



DrivAerStar: An Industrial-Grade CFD Dataset for Vehicle Aerodynamic Optimization

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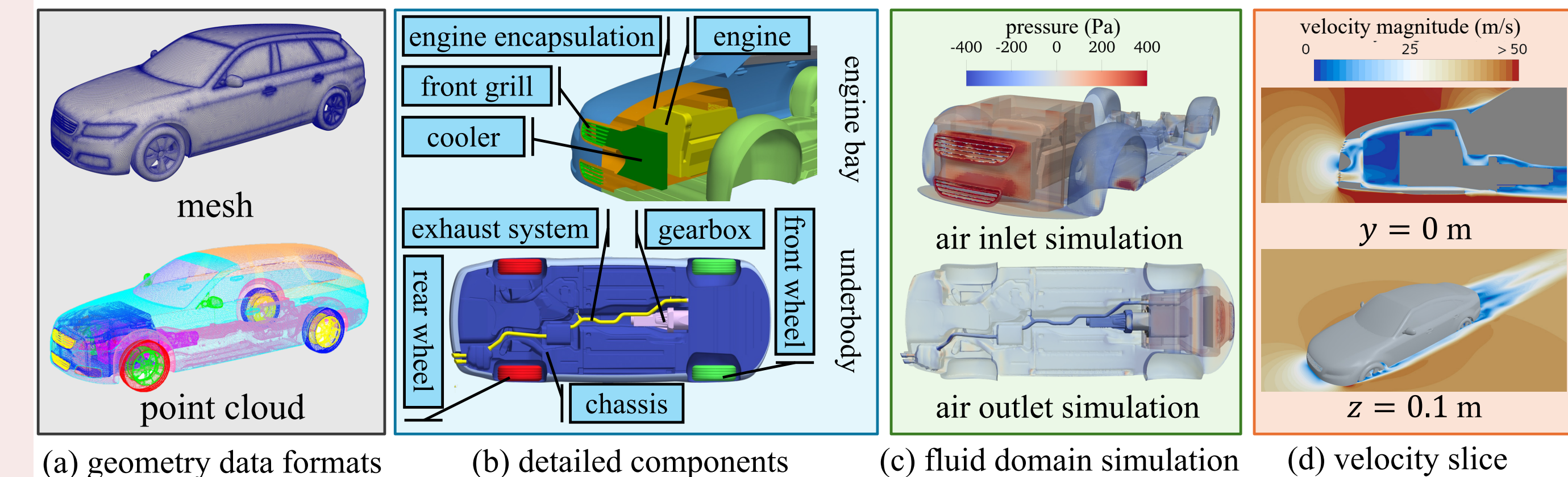
The Challenge

- **The Problem:** Aerodynamic optimization is critical for maximizing energy efficiency and extending EV range.
- **The Bottleneck:** Traditional CFD is resource-heavy and slow (days per iteration). While ML surrogate models can simulate in seconds, they lack reliable training data.
- **The Gap:** Existing datasets lack industrial fidelity—often featuring simplified geometry, missing components, or loose mesh tolerances.
- **The Solution:** DrivAerStar bridges academic ML research and industrial engineering, empowering surrogate models with a high-fidelity, production-grade dataset.

