Numeric systems

pacefish

Pacefish

GPU native end-2-end LBM CFD

5th Automotive CFD Prediction Workshop

Eugen Riegel

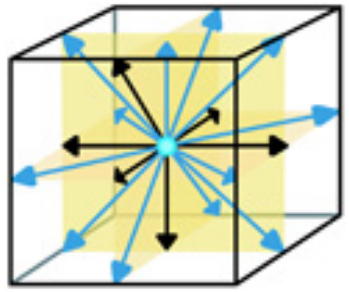
08.10.2026



Pacefish Introduction

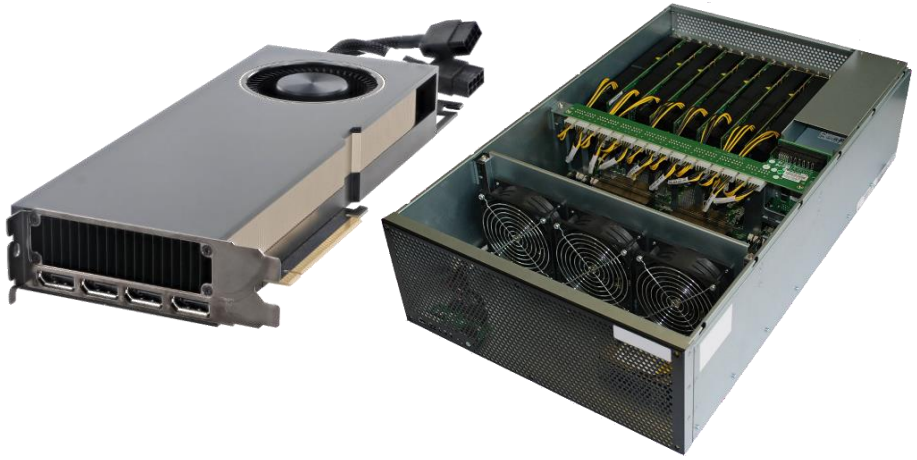
accurate, fast and cost-effective end-2-end transient CFD

Pacefish – end-2-end CFD for scale

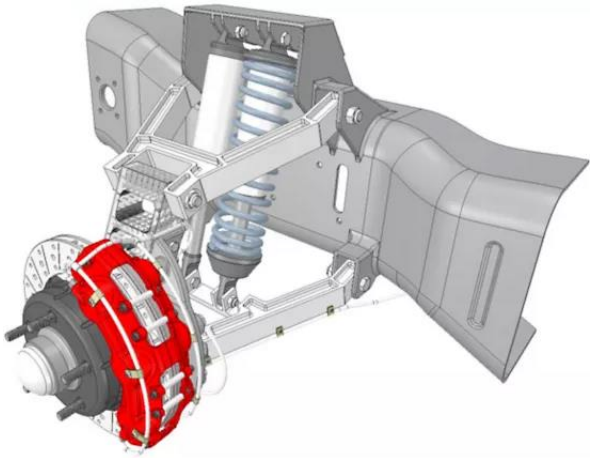


LBM (Lattice-Boltzmann Method) based **CFD**

Coherent FDM (Finite Difference Method) for turbulence modelling and more



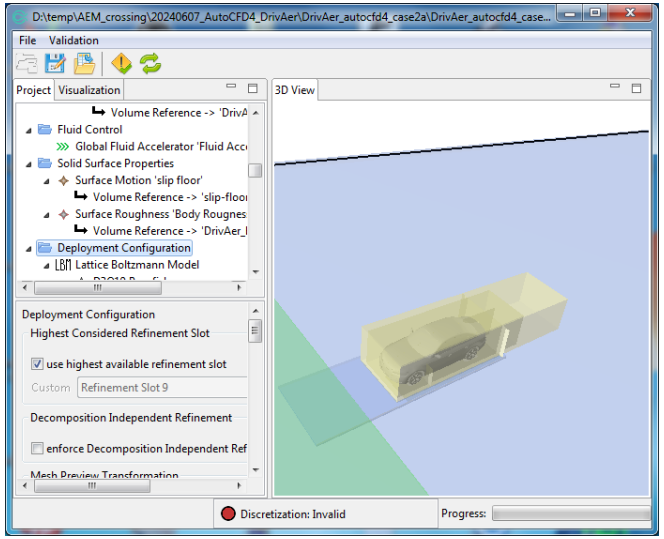
multi-GPU acceleration delivers **time** and **cost reduction** of **~20x** and **beyond**



Robust **proprietary** LBM **Wall Model** implementation **works** directly on **dirty** geometries, no CAD cleanup required

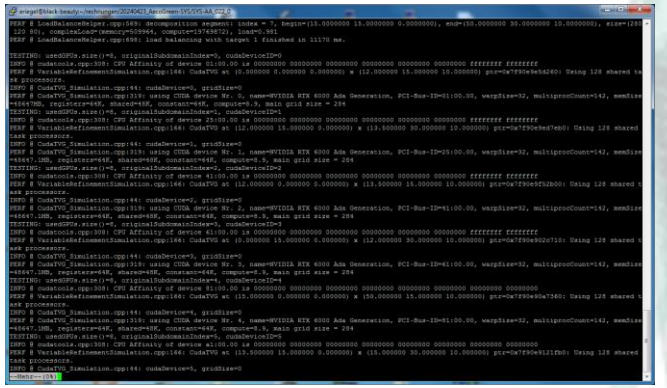
Pacefish CFD – Complete Workflow

Pacefish Workbench (SETUP)



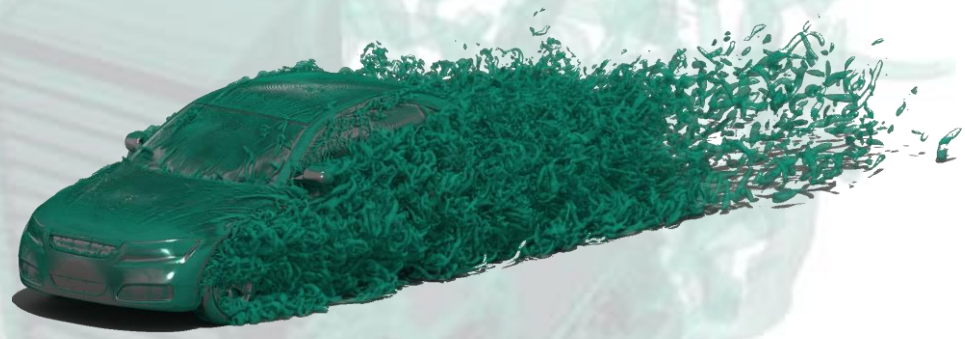
- Definition and Modification of the Case Setup
- Rich-Client Application (Windows and Linux)

Pacefish Backend (PREPROCESSING and SIMULATION)



- Console Based Application (Windows and Linux)
- GPU-Accelerated

ParaView (POSTPROCESSING)



- 3D Results written to Storage
- compatible with ParaView (open source)
- Works also with other Post-Processors (like Tecplot)

18+ Years of GPU-CFD Leadership

2007: **First mover** in GPU-native CFD

2008: 1 of 8 demo project displayed at **NVIDIA** CUDA launch event

2014: **EXIST Funding** by German Ministry of Economics

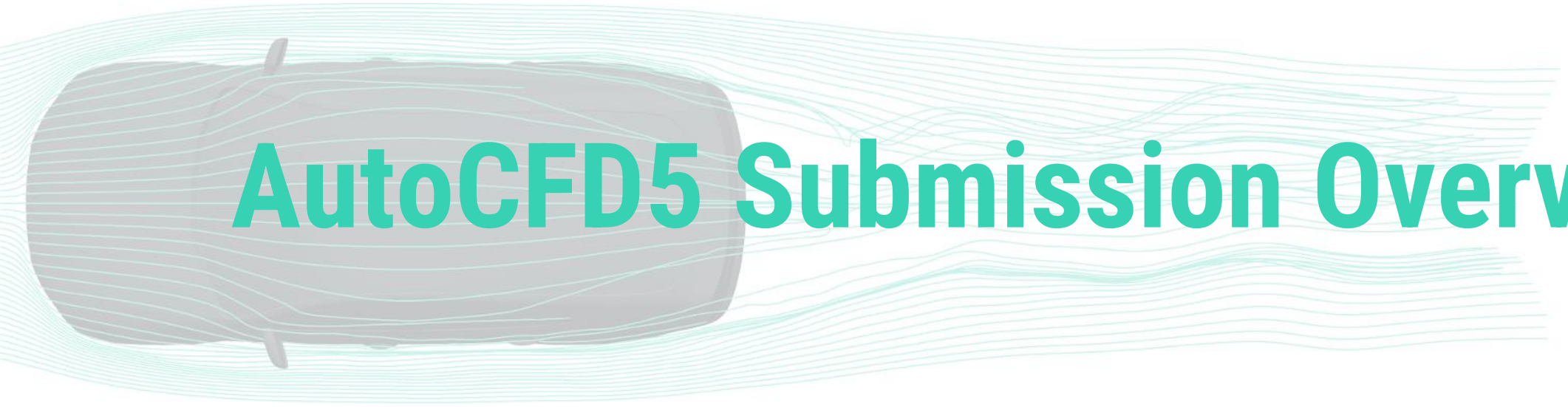
2016: production working **SST-DDES** Turbulence model for **cartesian meshes** (LBM)

