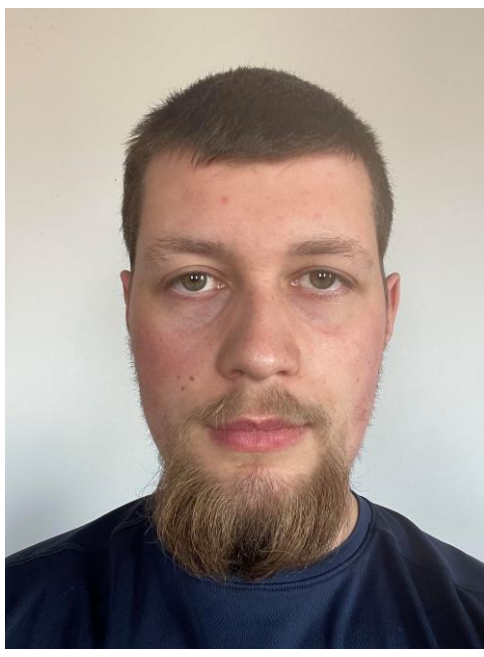




Computational Simulation in Motorcycle Industry

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Introduction

Computational Simulation technologies are used in the motorcycle industry, as well as the wider world of motorsport and automotive engineering. It essentially uses mathematic equations many times over on a virtual platform to aid in design, testing and manufacture. Manufacturers will use Computational Simulation to evaluate and develop designs and produce the final product, and it is used in motorsport to a similar effect except for smaller runs of high-performance components.

Key Concepts

The main components of Computational Simulation are Computer Aided Design, Computer Aided Engineering and Computer Aided Manufacturing (CAD/CAE/CAM).

Different models are used for simulating different things: Finite Element Analysis (FEA) is used for solid objects, and Computational Fluid Dynamics (CFD) is used for fluids, such as liquids or airflow (Neural Concept).

In their study Dai, Chen *et al.* (2024) utilize FEA technology to analyze and optimize a design for an electric motorcycle frame. Figures 1, 2 & 3 show their model and the results of the analysis. The model predicted areas subjected to the most stress and compared this with the model and estimated strengths to calculate the weakest part of the frame.

In a similar study Om Raj, Tharakaram *et al.* (2022) use CFD Analysis to study a rear wing they designed for a Formula style car. Figure 4 shows the result of air pressures around the wing, allowing them to optimise the shape.

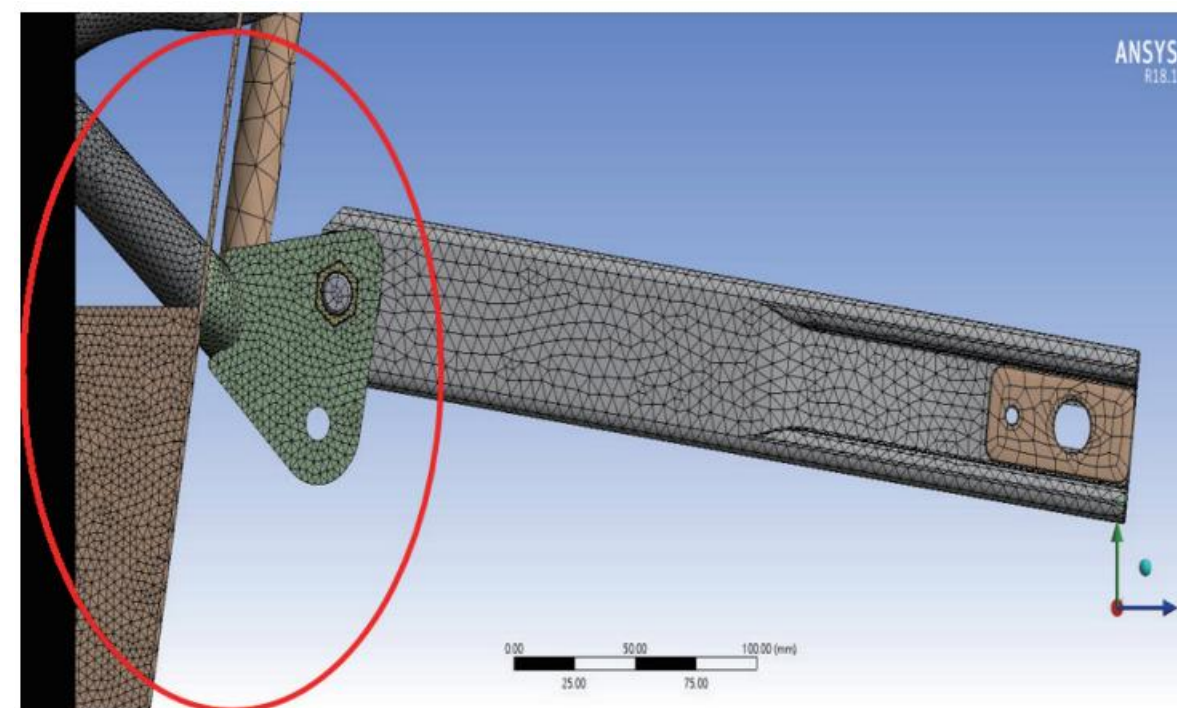


Figure 1 - Mesh model of Swinging Arm on an Electric Motorcycle (Dai, Chen *et al.* 2024)

