The 2025 Simulator is in early stages since the car is still being manufactured.

Below is a presentation outlining the brainstorming stage and overarching goals of the project.

Formula Student

International engineering competition requiring students to **design**, **manufacture** and **race** vehicles.

Driver Preparation

For the autocross event, drivers only get

two attempts, without practice

to produce a best, single-lap time

Objectives

Assist in **preparing drivers** for tracks they **have not driven**

Evolve the presentation of Monash Motorsport at public events and **improve engagement**

Explore **unconventional avenues** for concept generation with driver-in-the-loop feedback

Manufacturing

Built from the 2013 chassis to provide the **closest experience** to driving the real car, with peripherals from **Fanatec**

Live for Speed (2003)

Assetto Corsa (2014)

Track Rendering

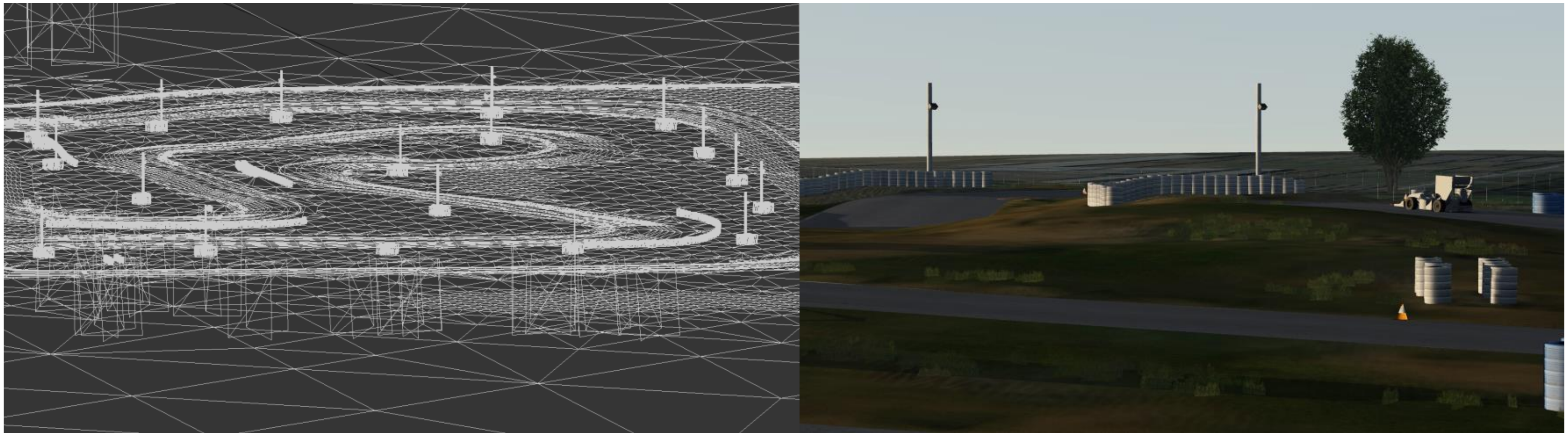
We can **create our own content** for Assetto Corsa and learn track layouts, including ones that we **haven’t driven in the real car.**