2017: production working dirty-CAD **TBL wall model** for LBM

2019: **Release** on SimScale and On-Premises

2019: **EU** Horizon 2020 **SME Funding**

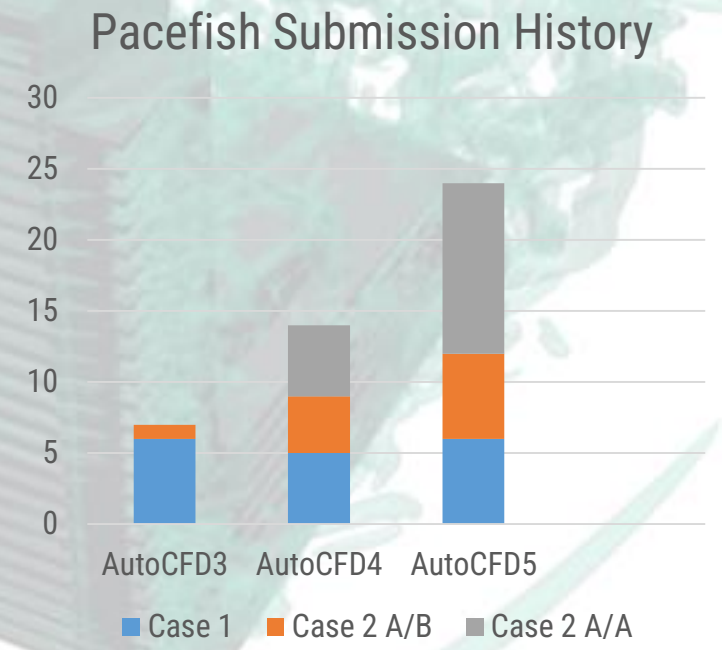
2026: **250K** productive GPUh, **900+** productive in-house simulations



AutoCFD5 Submission Overview

Pacefish – Submission Overview

- AutoCFD5: **24 Submissions** in total
- Contributed to **HPC**, **NOISE** and **SRS** Technical Focus Groups (TFGs)
- Case1: **6 Submissions**, variance on
  - resolution (g1-g4) and
  - turbulence modelling (hybrid SST-DDES, uRANS kOmegaSST)
- Case2: **18 Submissions:**
  - **6 A/B Submissions:** DDES 34M (guess), DDES 61M (vcoarse), DDES 90M (coarse), DDES 195M (baseline), uRANS SST 195M (sst), DDES 627M (fine)
  - **6 A/A Model Noise TFG Submissions:** DDES 195M
  - **6 A/A Geometrical Noise TFG Submissions:** DDES 195M

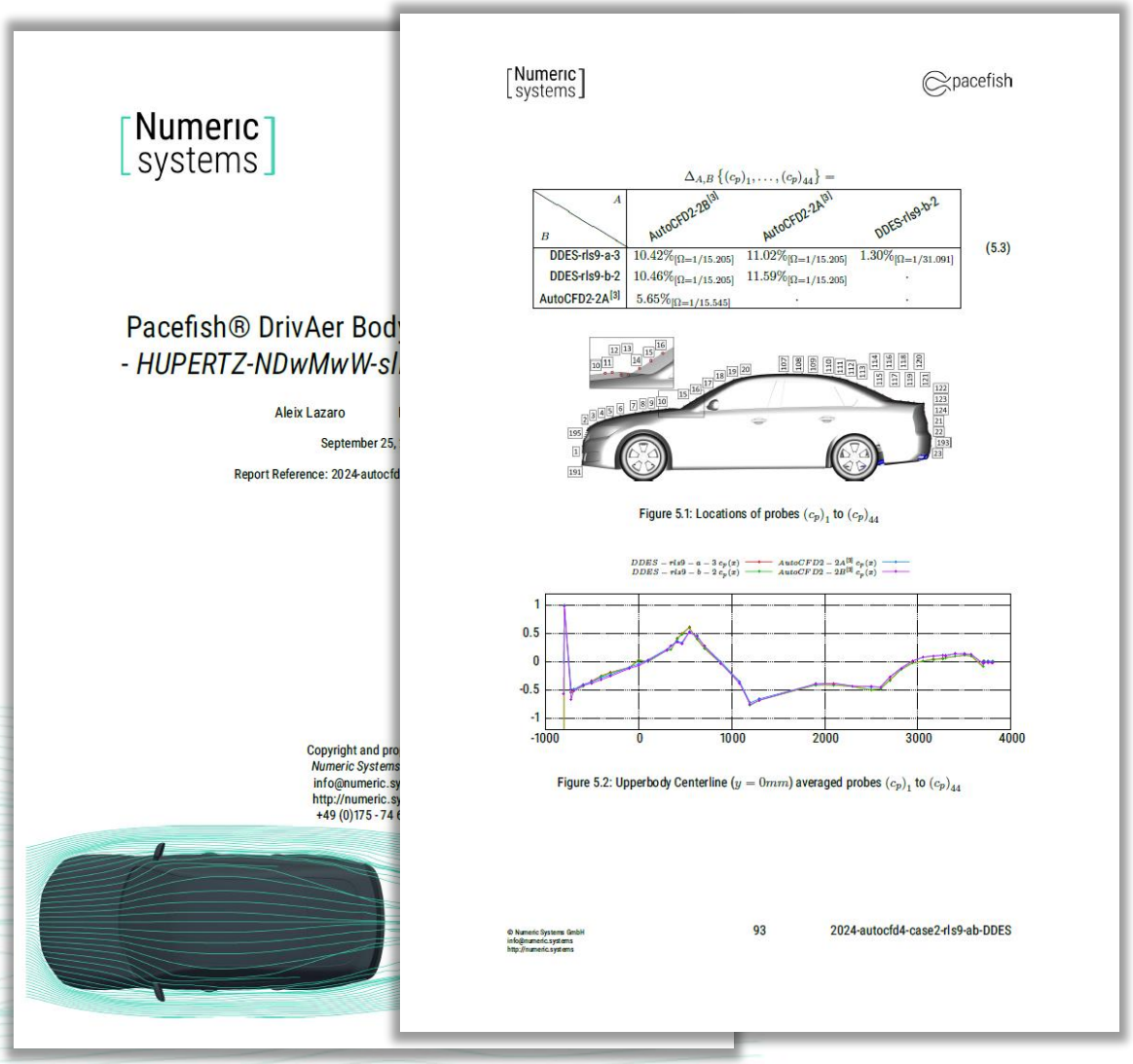


Pacefish Updates since AutoCFD4

- **3.6×** Productivity Boost since AutoCFD4 (2024), Case 2A DDES 195M:
  - AutoCFD5 (2026): **2h** @ 8x GPUs
  - AutoCFD4 (2024): **7.15h** @ 4x GPUs
  - AutoCFD3 (2022): **48h** @ 4x GPUs
- Performance Improvement Breakdown:
  - **1.45x**: GPU hardware upgrade (NVIDIA Ada → NVIDIA Blackwell 600W)
  - **1.9x**: GPU count doubled (strong scaling, 4 → 8 GPUs)
  - **1.3x**: Software optimization
- Key Software Improvements:
  - Geometry preprocessor reworked: highly complex geometries: **30 h → 12 min**
  - DDES shielding function improvements: not completed in time for AutoCFD5