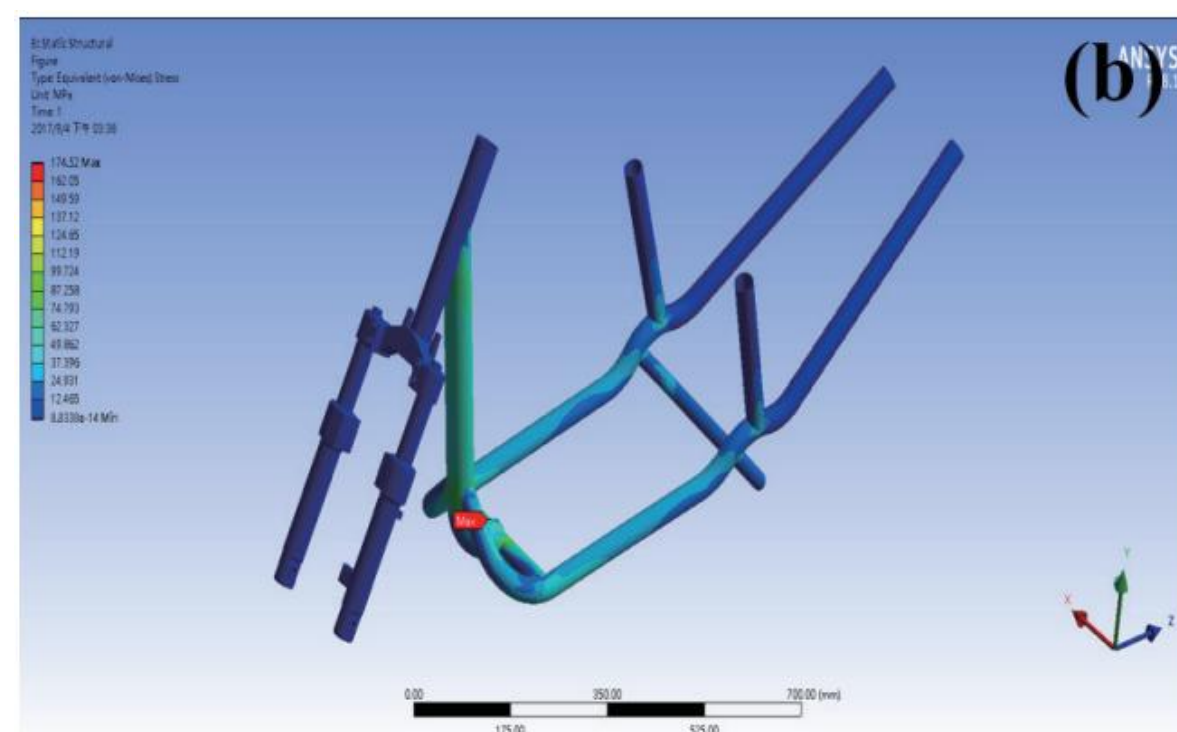


Figure 2 – Stress analysis of left and right bending moments on Motorcycle Frame (Dai, Chen *et al.* 2024)

