Design of a 3d printable open plenum hovercraft

Introduction

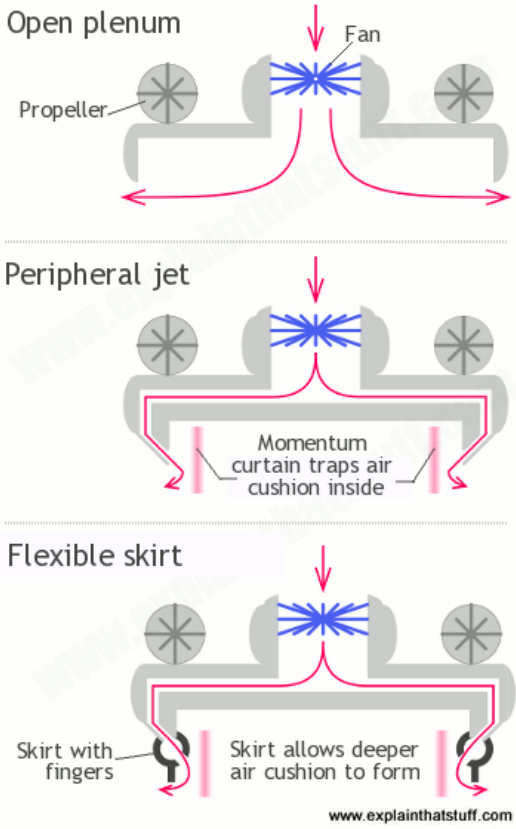
At the beginning of the history hovercraft was created for military marine vehicle. In this era of globalization, hovercraft is also used in the public transportation, travelling, agricultural, forestry, sport activities, recreational and others. The other term of hovercraft is called as “Air Cushion Vehicle” (ACV). Hovercraft can provide a better speed compared with the other marine vehicles and also an excellent performance on the different surface as well. In the hovercraft design, the vehicle is equipped with one or two engines to create the air cushion (Lift force) and to create the thrust to move to any direction.

However this design will be using three engines; two are located at the back of hovercraft for the thrust to move forward or reverse motion and steering, while the third is located at the centre of the model to create the “Lift”.The air escapes from the bottom part of hovercraft produces the hovering effect.

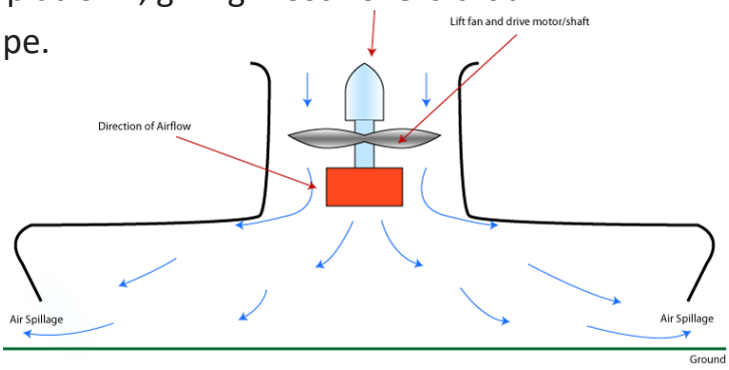
Methodology

While there are many types we will be focussing on an open plenum hovercraft.

An open plenum hovercraft is one where there is no skirt or momentum curtain to assist with the trapping of air.
It is one of the simplest forms of hovercraft to construct.