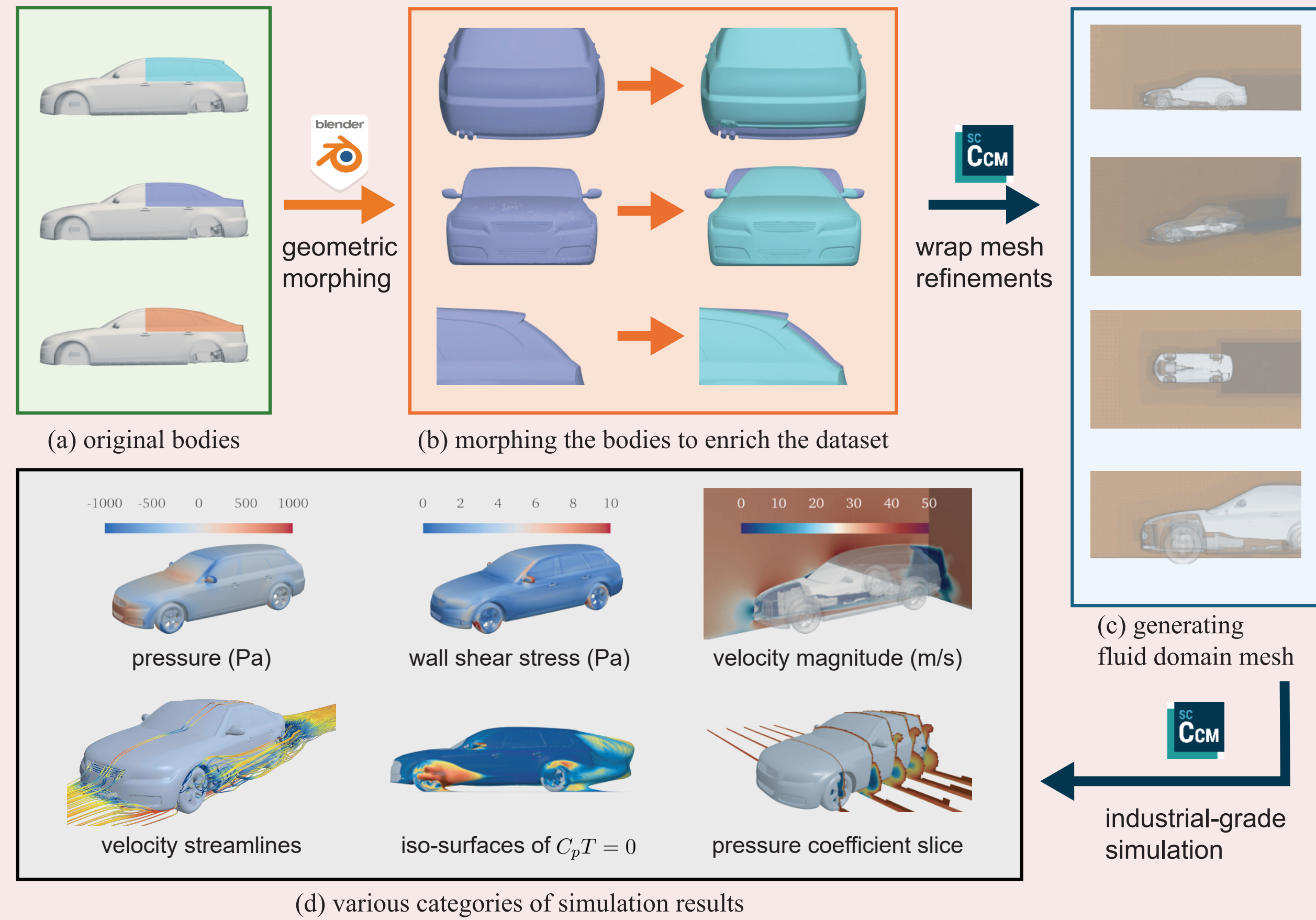
Our Contributions

- **High-fidelity dataset:** DrivAerStar provides 20 TB of external flow field data from 12,000 industrial-grade STAR-CCM+® simulations across multiple configurations.
- **Adaptive mesh methodology:** We employed refined mesh strategies with adaptive regional refinement and strict wall y^+ control, achieving superior boundary layer.
- **Complete vehicle modeling:** Integration of front compartment assemblies with engines and cooling components creates continuous cooling flow channels.
- **Comprehensive benchmark:** We established multi-scale performance evaluation across surface and volumetric data, identifying research directions.

