Drag Reduction Mechanism of an Automobile with Inside-Fin Tires

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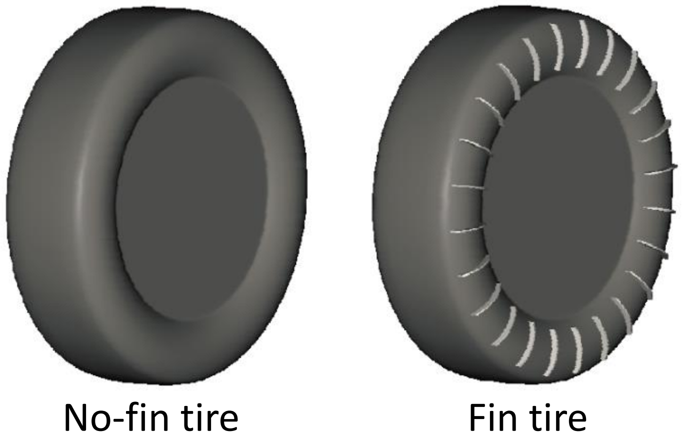
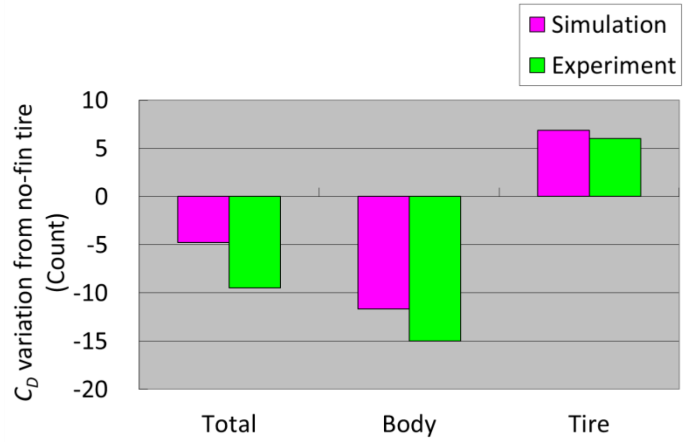
Background





Aerodynamic Drag

- Accounts for 50 % of running resistance at 60 km/h
- Affected by the appearance

Fin Tires

✓ Expected to reduce drag without sacrificing appearance

✓ Demonstrated to be effective for drag reduction in experiments and numerical simulations

x Do not clarify its detailed mechanism yet

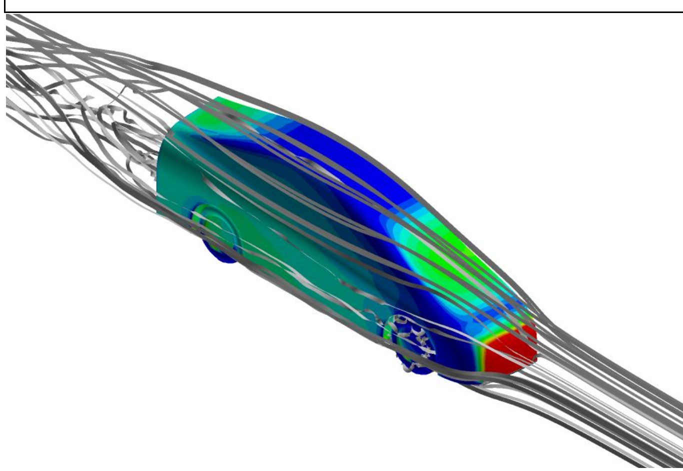
Objective

Clarify the drag reduction mechanism induced by fin tires through the large eddy simulations (LES) for