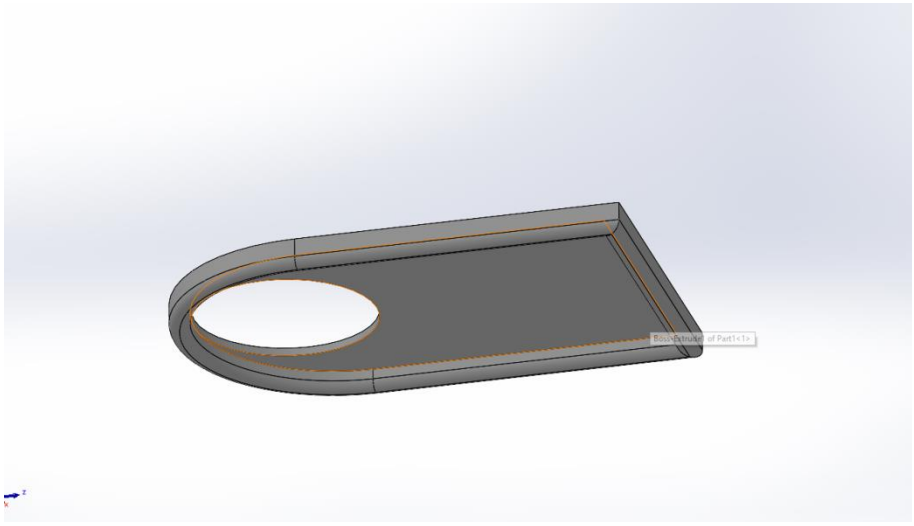
Hovercraft use blowers to produce a large volume of air below the hull, or air cushion, that is slightly above atmospheric pressure. The pressure difference between the higher pressure air below the hull and lower pressure ambient air above it produces lift, which causes the hull to float above the running surface. For stability reasons, the air is typically blown through slots or holes around the outside of a disk- or oval-shaped platform, giving most hovercraft a characteristic rounded-rectangle shape.

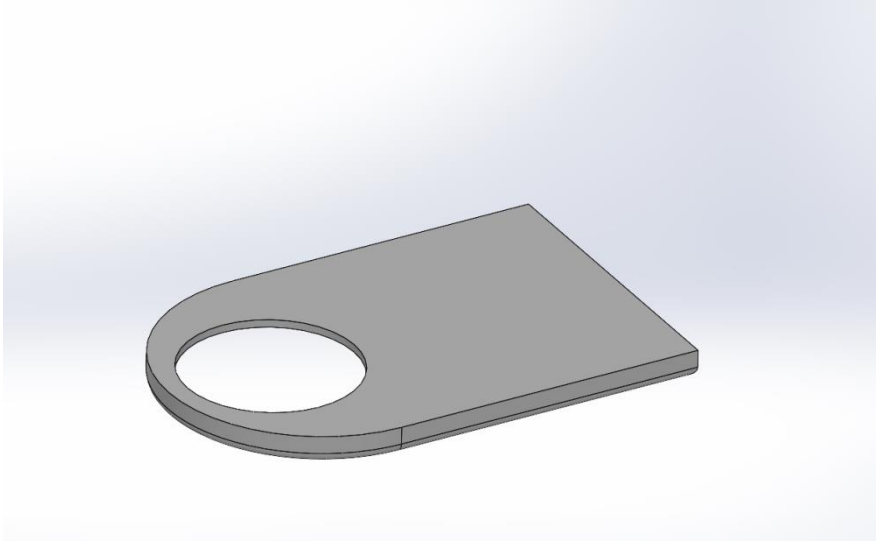


Basic Principles of the Hovercraft:
Open plenum, no Momentum Curtain effect

Design of the hull

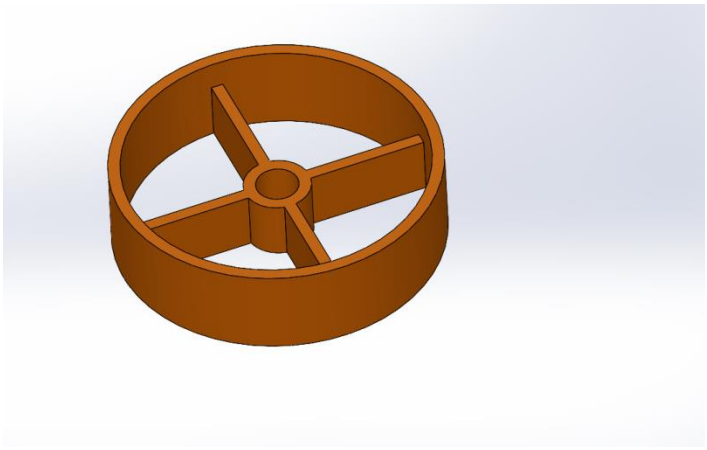
Since we will be using **an open plenum** design the hull of the hovercraft will be such that it effectively channel air into the plenum chamber.