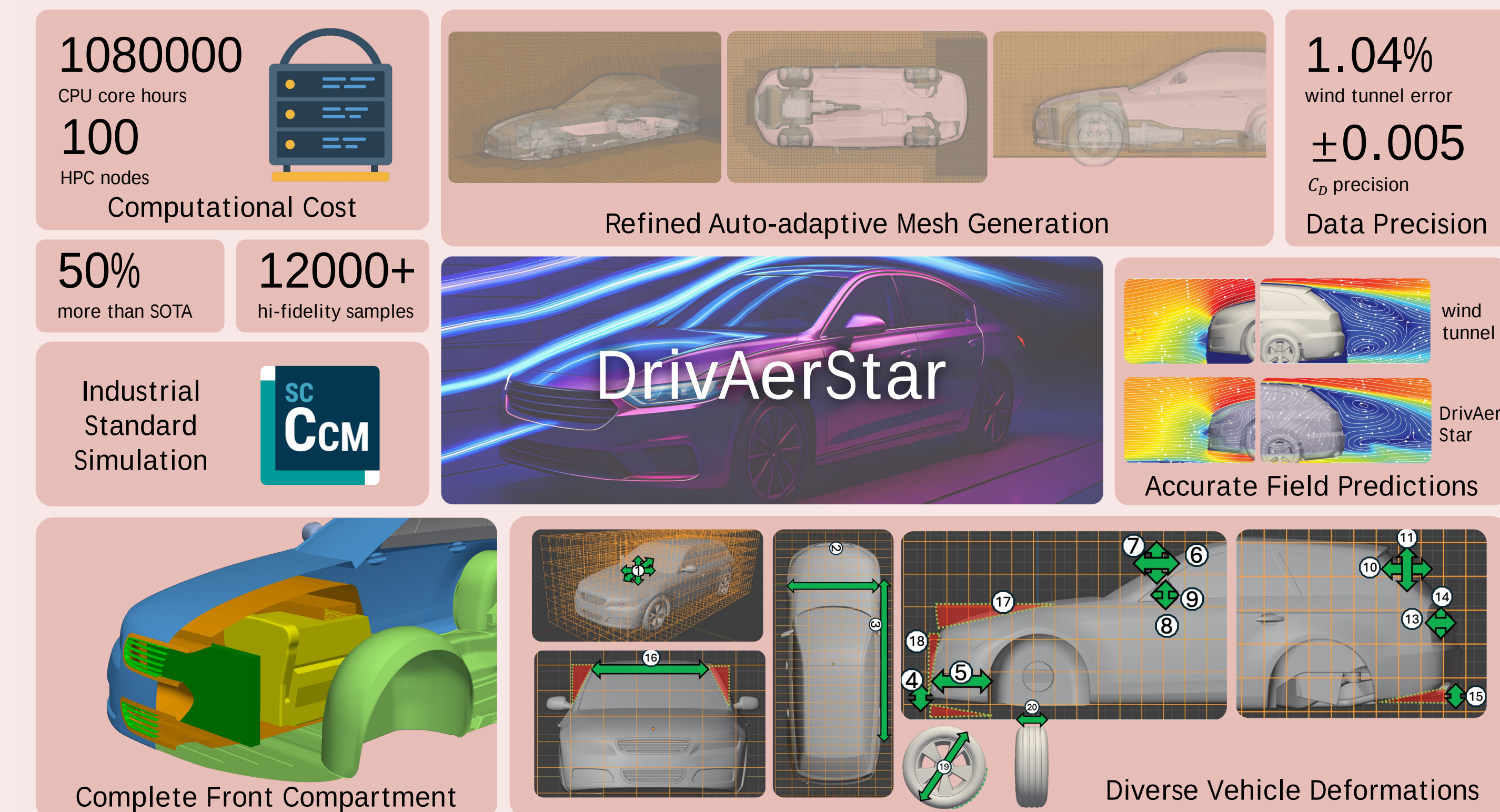
Dataset Features



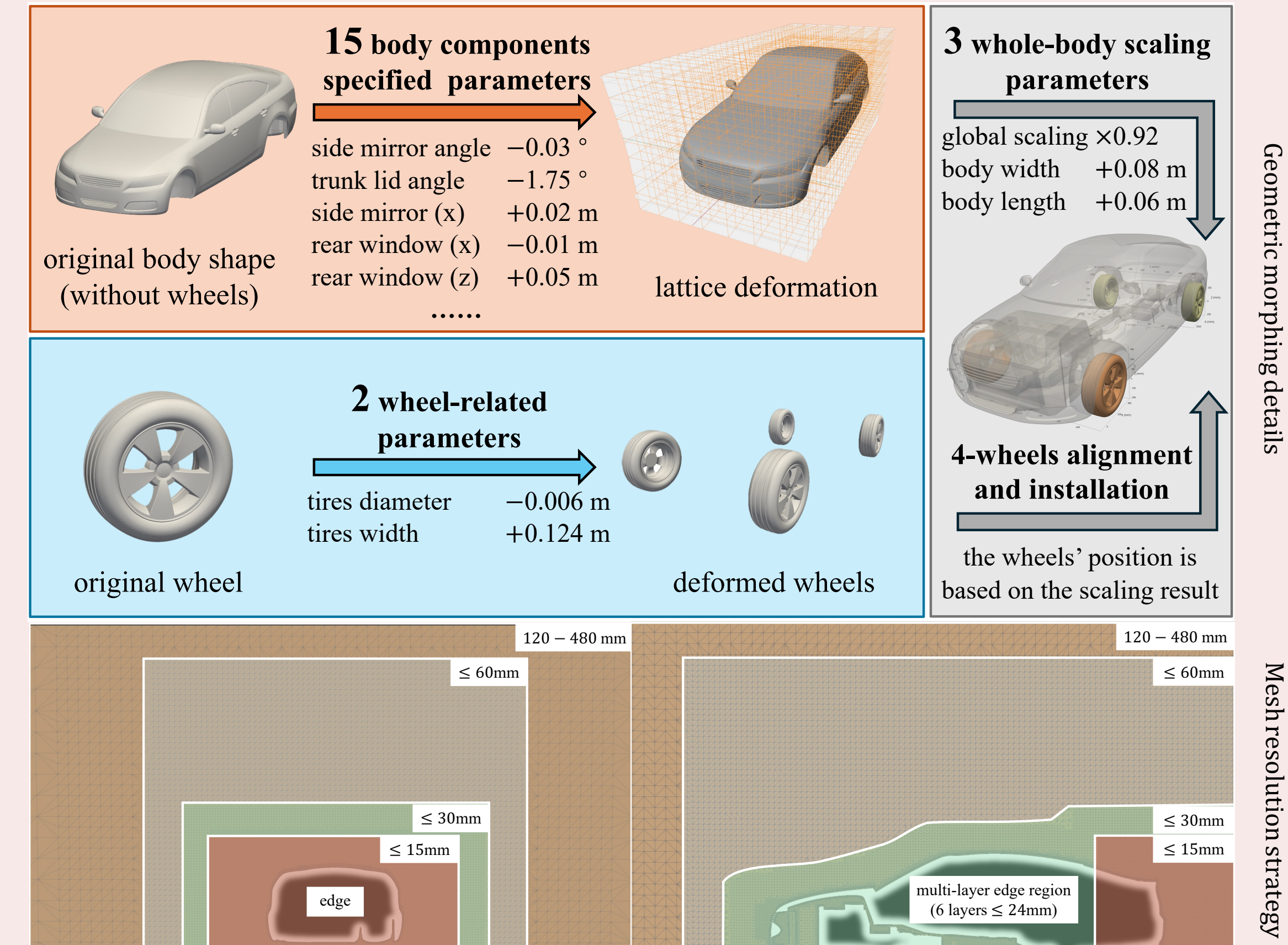
Generation Pipeline



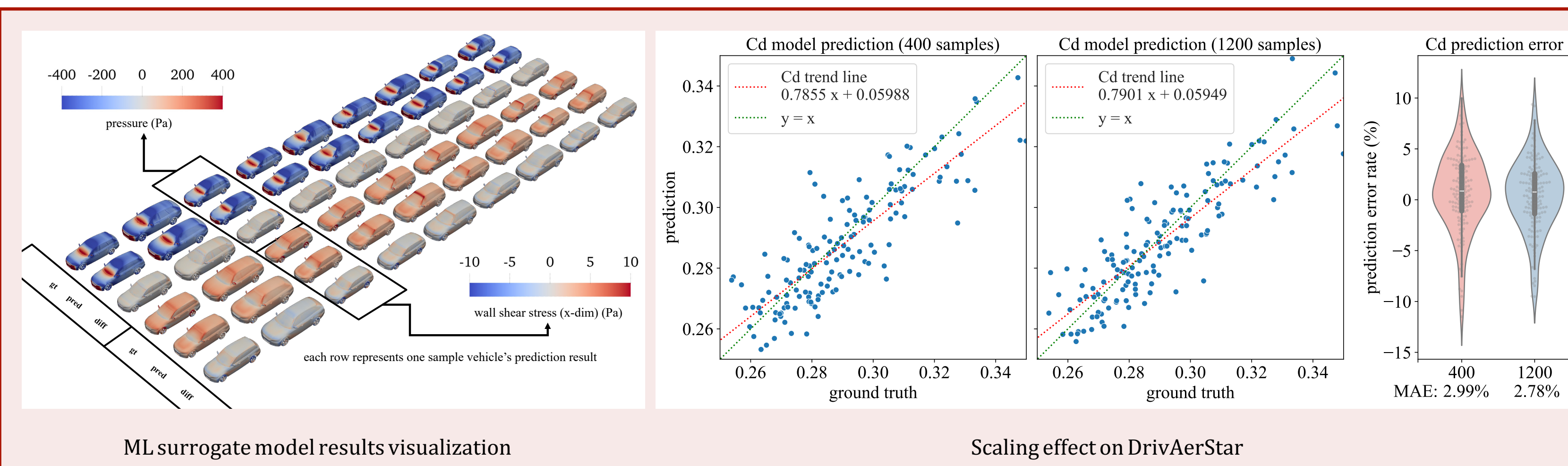
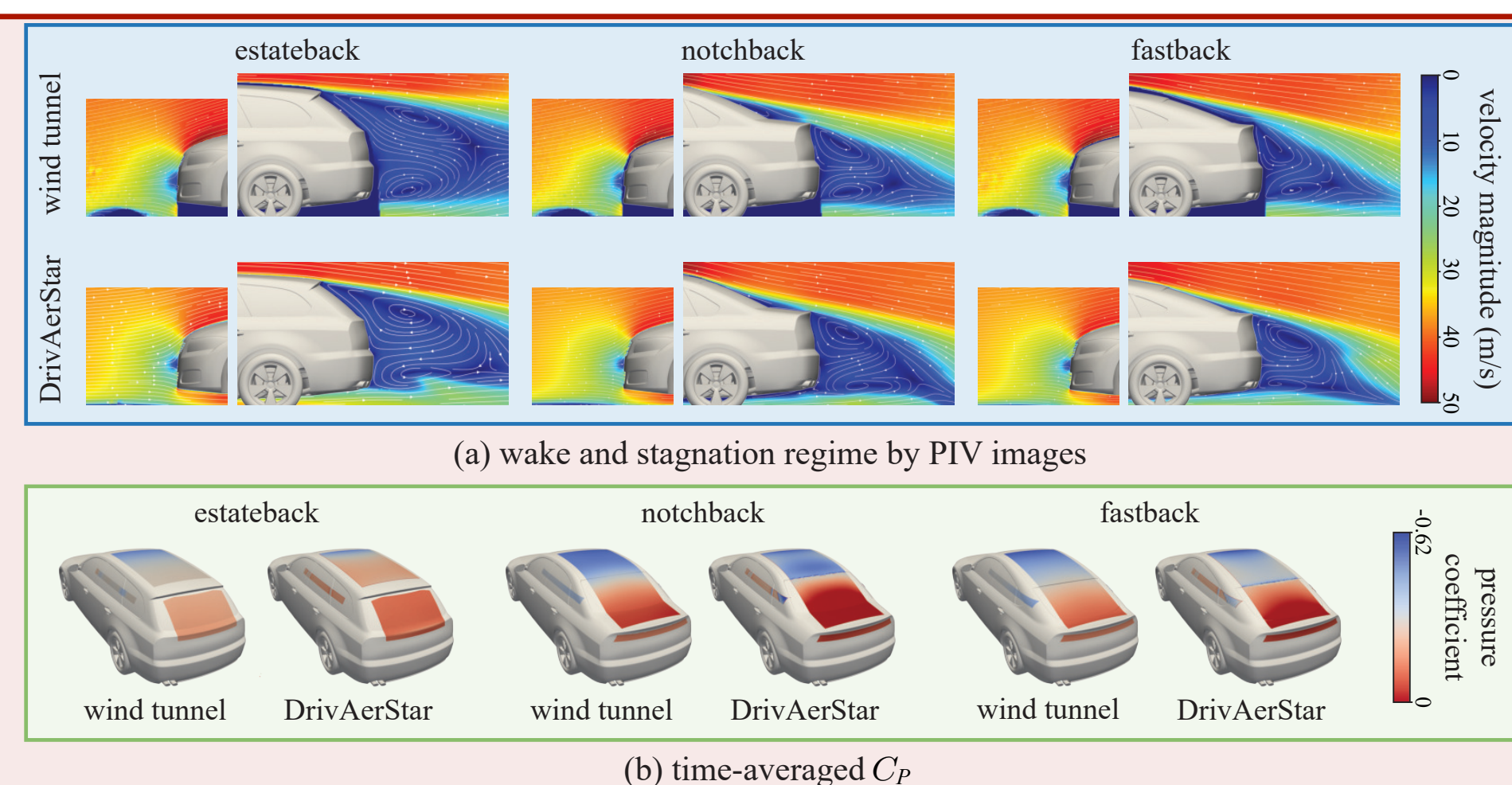
Overview



Pre-processing



Validation



Configuration	Train: Pressure	Train: WSS	Train: Cd	Val: Pressure	Val: WSS	Val: Cd
400×Estateback	0.2112	0.7841	0.0305	0.2173	0.7889	0.0314
800×Estateback	0.205	0.7793	0.0296	0.2086	0.7837	0.0283
1200×Estateback	0.1969	0.7881	0.0315	0.1996	0.7953	0.0266
133×3 Vehicles	0.2076	0.805	0.0421	0.2194	0.8049	0.0375
266×3 Vehicles	0.1967	0.813	0.0335	0.2075	0.817	0.0335
400×3 Vehicles	0.1957	0.7973	0.0333	0.2074	0.7871	0.0286

ML Benchmarks

Dataset Homepage:
<https://drivaerstar.github.io/>