Validation Reports with all Details

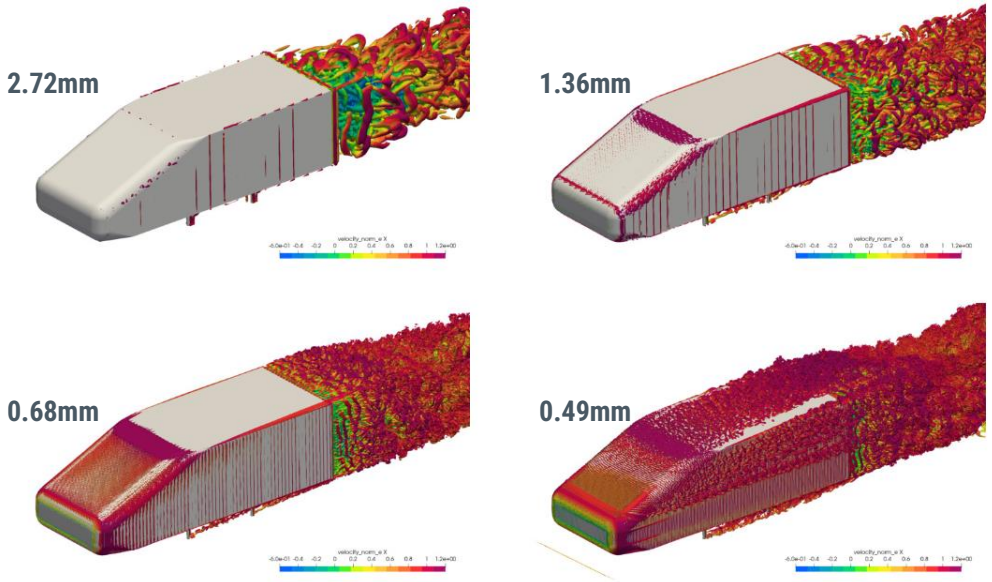
- Validation **Reports** available for all Numeric Systems' AutoCFD5 submissions
  - 5 Reports **in PDF** format
  - Between 147and 376 Pages each
  - **Qualitative** and **Quantitative**
  - **Clearly** structured for **easy** reading
- Links to the PDF files are shared on related slides:
  - Case 1: all results in 1 Report
  - Case 2: A, B, noise and geonoise (4 Reports)