Oakleigh Go-Kart Club

Gloria Pyke Netball Courts

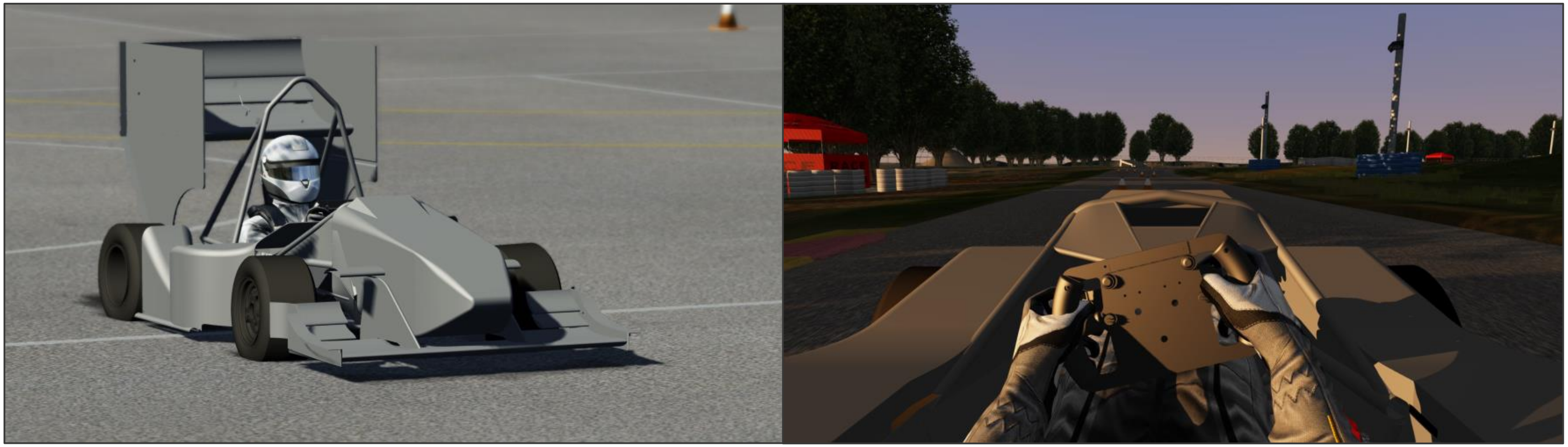
Track Render Generation

1. Use Google data for location
2. Draw environment/track in software
3. Run optimisation where necessary
4. Import into game



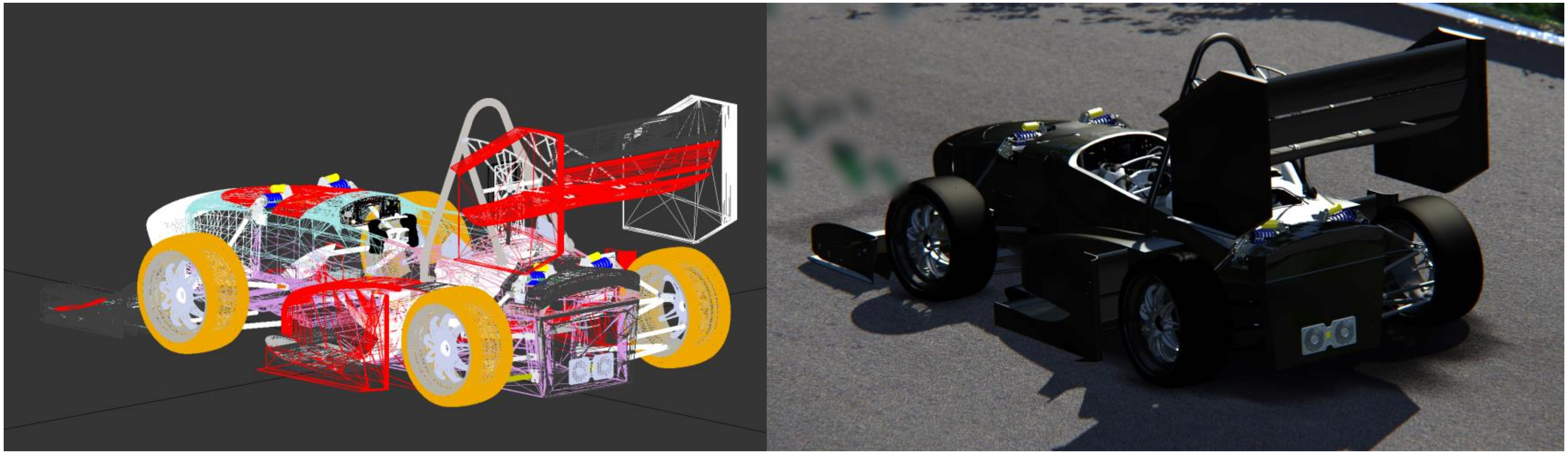
Car Rendering

We can **import any CAD model** and get a drivers perspective on **any rendered track.**



