**Drag Reduction System**

**Why a DRS System:**

To briefly summarize why the DRS would be an important improvement, we have to analyse the aerodynamic impact when racing. On one hand, downforce is extremely important to keep the car stuck to the ground and avoid slippage, especially while turning. But on the other hand, it is not possible to increase downforce without increasing drag force, what reduces acceleration in straight line. In conclusion, the car needs different requirements depending on the circuit section. The DRS allows to vary the aerodynamic forces, maintaining downforce while turning and reducing drag while driving in straight line. Reducing the drag directly effects on the car's performance on acceleration and maximum speed.

For input to DRS System, we have analysed the following 3 methods:

* Brake Pressure Sensor: According to input of BPS while taking turns, the Servo will rotate and be actuated.
* Steering Pot: According to the input of the position of steering, above a certain threshold, the Servo will be actuated.
* Manual Actuation: In this method we manually actuate the Servo according to driver’s requirement.

The best suited for us is Manual Actuation. Reasons for this are:

* Since it’s not necessary that the driver will apply brakes at every turn, hence DRS won’t be properly used in case of that.
* Since the driver moves the steering even in a straight road, its not a good measure for DRS. Also, even in case we set a threshold above which DRS will be actuated, it’s not practical since different turns will have different radius of curvature hence proper actuation won’t result.
* Manual Actuation will permit the driver to actuate the DRS according to his wishes. Whenever he feels like to actuate the DRS he can do so. For this we can incorporate a manual push button on the dash.

For Aerodynamics related study of required design implementations and structures, Research Papers are attached for their reference.

**Actuation Methods:**

When we thought about moving objects under certain forces only pressing a button, we had to think what kind of actuation fits best our requirements. The main four actuation types are:

Electric, Pneumatic, Hydraulic and Mechanic. The last two ones should be discarded due to the excessive weight. In order to decide which actuation will be chosen we are going to compare the next features: Weight, actuation speed, cost and Formula SAE regulations.

○ **Cost:** When we talk about cost, we need to consider not only all the devices,

but also, the manufacturing techniques. Electric actuators become expensive

when we look for fast motion and light weight. However, pneumatic devices

are cheaper. Nevertheless, the pneumatic actuation requires more devices,

including an electro valve, an air compressed tank and braided hose.

○ **Weight:** This feature is similar in both systems. the electric actuators are

heavier than pneumatic ones, but summing all the pneumatic components the

overall weight of the pneumatic version overcomes the electrical.

○ **Actuation Speed:** This feature is controversial. Both systems can be

extremely fast if you are willing to pay the price. While it is true that all

pneumatic systems are fast using Medium High speed, electric systems are

normally slow. Electric actuators designed for racing are necessary to be fast

enough.

○ **FSAE regulations:** The regulations are not tight in electrical devices.

However, it is hard to achieve all the pneumatic regulations, especially those

related to the air compressed. Due to the places to set the tank and how the

car is designed, the only available place was really close to the exhaust

system. The high temperatures pose a risk.