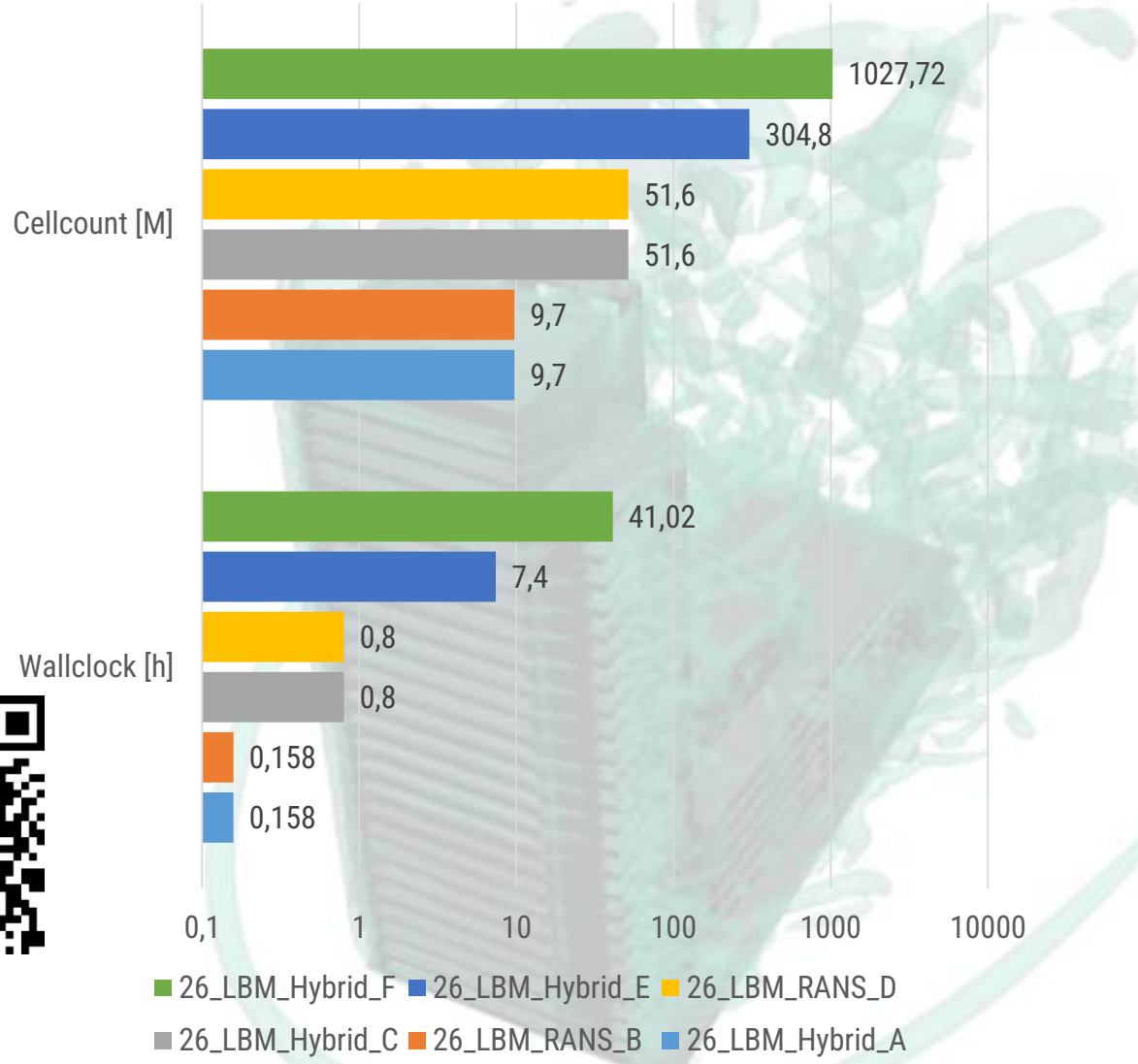




Case 1 ‚Windsor‘ Submissions

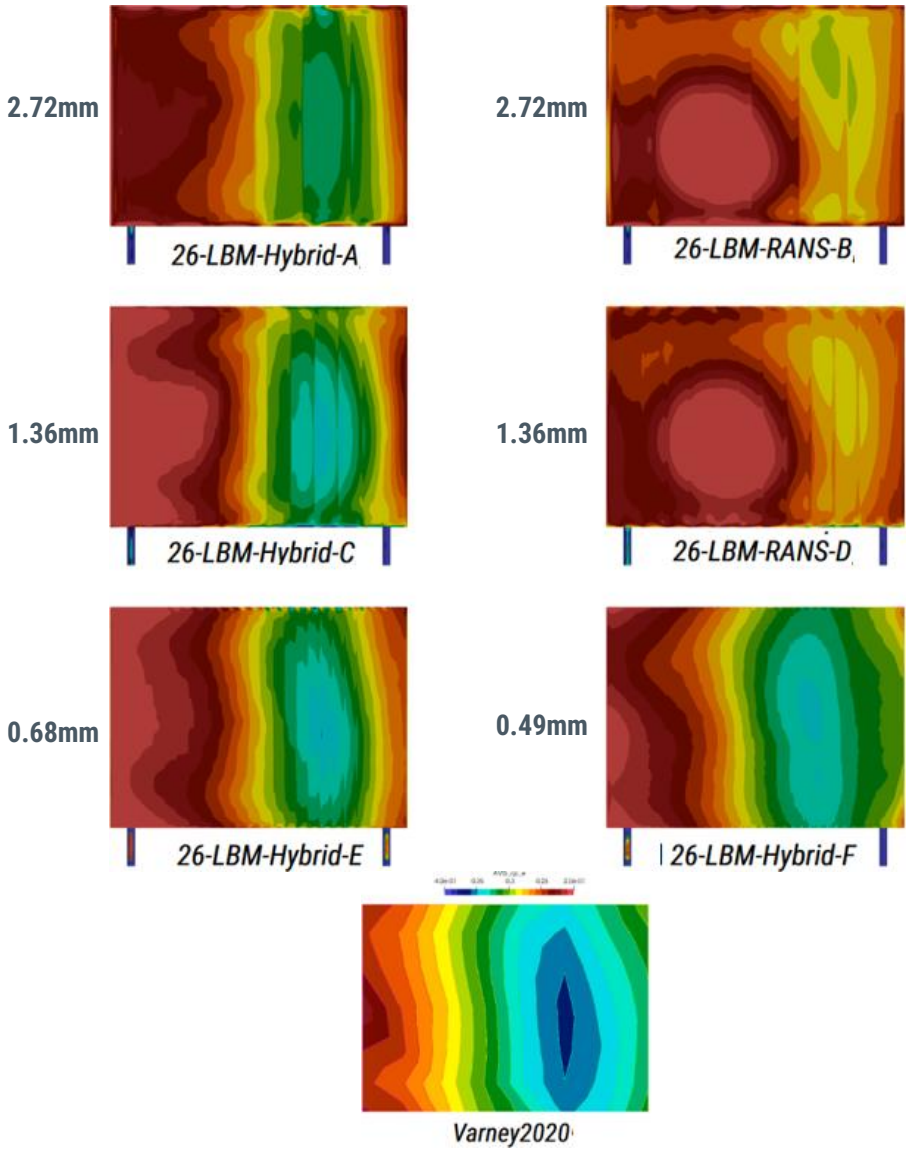
Windsor – Complexity and Compute

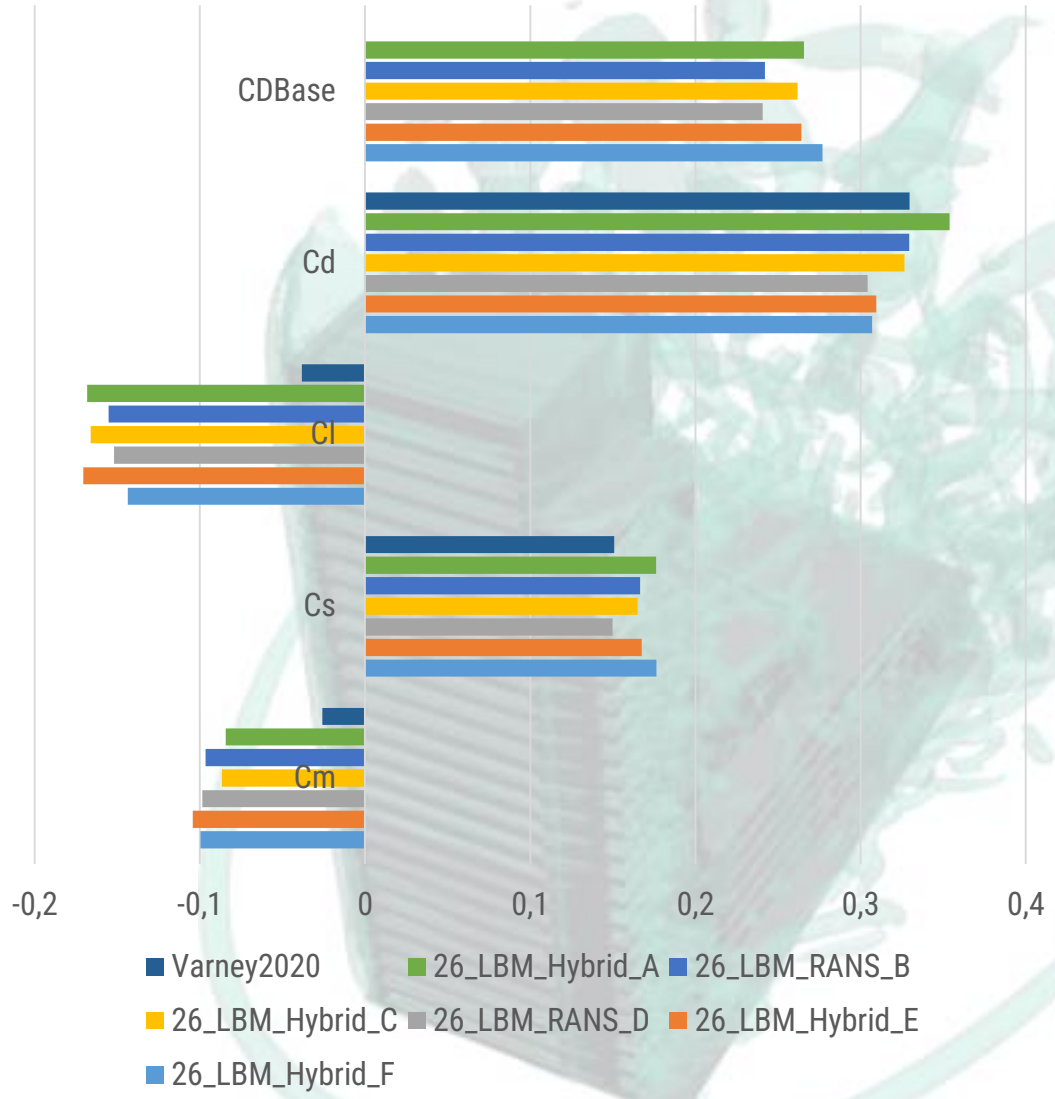




- New AutoCFD5:
  0.494mm mesh SST-DDES
- Report PDF:
  https://tinyurl.com/ms66dcpm