Car Render Generation

1. Start with CAD model
2. Remove small features such as a fasteners
3. Convert CAD to mesh, use optimisation techniques to reduce vertices
4. Apply textures and import into game

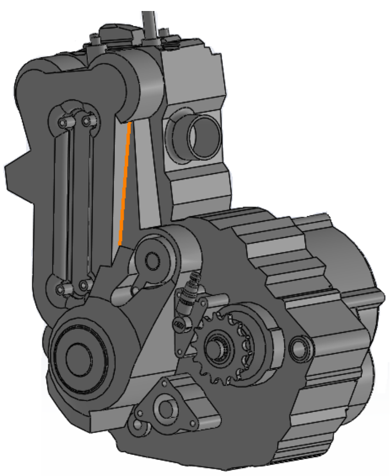


Optimising – Mesh Decimation

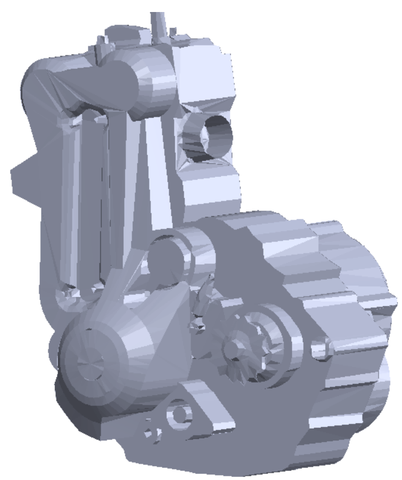
2017 CAD model with **~5,000,000 vertices** needs to be reduced to

4.76%

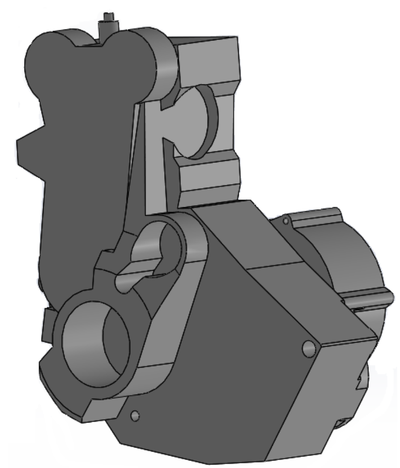
Of its **original size**



~18,000 Vertices
(**1.8mb** file)



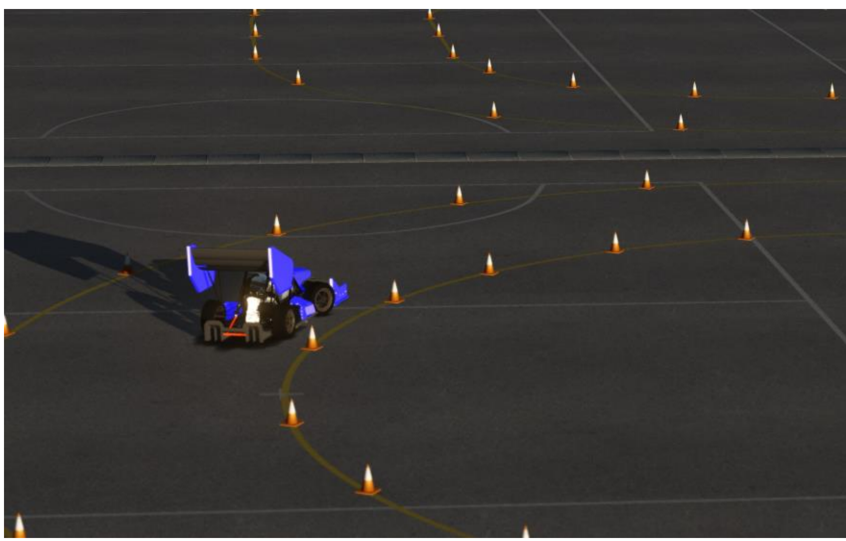
~2,500 Vertices (3dsMax)
(**0.27mb** file)