1. No-fin tire model
2. Fin tire model

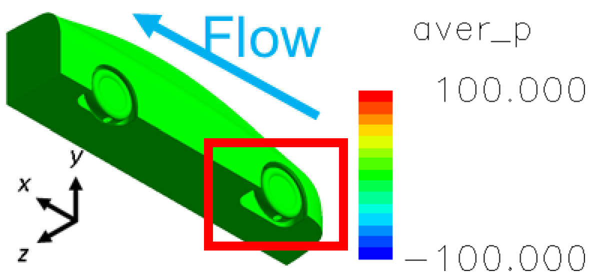
Method

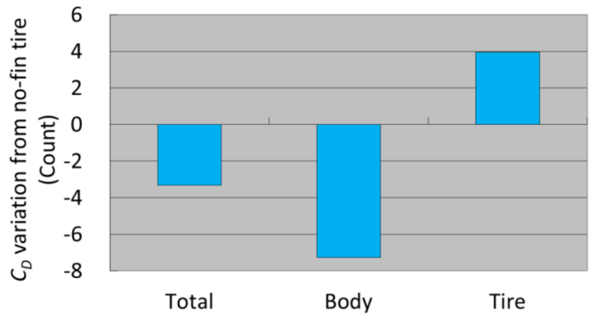
Flow solver	FrontFlow/red
Governing equation	Incompressible Navier-Stokes equations
Sub-grid scale model	Standard Smagorinsky (Constant: 0.15)
Pressure-velocity coupling	SMAC method
Time integration	Implicit Euler method
Spatial discretization	Cell-vertex finite volume method > Second-order central difference (95 %) > First-order upwind difference (5 %)

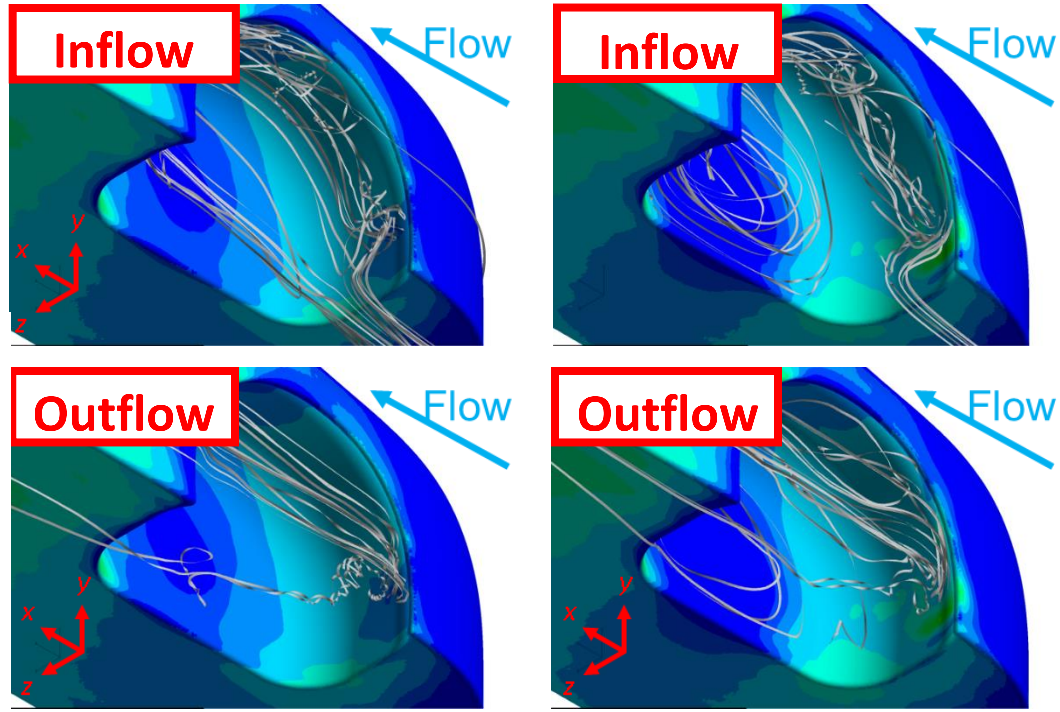


Model: Wind tunnel model
(1/4 the size of a real car)
Velocity: 20 m/s
Re= 2.1×10^5 (based on the tire diameter)

Results







No-fin   Fin

- The fins enhance the interaction between the flow along the tire rotational direction and under-floor flow
- This interaction increases the pressure acting on the front part of the wheelhouse

Thank you for your attention.

If you have any questions, please come to my poster.