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Impact of a vehicle exhaust pipe position on the lift and drag coefficients: 2D and 3D simulations

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Abstract: Optimizing vehicle aerodynamics is more effective than solely reducing engine weight and improving efficiency. The exhaust pipe ejects hot air that affects the vehicle's aerodynamics by interacting with its surroundings. Simulating a 3D vehicle model requires significant computing capabilities, so a cheaper alternative is sought. This research simulated the DrivAer model in 2D and 3D and compared results to prove the ability of 2D simulations to represent 3D models. The more cost-effective dimension was used to determine the optimal configuration for different exhaust pipe positions. The 2D simulation had a 12% discrepancy in drag coefficient compared to the 3D simulation, but required significantly fewer computational resources due to its lower number of elements (5 million less elements). The position of the exhaust pipe significantly impacts the lift force, with a possible 41% decrease in stability and 18% potential for improvement. Findings reveal that there is a higher possibility of performance setback due to the exhaust pipe position rather than improvement. The results provide a guide on which exhaust locations to avoid for optimal performance.