

## ABSTRACT

Nowadays, research in the field of technology is growing rapidly. This happens because of the design capabilities from the engineers are improved alongside with the development of their simulation analysis that nearly close to reality. All these improvements are needed for the future development. This kind of improvement not only provided by the capabilities from the software but still required high competency and creativity from the engineers that to be able to produce innovation, furthermore if the innovation can be directly implemented in reality.

Inside the Department of Mechanical & Industrial Engineering in Universitas Gadjah Mada, Bimasakti FSAE team was formed to implement the technology development in a shape of formula student car. First joining FSAE competition in 2010 and already developing almost 9 years until now. Many developments have been reached by the team, especially by the aerodynamics division. This division was aimed to improve the car aerodynamic performance. By using the engineering approaches, this division developing car aerodynamic performance using numerical analysis through 3D modeling and aerodynamic simulation with computational fluid dynamics using ANSYS Fluent software. Aerodynamics devices, such as front wing was designed through that process to improve the car aerodynamic performance.

This research is aimed to find the best front wing configuration that will be applied in student formula car. For the note, this configuration must be fitted in the strict FSAE aerodynamics regulation. This research will analyze variates of front wing configuration, included the application of cascade winglets feature that will be simulated in a different angle of attack. Best configuration is achieved by front wing model that using two element cascade winglets feature and extra turning vanes at 18-degree angle of attack. This research proved that by installing the best front wing cascade winglets configuration can reduce 27% amount of drag that received by the front wheels, compared to the car that not installed this feature. This improvement is achieved with the Coefficient of lift value at -1.653 and Coefficient of drag value at 0.283.

**Keywords :** Aerodynamic, Cascade winglets , ANSYS Fluent, Front wing, FSAE, Numerical Analysis, Simulation, Race car, Coefficient of lift, Coefficient of drag.