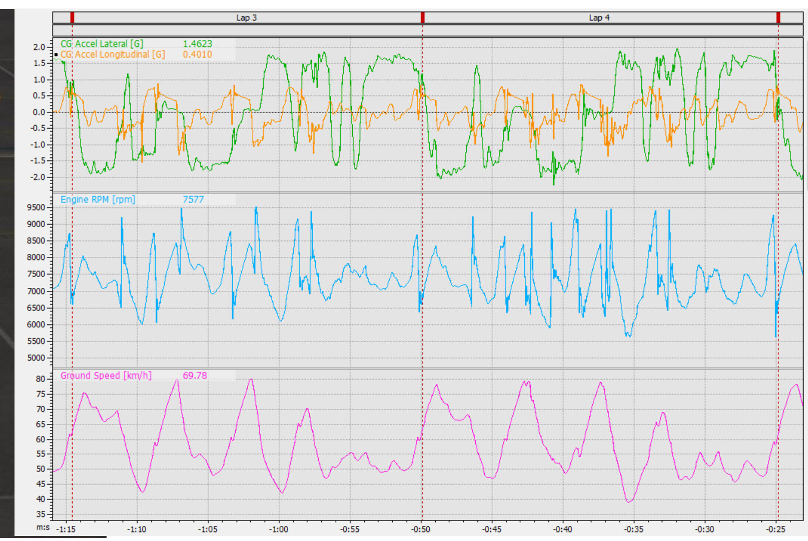


~2,500 Vertices (SolidWorks)
(0.27mb file)

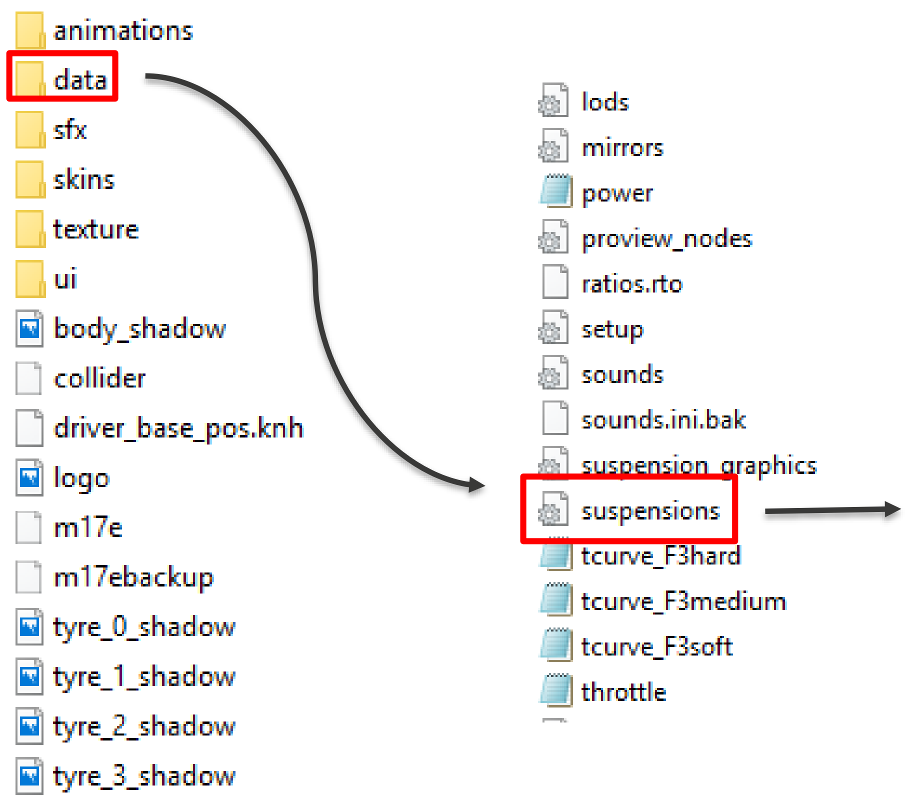
Physics Modelling

We can simulate driving a **real track** in an **approximately calibrated model,** and **estimate** fundamental vehicle characteristics such as **gear position** and **lateral acceleration** for **undriven tracks**.