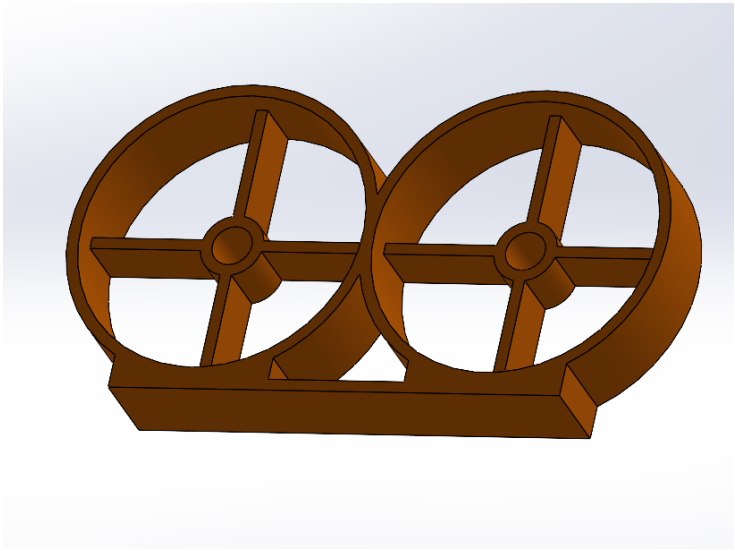


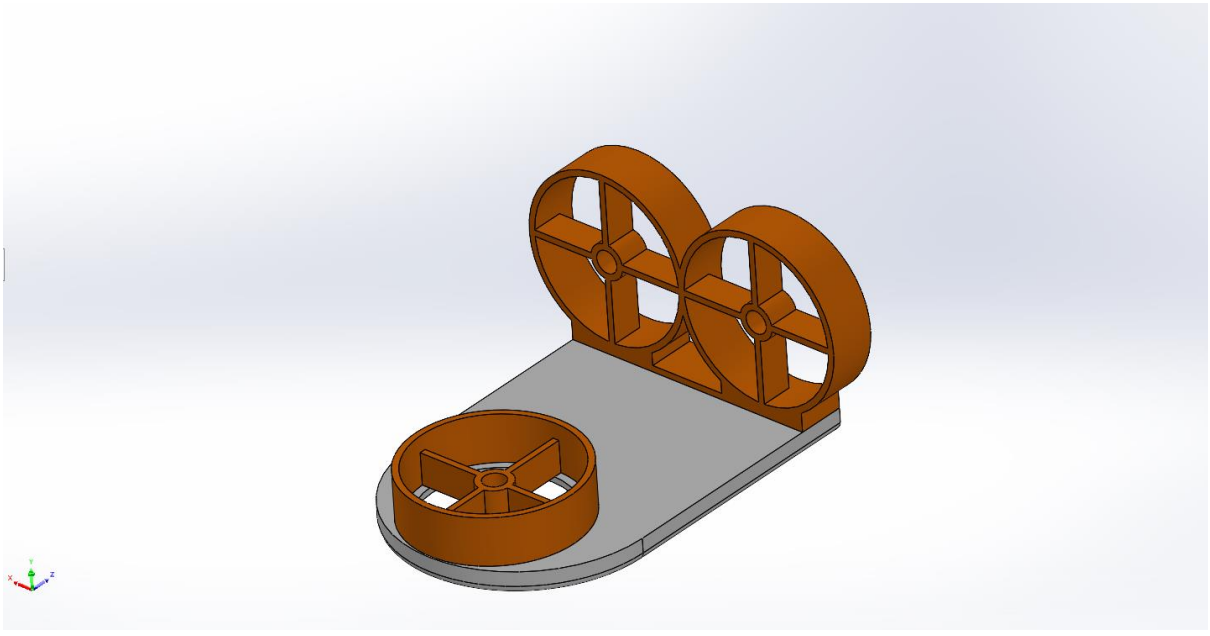


Design of the body to support the motor, house the battery and electronics.

