



Aerodynamics

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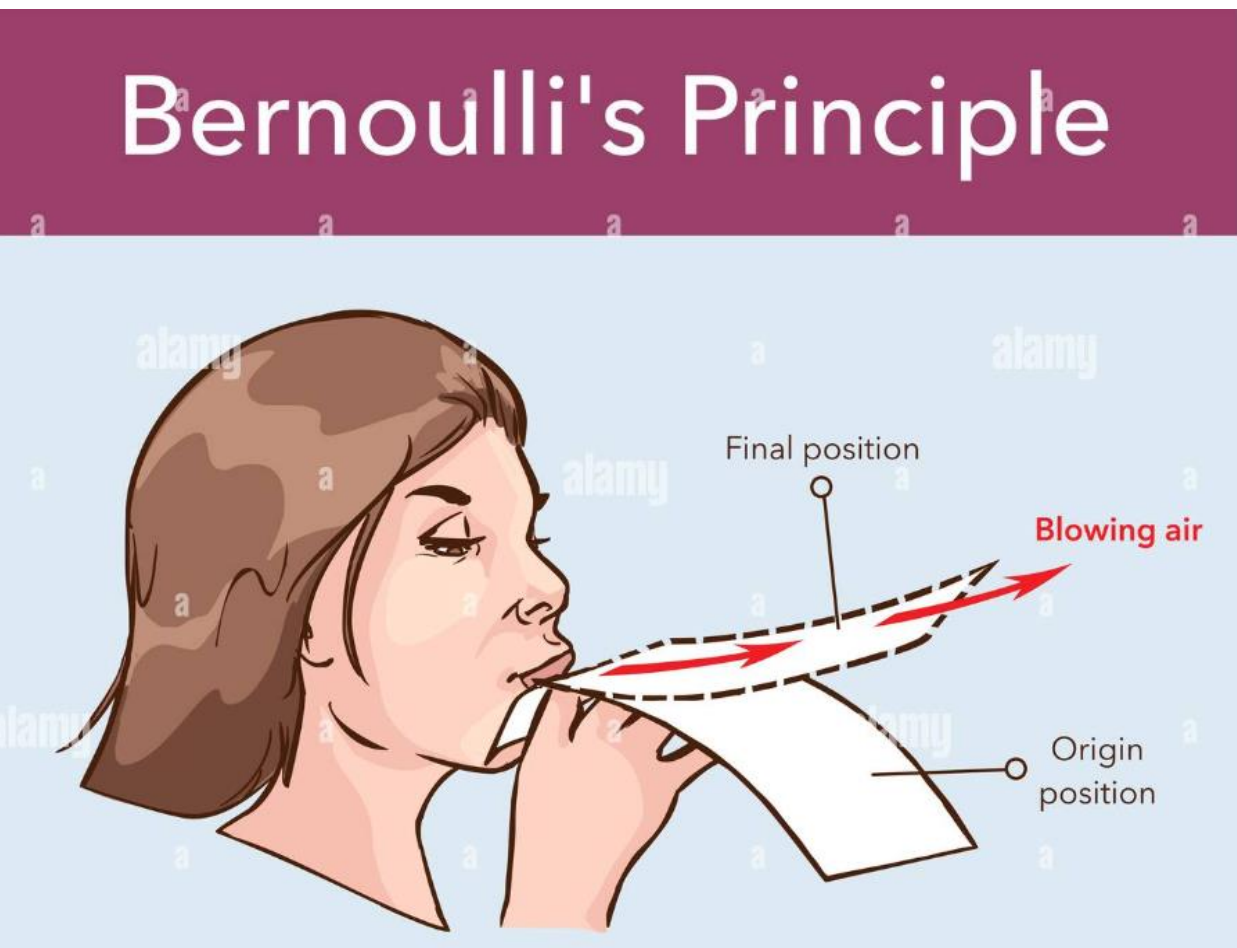
BEng Automotive Engineering

Aerodynamics is the study of how gasses, mostly air, interact with solids and primarily focuses on forces such as lift and drag.