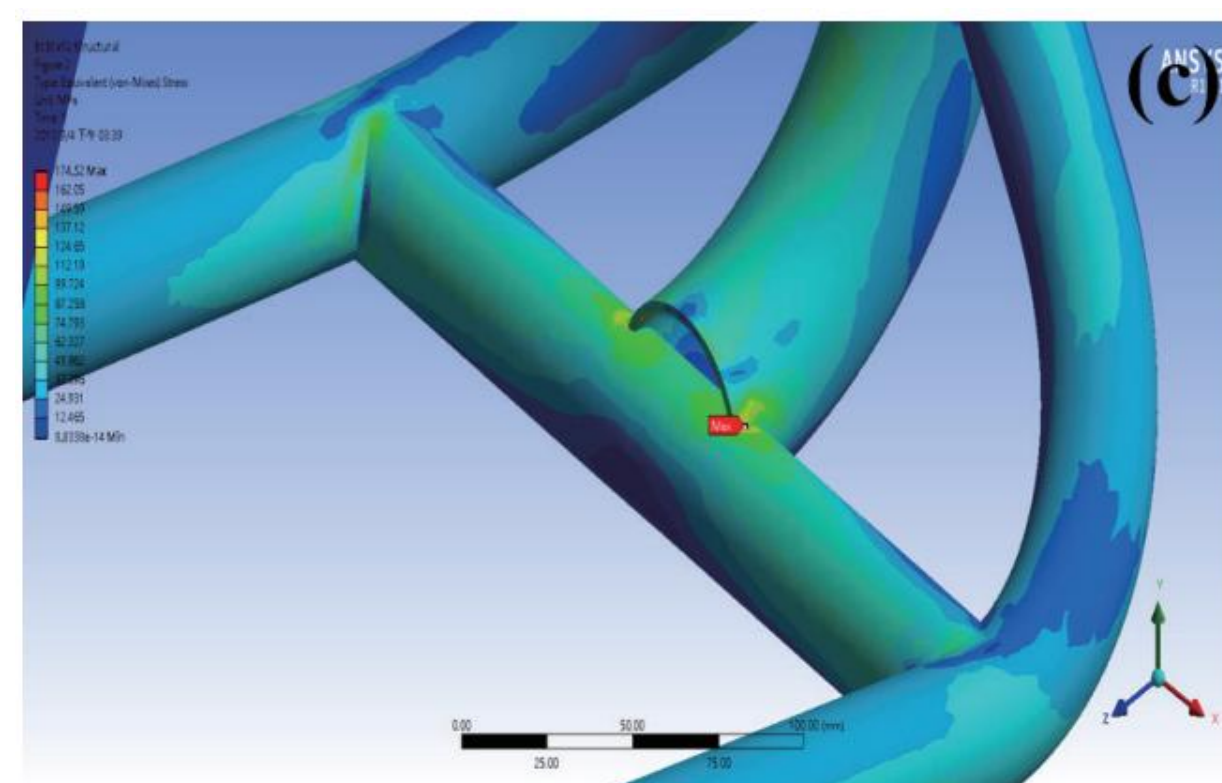


Figure 3 – Weakest point on Motorcycle Frame illustrated by FEA process (Dai, Chen *et al.* 2024)

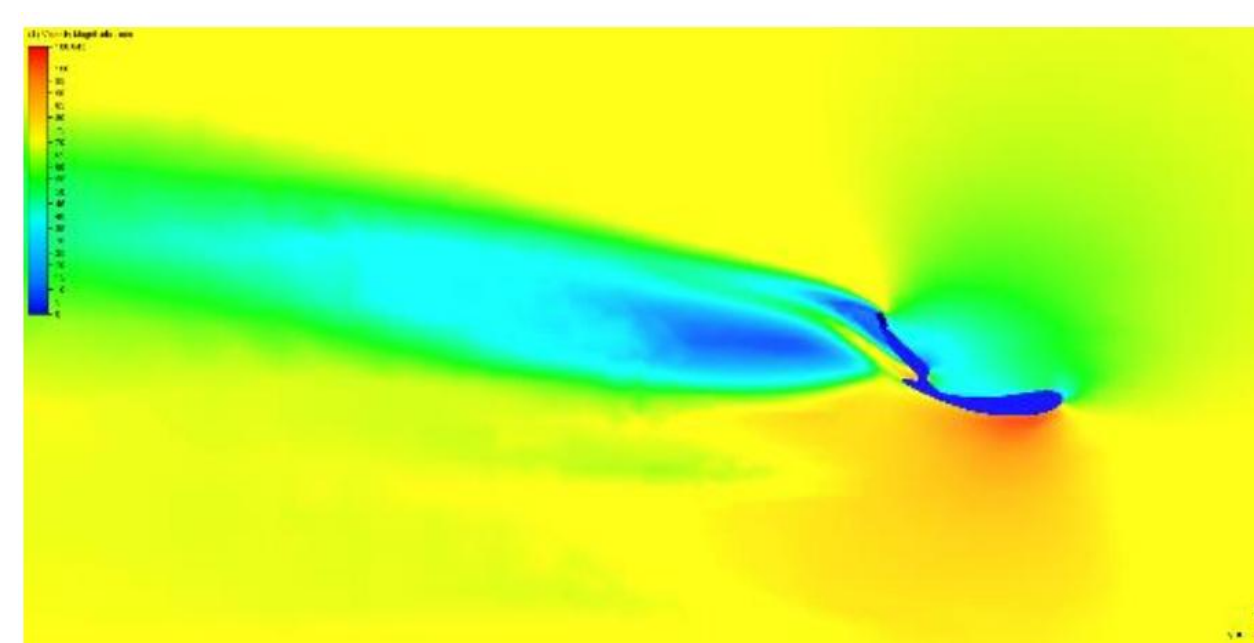


Figure 4 – CFD Analysis of a Rear Wing in air (Om Raj, Tharakaram *et al.* 2022)

Innovations and Applications

As modern computing technology advances, so does the capacity for Computational Simulation. Running simulations uses an enormous amount of computing power and can take a lot of time and energy.

Advancements in the computing power available to engineers mean that simulations can be run faster, and more complex simulations can be run. The more complex the simulation the more accurate it becomes (Dai, Chen *et al.* 2024).

In terms of motorcycles, simulation of the whole system has been a challenge for a while. Unlike 4-wheeled vehicles there are many more rider inputs than just throttle, brake, clutch and steering which become very difficult to measure and model. More people are starting to research simulators that work with all these inputs and conditions, which will allow manufacturers for both road and racing applications to test the whole motorcycle package with a Rider In Loop (Arioui, Nehaoua *et al.* 2010).

Conclusions

Tools such as FEA processes and CFD analysis have become useful tools for modern engineering. They are used to develop items such as:

- Engine parts and assemblies
- Chassis components
- Aerodynamic packages

They can be used to speed up design and testing processes and reduce costs, which are essential points for modern engineers.

References

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