Windsor – Integral Results & Base Pressure





Windsor – Drag Development

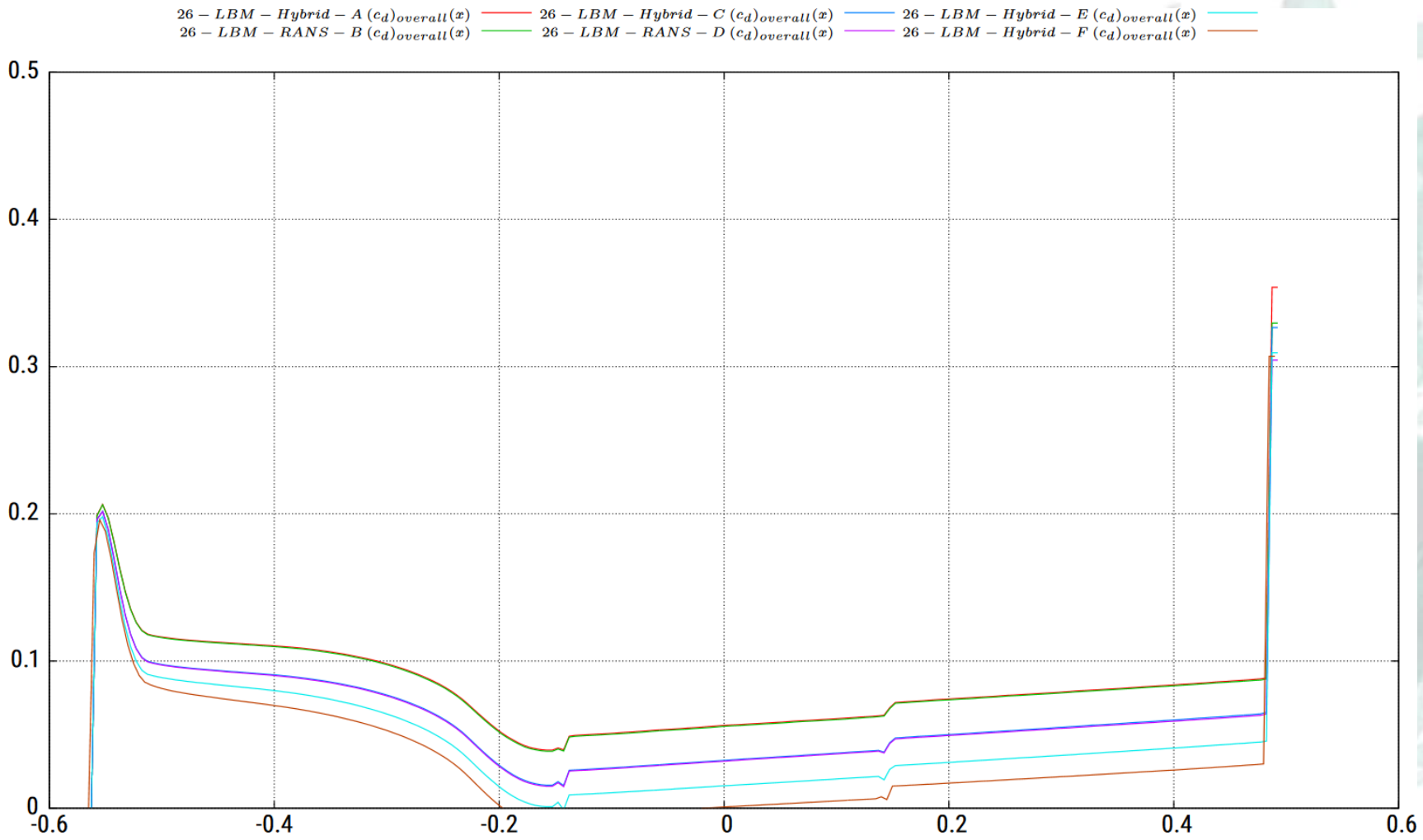
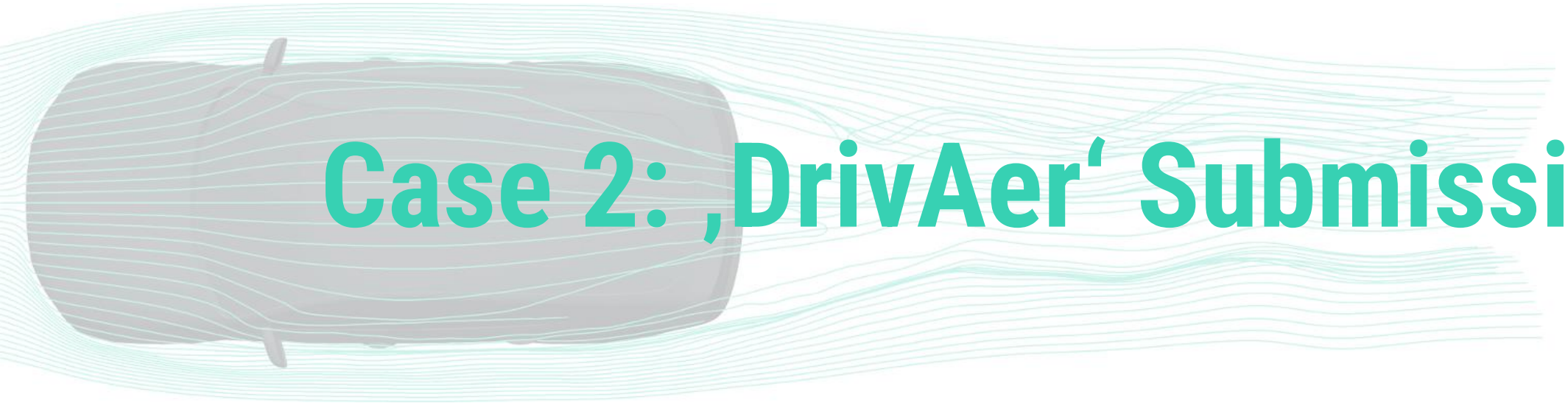
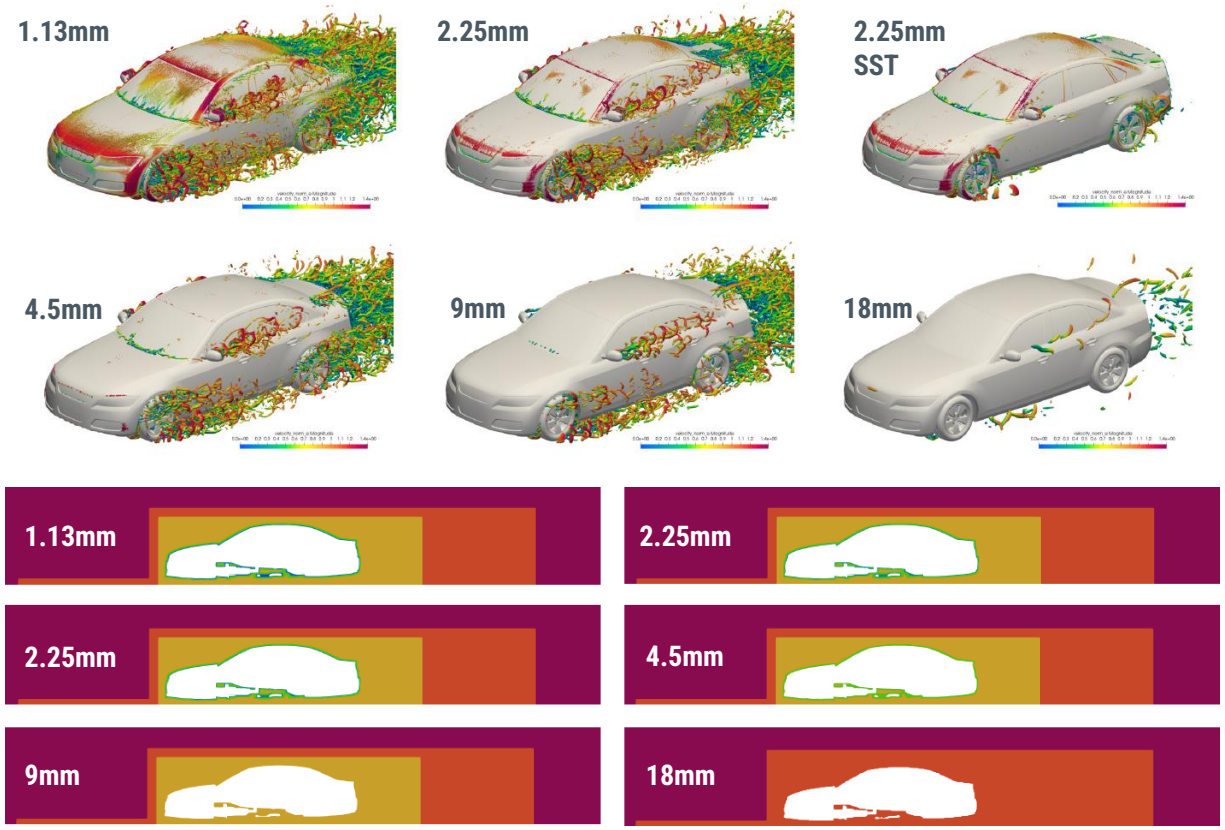