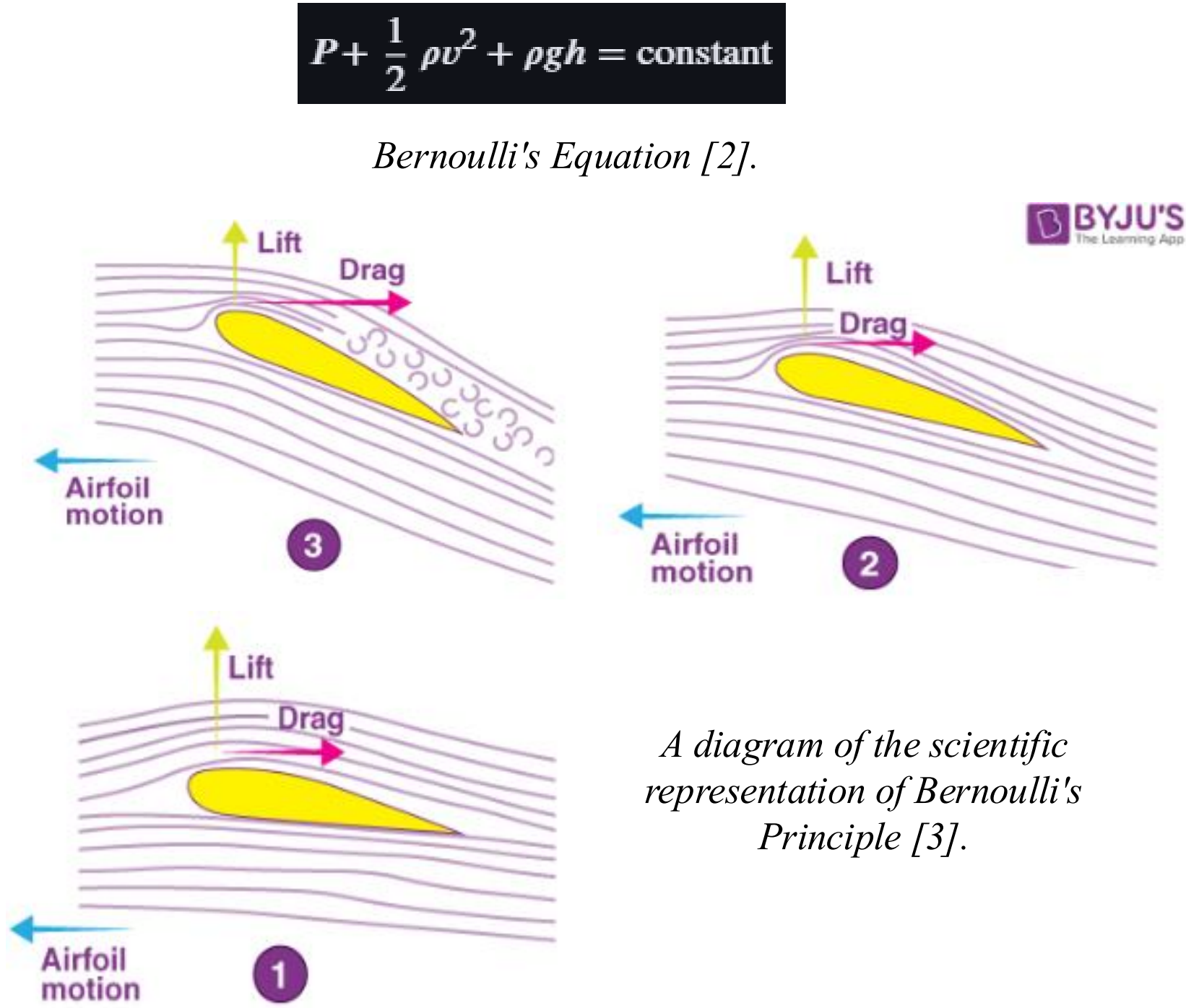
The study of aerodynamics is especially important in the space of engineering, since it is essential for cars and other motor vehicles to correctly perform, no matter if it is to be driven on a racetrack or normal roads.

Bernoulli's Principal

Bernoulli's principal states that with a steady flow of fluid whether it is liquid or gas, the velocity increase comes with a decrease of static pressure simultaneously. This happens due to the conservation of energy. Bernoulli's principal is essential in aerodynamics as this is what helps us understand how to calculate lift which is essential for planes. A prime example of this is what happens after you blow across the top of a sheet of paper, the sheet of paper will lift due to the Increase in velocity across the top and decrease in static pressure underneath, below is an image of this phenomena. [1]



The most important equation for Bernoulli's principle is Bernoulli's equation. This equation is used to calculate lift on wings, measure flow rates with venturi meters, and the pressure change in pipes.[2]



