecting CXX compile features
14 -- Detecting CXX compile features - done
15 -- Found MPI_C: /cluster/intel/oneapi/mpi/2021.5.0/lib/release/libmpi.so (found version "3.1")
16 -- Found MPI_CXX: /cluster/intel/oneapi/mpi/2021.5.0/lib/libmpicxx.so (found version "3.1")
17 -- Found MPI: TRUE (found version "3.1")
18 -- Found PkgConfig: /usr/bin/pkg-config (found version "1.4.2")
19 -- Checking for one of the modules 'craypetsc_real;PETSc'
20 -- Looking for sys/types.h
21 -- Looking for sys/types.h - found
22 -- Looking for stdint.h
23 -- Looking for stdint.h - found
24 -- Looking for stddef.h
25 -- Looking for stddef.h - found
26 -- Check size of PetscInt
27 -- Check size of PetscInt - done
28 -- Found PETSc: TRUE (found version "3.16.4")
29 -- Found ZLIB: /usr/lib64/libz.so (found version "1.2.11")
30 -- Enable ionic shared library loading
31 -- Found OpenMP_C: -fopenmp (found version "4.5")
32 -- Found OpenMP_CXX: -fopenmp (found version "4.5")
33 -- Found OpenMP: TRUE (found version "4.5")
34 Processing param
35 Processing simulator
36 -- Found Python: /usr/bin/python3.8 (found version "3.8.8") found components: Interpreter
37 Processing slimfem
38 Processing numerics
39 Processing fem
  
```

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**BIOS Version** 2.3  
**BIOS Revision** 5.22

## Future Work

- Extend monitoring (AMD GPUs, FPGAs, ARM, FileSystems)
- User Management
- Deployment at new HSU Cluster

### Collaboration with Akash Mundra @TUM for his Master's Thesis

- Explore possible strategies to support users in the analysis of the data
  - Detection of bottlenecks
  - Relating performance metrics with hardware properties (micro-benchmarking)

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Thank you for your Attention!



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