Physics Modelling - Files

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WBCAR_BOTTOM_REAR=0.415, -0.134, 0.110
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Physics Modelling - Conversion

Converts the geometry from NX Mastermodel coordinates to the values required for Assetto Corsa

For wishbone geometry of one side of the car (either side):

Enter wishbone points at outboard and to chassis in the orange text box

Enter coordinates of midpoint between front wheel centres & rear wheel centres in pink text boxes

FLF - Front Lower Fore
FUF - Front Upper Fore
FLA- Front Lower Aft
FUA - Front Upper Aft

RLF - Rear Lower Fore
RUF - Rear Upper Fore
RLA- Rear Lower Aft
RUA - Rear Upper Aft

FL - Front Lower
FU - Front Upper
RL - Rear Lower

Geometry

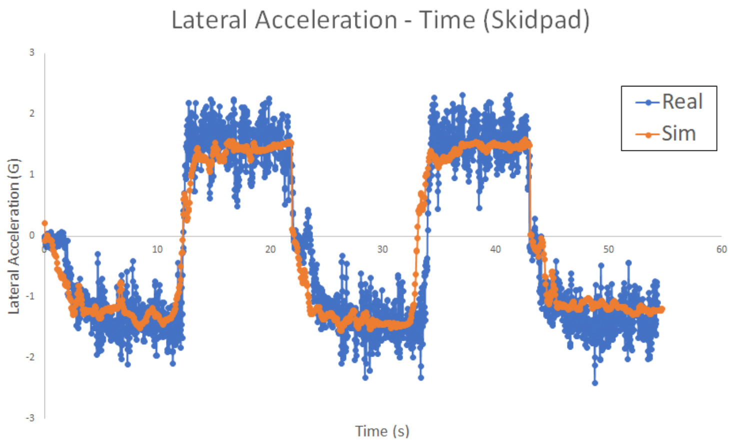
Car_Origin = Centre of front contact patches			
	0	**0**	**0**
Chassis Points	X	Y	Z
FLF			
FUF			
FLA			
FUA			
Front Shock			
RLF			
RUF			
RLA			
RUA			
Rear Shock			
Steering Link			
Rear Toe Link			
Outboard Points	X	Y	Z
FL			
FU			
Front Shock			
RL			
RU			
Rear Shock			
Steering Link			
Rear Toe Link			
Pashck	X	Y	Z
Front Tyre Contact Patch			
Rear Tyre Contact Patch			

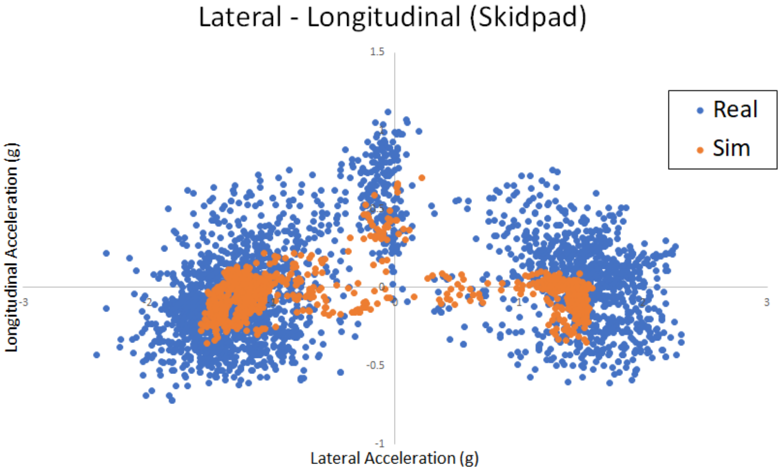
Car_Origin = Centre of Wheel (Front)			
RHS			
Chassis Points	X	Y	Z
FLF	0	0	0
FUF	0	0	0
FLA	0	0	0
FUA	0	0	0
Front Shock	0	0	0
RLF	0	0	0
RUF	0	0	0
RLA	0	0	0
RUA	0	0	0
Rear Shock	0	0	0
Steering Link	0	0	0
Rear Toe Link	0	0	0
Outboard Points	X	Y	Z
FL	0	0	0
FU	0	0	0
Front Shock	0	0	0
RL	0	0	0
RU	0	0	0
Rear Shock	0	0	0
Steering Link	0	0	0
Rear Toe Link	0	0	0
Pashck	X	Y	Z
Front Tyre Contact Patch	0	0	0
Rear Tyre Contact Patch	0	0	0