Since the propellers will be rotating at a high rpm it is necessary to ensure they are appropriately covered. For this we will be using cylindrical propeller guards which will also act as mounts for the motors.







Motors, propellers and electronics to control the Lift , Thrust and Steering

Here we will be using 20000rpm, 3.7V coreless brushed dc motors along with 45mm propellers for all applications(lift and thrust). These motors provide about 25-30 g of thrust and we will be using one for lift and two for thrust and steering.

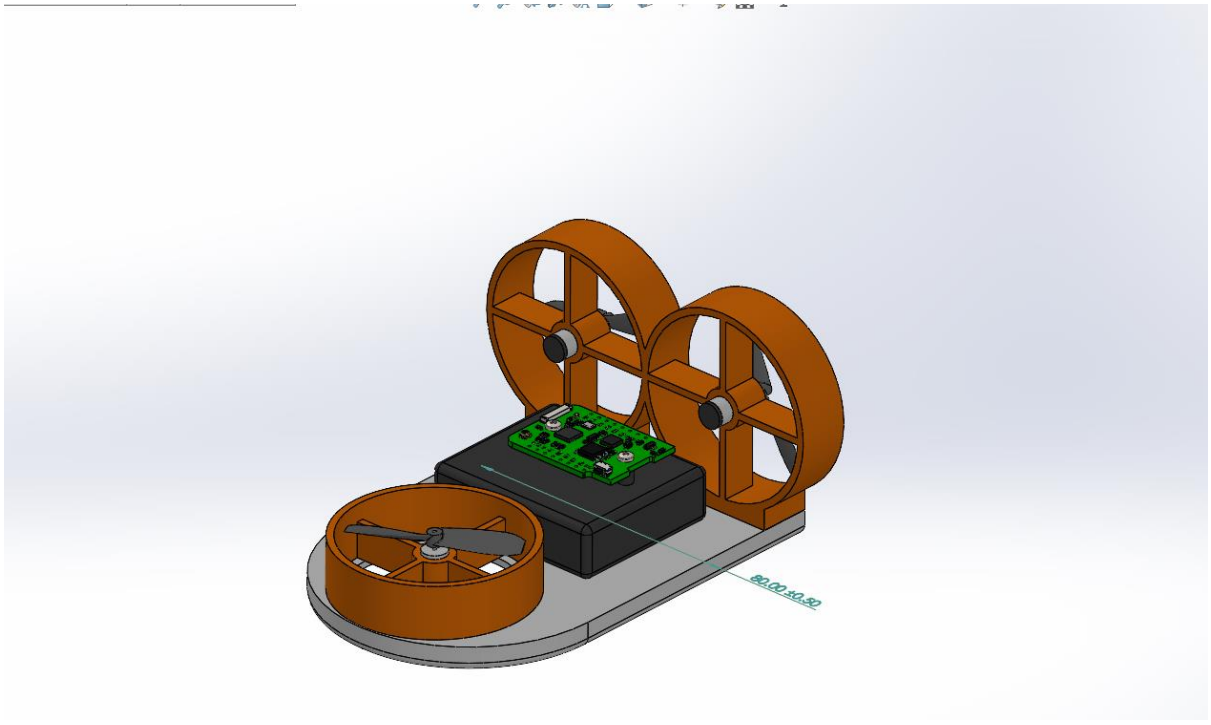
For lift a single motor blows air down into the plenum chamber and creates an air cushion.

For thrust the two motors act in unison and can propel the craft forward and backward.

For the steering we use differential thrust i.e the thrust from the motors will be unequal resulting in generation of torque.

For the wireless control we will be using a integrated 2 channel radio receiver and motor driver.

Image of assembled cad model



3D printing and assembly of hovercraft

- The parts were printed using fused deposition modelling and using ABS(**acrylonitrile butadiene styrene**). The infill density was 100 % and infill pattern was grid. The layer height used was 0.3mm. Grid infill was used as it contains two-dimensional lines every layer, with twice as much space in between lines. This infill pattern provides two-dimensional strength/rigidity and is somewhat strong. The grid pattern consumes an average amount of material and takes middling time to complete.