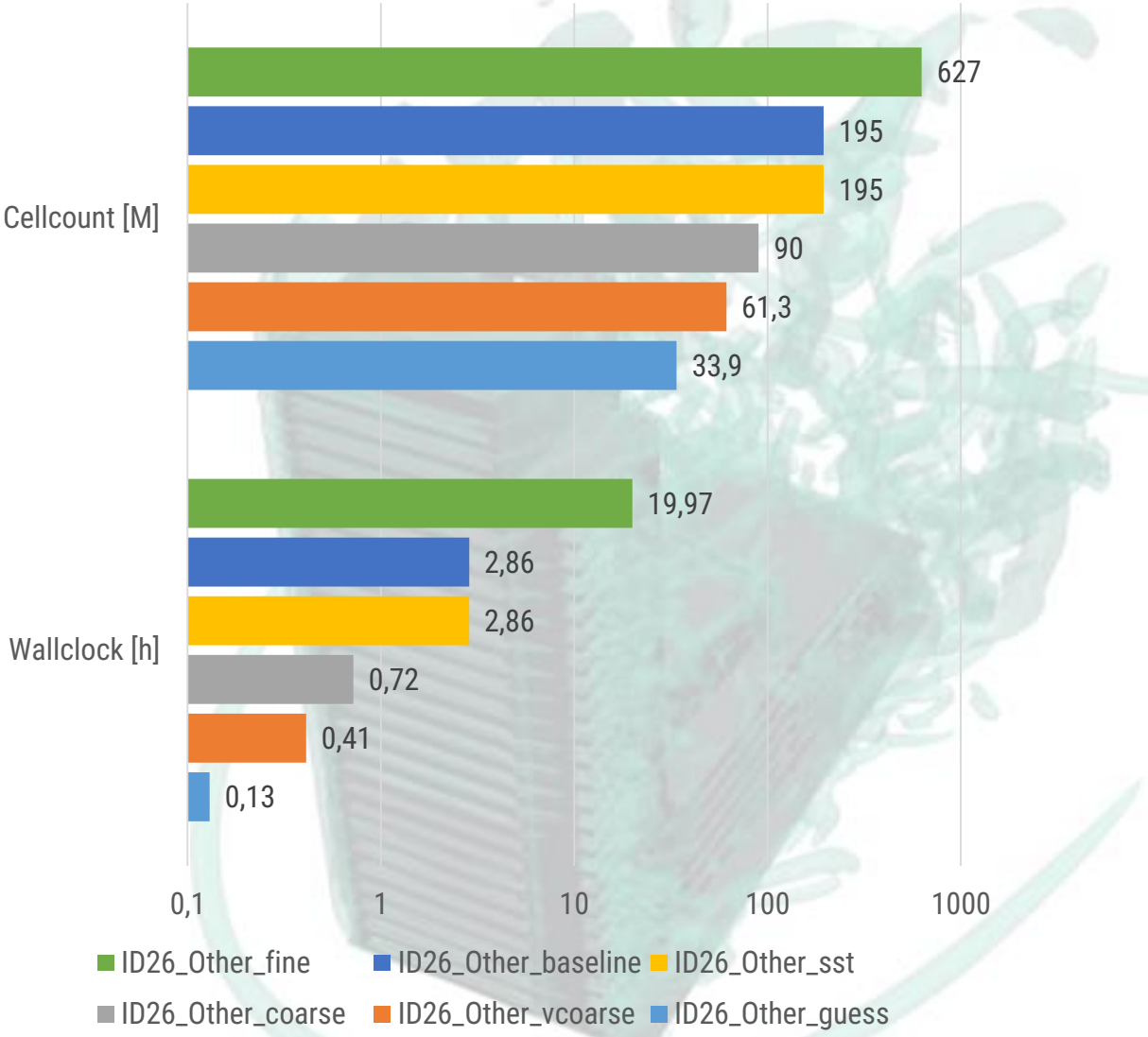
Figure 3.6: Development of drag force coefficient $(c_d)_{overall}$ on the model.



Case 2: ‚DrivAer' Submissions

DrivAer – Complexity and Compute

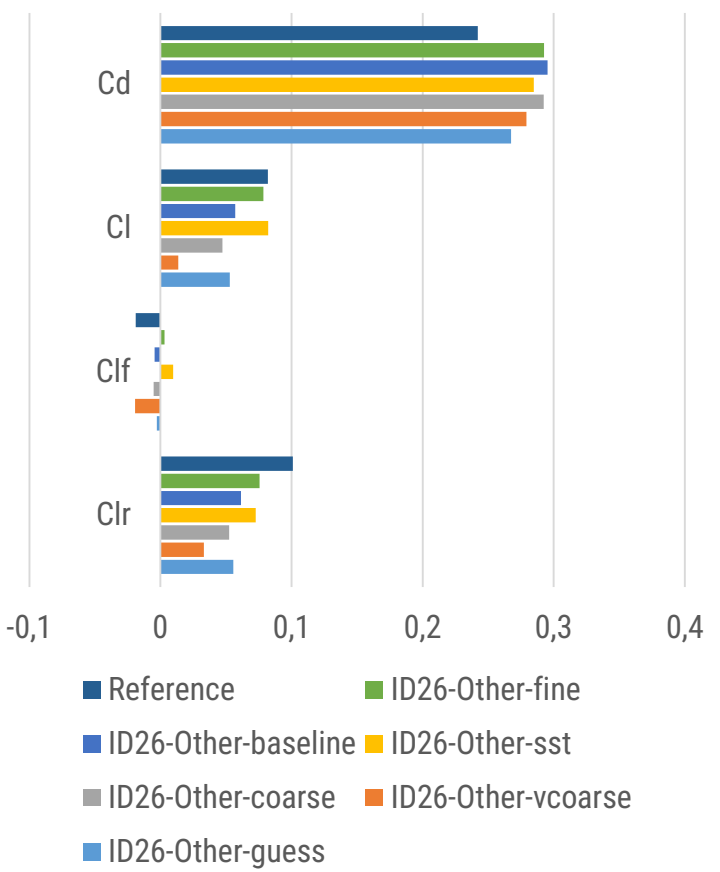




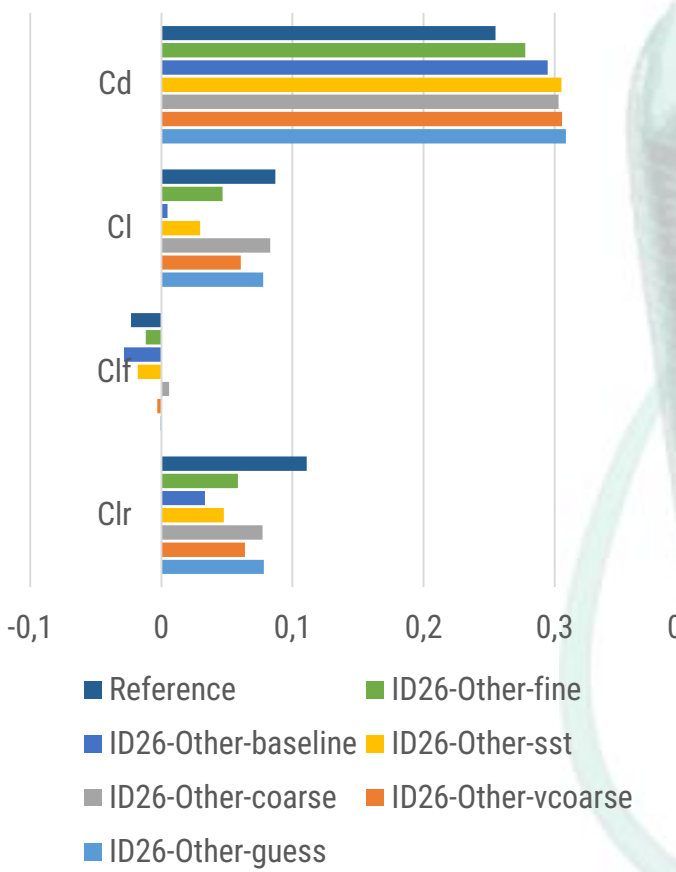
- New AutoCFD5: **9mm** and **18mm** Grid complexities as alternative to AI Surrogates
  - Delivers in 25 and 8 minutes
  - No data, no training, no surrogate, just end-2-end transient CFD