Car_Origin = Centre of Wheel (Rear)			
RHS			
Chassis Points	X	Y	Z
FLF	0	0	0
FUF	0	0	0
FLA	0	0	0
FUA	0	0	0
Front Shock	0	0	0
RLF	0	0	0
RUF	0	0	0
RLA	0	0	0
RUA	0	0	0
Rear Shock	0	0	0
Steering Link	0	0	0
Rear Toe Link	0	0	0
Outboard Points	X	Y	Z
FL	0	0	0
FU	0	0	0
Front Shock	0	0	0
RL	0	0	0
RU	0	0	0
Rear Shock	0	0	0
Steering Link	0	0	0
Rear Toe Link	0	0	0
Pashck	X	Y	Z
Front Tyre Contact Patch	0	0	0
Rear Tyre Contact Patch	0	0	0

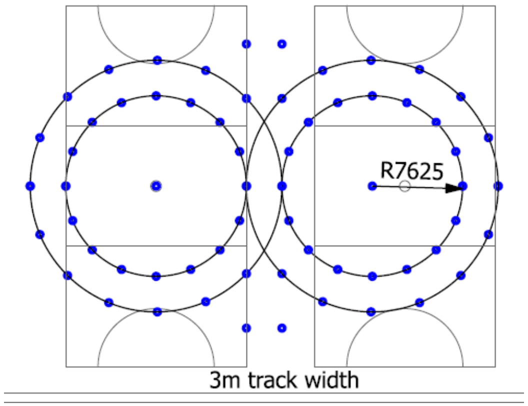
Car_Origin = Corrected for Assetto Corsa				
		-Y	**Z**	**-X**
Chassis Points	AC_Code	X	Y	Z
FLF	WBCAR_BOTTOM_REAR	0	0	0
FUF	WBCAR_TOP_REAR	0	0	0
FLA	WBCAR_BOTTOM_FRONT	0	0	0
FUA	WBCAR_TOP_FRONT	0	0	0
Front Shock		0	0	0
RLF	WBCAR_BOTTOM_REAR	0	0	0
RUF	WBCAR_TOP_REAR	0	0	0
RLA	WBCAR_BOTTOM_FRONT	0	0	0
RUA	WBCAR_TOP_FRONT	0	0	0
Rear Shock		0	0	0
Steering Link Front	WBCAR_STEER	0	0	0
Rear Toe Link Front				
Outboard Points				
FL	WBTYRE_BOTTOM	0	0	0
FU	WBTYRE_TOP	0	0	0
Front Shock		0	0	0
RL	WBTYRE_BOTTOM	0	0	0
RU	WBTYRE_TOP	0	0	0
Rear Shock		0	0	0
Steering Link	WBTYRE_STEER	0	0	0
Rear Toe Link				
Pashck				
Front Tyre Contact Patch				
Rear Tyre Contact Patch				

