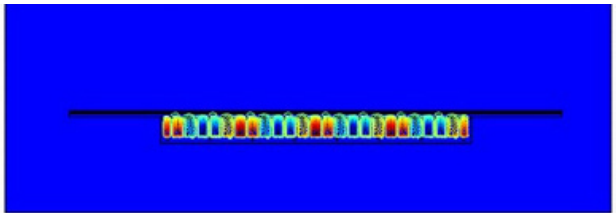
20th Nov, 2023

HYPED
HYPERLOOP EDINBURGH

SIMULATIONS TEAM

Introducing the Simulations Team, responsible for simulating the propulsion system, mechanical system, and the chassis of the hyperloop pod. COMSOL Multiphysics is a finite element analysis, solver and simulation software for a lot of physics and engineering simulation such as Electromagnetics, Fluid Mechanics and much more! They are one of our proud sponsors and one of the main software used for simulations in HYPED.



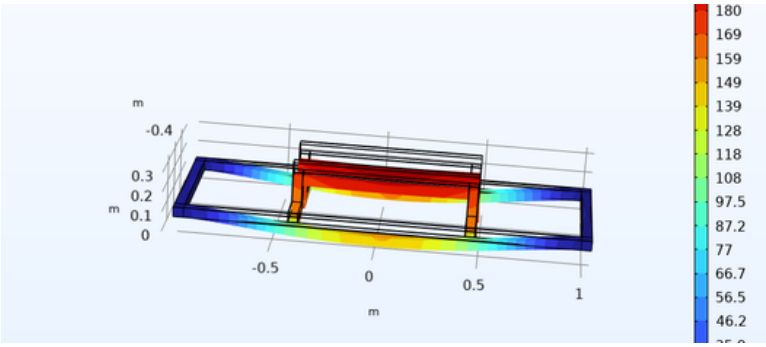
The simulation of the Linear Induction Motor. Fine lines showing the electromagnetic properties of the motor.

Propulsion

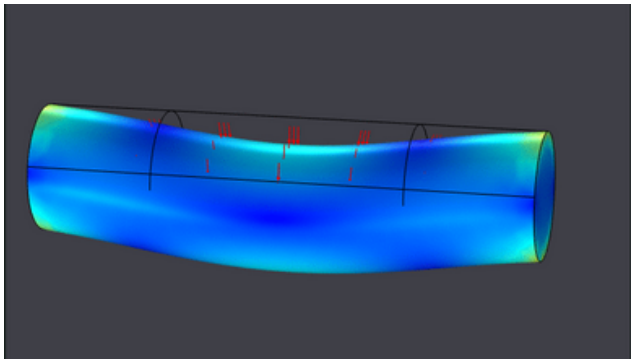
LIM is short for Linear Induction Motor. Designed and built by the Propulsion Team and acts as the engine of the pod. Using input values specified by the Propulsion Team, electromagnetic behaviour of the motor is simulated. The results include phase current, phase voltage, and thrust force. The former two are important to ensure that the design is safe and that the chosen materials are rated for those values. Thrust force helps us see how powerful the LIM is and by varying the input velocity and frequency. We can optimise the LIM by handing the results back to Propulsion who tweak their designs as necessary.

Dynamics

Braking system is one of the most vital parts of any moving vehicle, thus it requires extensive research and effort to ensure it is working perfectly! A non-functioning braking system would risk a fatal accident. The hyperloop braking system is designed by Dynamics Team and they run their own simulations on it before passing to Simulations for more dynamically complex scenarios. Multiple aspects of the design are tested, such as deformation, stress, and heat transfer. Thanks to COMSOL's wide choice of materials, exact materials are used in the simulation process to get as accurate result as possible. Designs could also be tested in free air, tunnel, and in vacuum conditions. These tests are important not only to ensure the functionality of the design, but also to check the durability and reliability of the chosen materials.



The simulation of the chassis. Colour contour showing the magnitude of the displacement of the structure.



The simulation of stress on specific material with specific dimension.

Static

The chassis is the skeleton of the pod, holding and connecting all its components together. It is important to have a strong and lightweight chassis to support everything without adding unnecessary weight. The same applies to the outer shell of the pod which needs to be aerodynamically efficient while protecting all the parts inside. The key factor is the optimal material and structure! Besides the chassis and shell, the team is also responsible for the simulation of the tracks. Hyperloop is based on the concept of levitation. What will happen to the track if the pod falls? How much damage would it cause? Can we build a track that could support such incident? How do we get the answers? By simulating them!

To sum it all up, simulations team is a vital element in the technical team in order to determine if a design is feasible. There may be some important small details that may be overlooked during the design process. Manufacturing the items without simulating them will definitely set the society back financially. Finally, after confirming that the design is working, parameters will be optimised and ready to be manufactured!