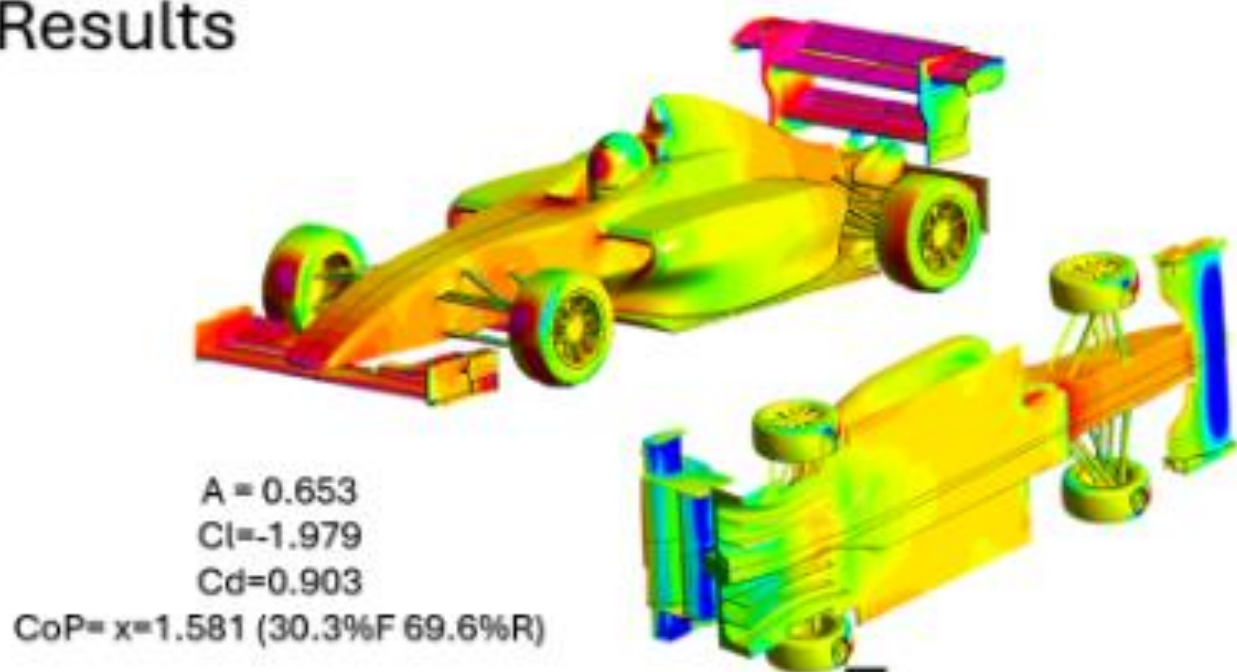
$$F_D = \frac{1}{2} \rho v^2 C_D A$$

Drag Force Equation [4]

$$L = C_L \times \frac{1}{2} \rho v^2 \times A$$

Lift Equation [5]

Results



Am image showing results from a Computational Fluid Dynamics simulation show the results of the analysis [6].



This here is a famous image where a Mercedes CLR flipped at Le Mans in 1999 [7]

Application

To apply aerodynamics, you must understand Bernoulli's Principal, as well as drag and lift and know the corresponding equations.

Drag is the force of opposition to the relative motion of an object moving through a fluid(liquid or air)[4].

Lift is a force that Is generated by a solid object when interacting with a fluid perpendicular from the direction of which the flow is coming from [5]

The diagram in [6] is a prime example of the application of these forces this shows which areas are most aerodynamic while pointing out the parts in which are not, if the this is incredibly important for if the forces hit the object. In this case a formula car in the wrong way it can go horribly wrong, once again emphasising the importance of aerodynamics.[7]

Conclusion

Bernoulli's Principle, lift and drag, are and will always be essential to how any motor vehicle Is made, it is part of the core principles to how a car can stay on the ground, the way we understand and calculate how a plane can generate enough lift to get itself into the air. Without Bernoulli's Principle there would not be any of this, which emphasizes the importance of aerodynamics and why the study of such a practice is important to engineering.

References

[1]Alamy Limited (2020). *The Bernoulli's effect on a sheet of paper*. [online] Alamy.com. Available at: <https://www.alamy.com/the-bernoullis-effect-on-a-sheet-of-paper-image341626619.html> [Accessed 19 Apr. 2026].

[3] BYJU's (2017). *Bernoulli's Principle*. [online] BYJUS. Available at: <https://byjus.com/physics/bernoullis-principle/>.

[7] Bierenkoven, C. (2021). *This Is What Makes The Mercedes CLK GTR An Absolute Beast*. [online] HotCars. Available at: <https://www.hotcars.com/mercedes-clk-gtr-absolute-beast/> [Accessed 19 Apr. 2026].