DrivAer – Integral Results

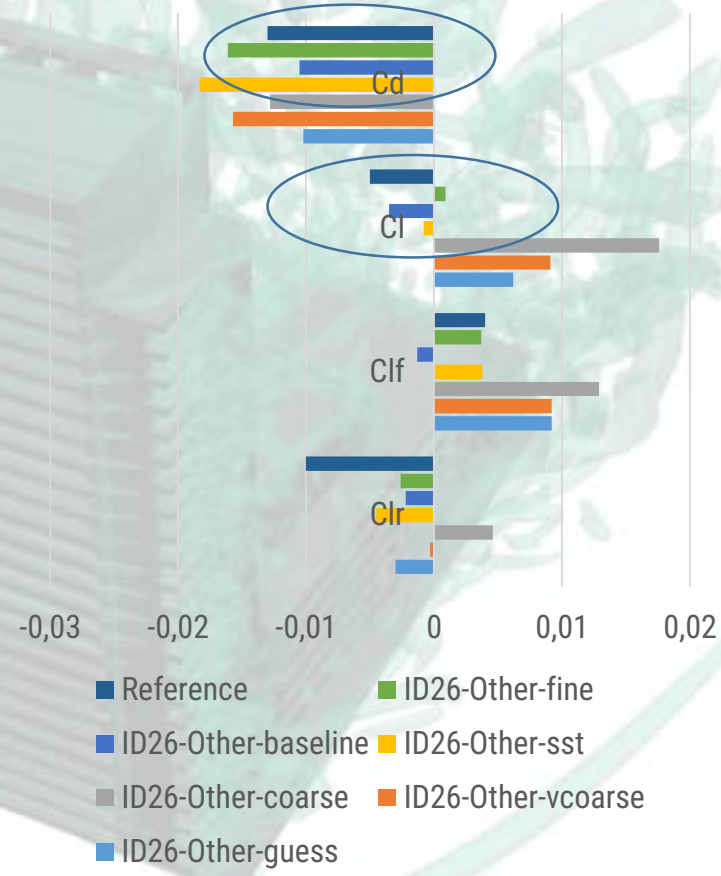
Case2A



Case2B

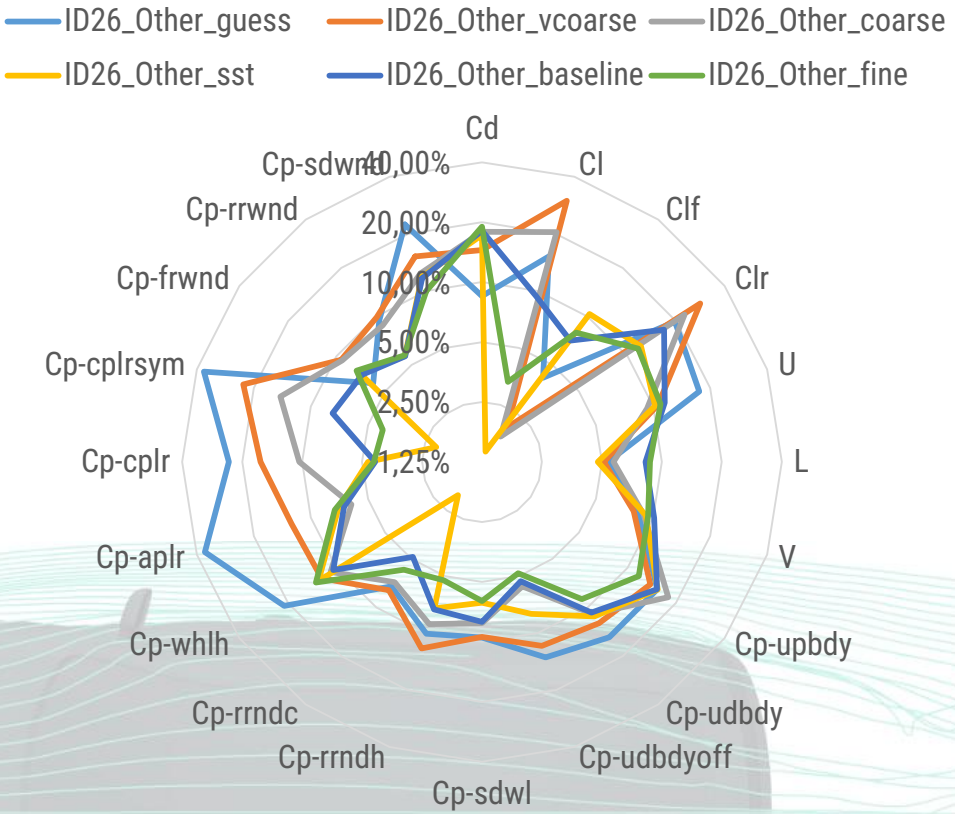


Case2B - Case2A



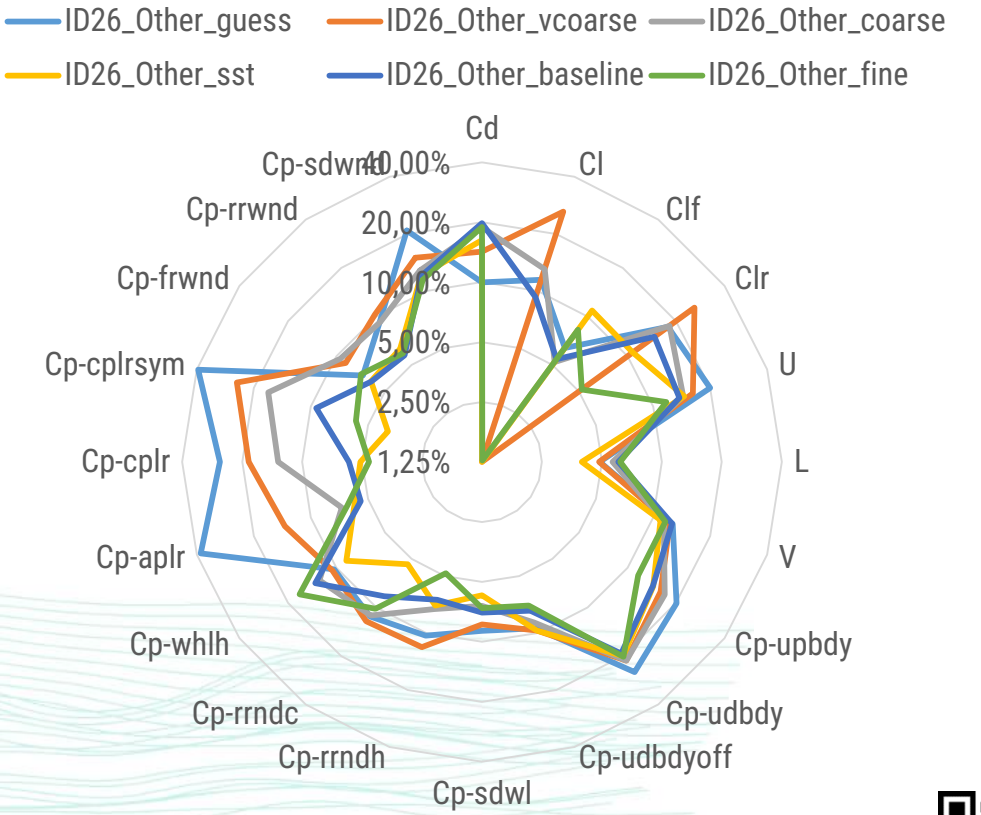
DrivAer – Overall Results Correlation

Deviation from Hupertz2017-A



A-Report PDF: https://tinyurl.com/mveckuuy

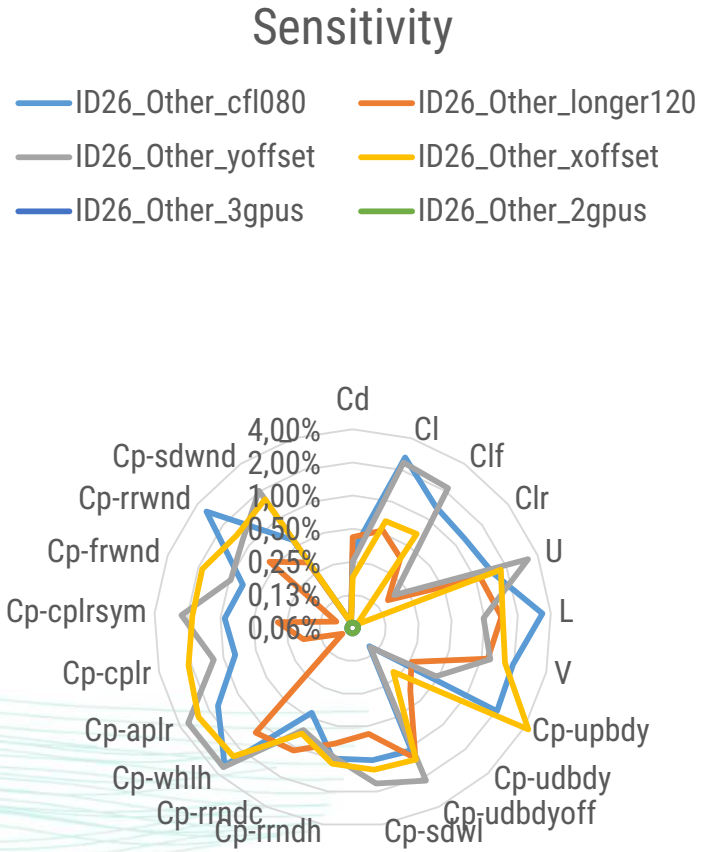
Deviation from Hupertz2017-B



B-Report PDF https://tinyurl.com/4xcj9n95

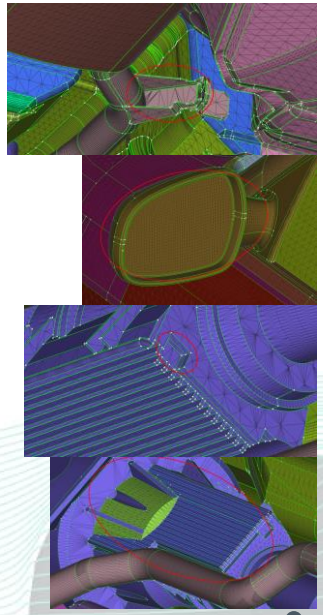
DrivAer – Model Noise

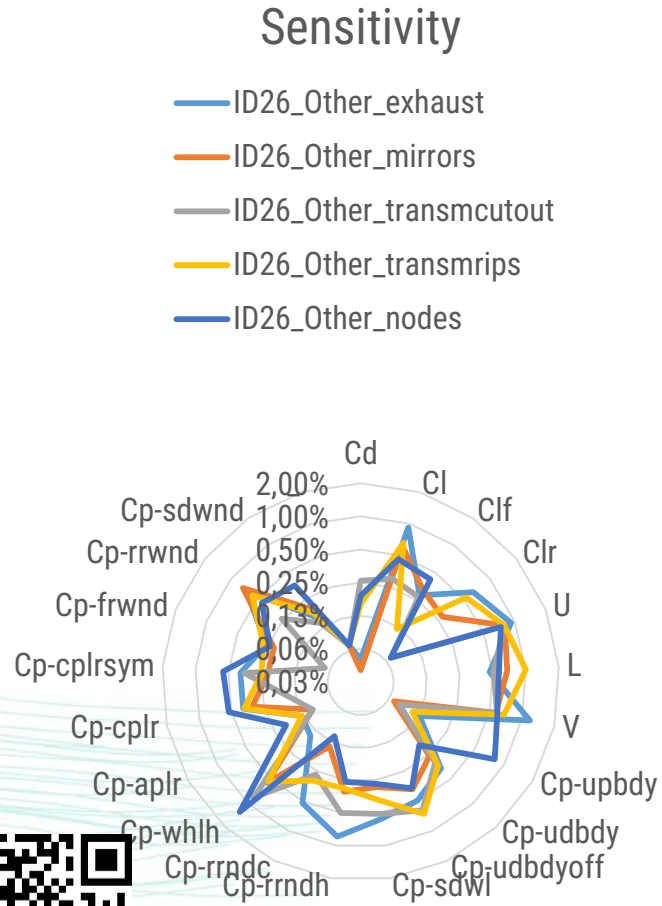
- Variation of **6** Aspects relative to **ID26_Other_Baseline**
  - **ID26_Other_cfl080**: 80% CFL reduction + reduced modeled compressibility
  - **ID26_Other_longer120**: +20% simulated time
  - **ID26_Other_yoffset**: Geometry shifted spanwise by 1 mm (½ cell)
  - **ID26_Other_xoffset**: Geometry shifted streamwise by 1 mm (½ cell)
  - **ID26_Other_3gpus**: 3 GPUs instead of 8
  - **ID26_Other_2gpus**: 2 GPUs instead of 8
- https://tinyurl.com/3snk3vhn



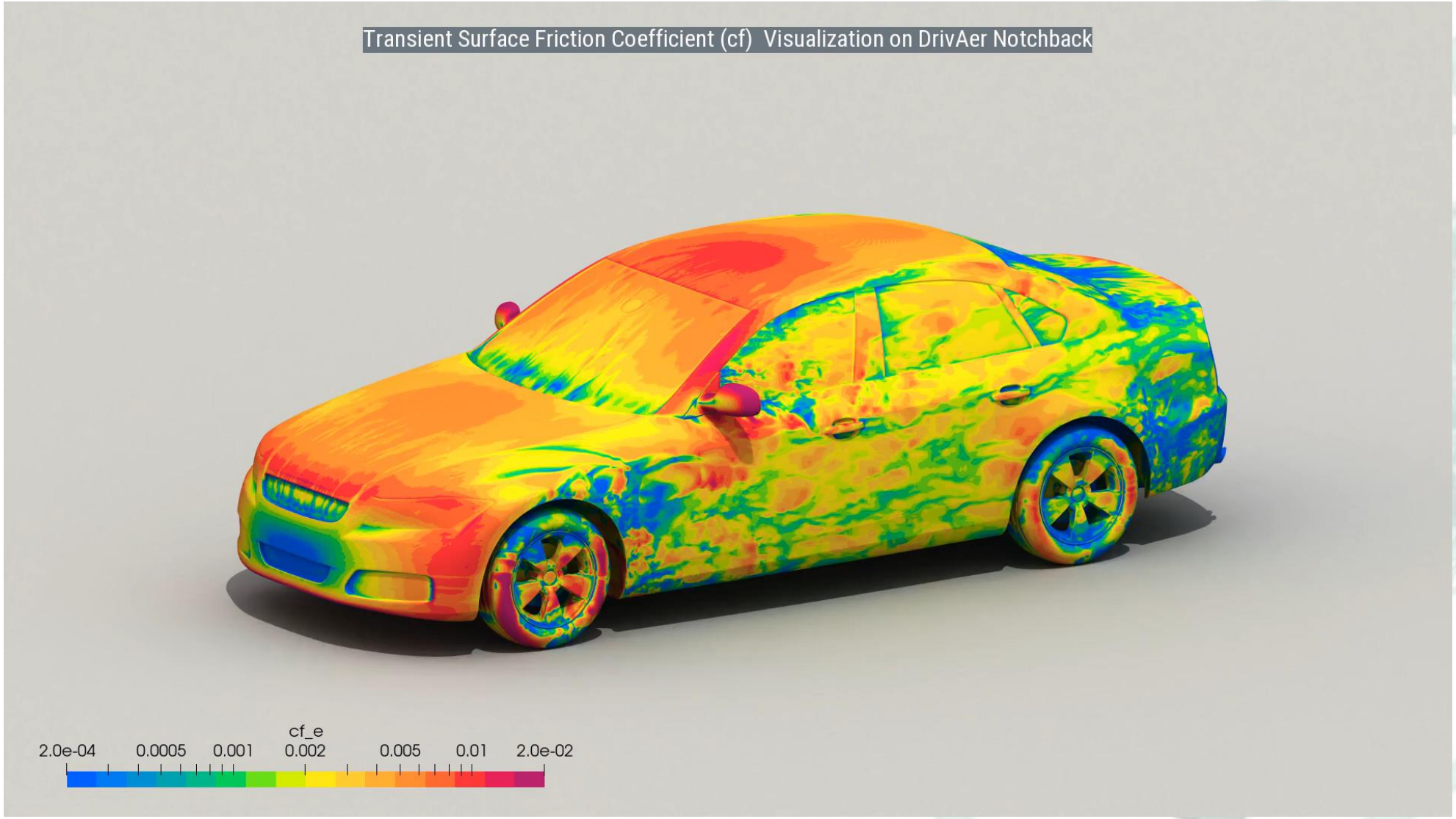
DrivAer – Geometric Noise

- Variation of **5** Aspects relative to **ID26_Other_georef**
  - In collaboration with FORD
  - **ID26_Other_exhaust**: minor modification of the exhaust mounting
  - **ID26_Other_mirrors**: mirror glass shifted slightly into the housing
  - **ID26_Other_transmcutout**: minor cutout at the transmission casing
  - **ID26_Other_transmrips**: closed cooling rips on the transmission casing
  - **ID26_Other_nodes**: All geometry nodes randomly displaced by an infinitesimal offset
- https://tinyurl.com/bdf9fybb





DrivAer – ID26_Other_fine Transient Data



Thank you for attention!

Contact and Information:

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Pacefish is available for cloud based usage over our integration partner SimScale. Visit https://simscale.com