Physics Modelling - Calibration





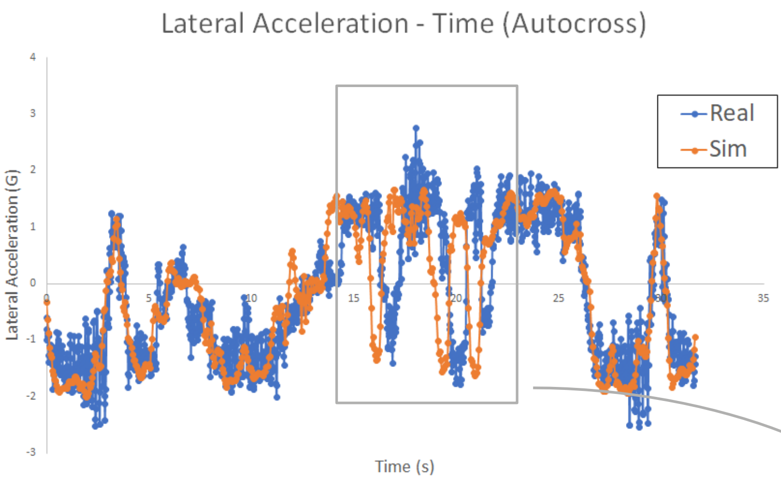
Skidpad

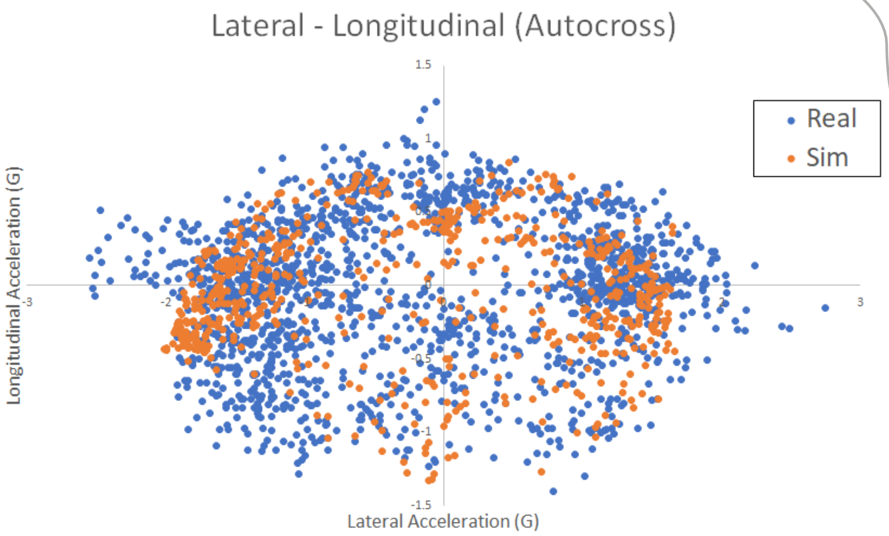


Lateral acceleration gives a good representation of **real car**

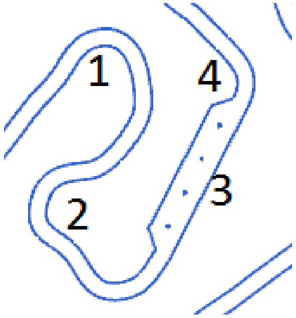
Longitudinal acceleration shows **less** similarity

Calibration





Autocross

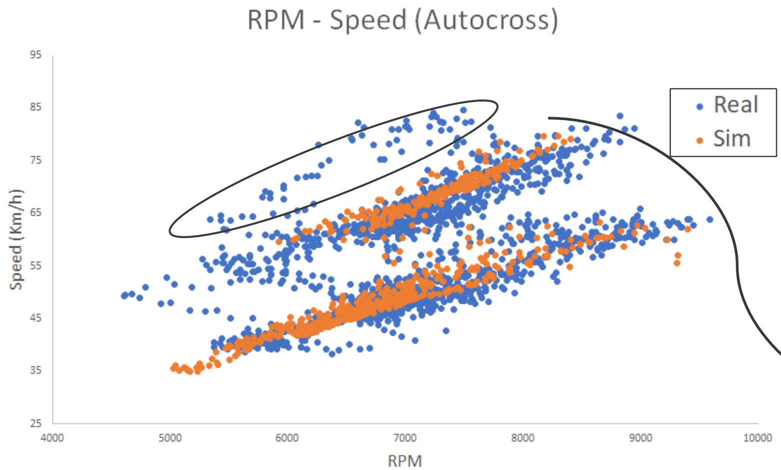


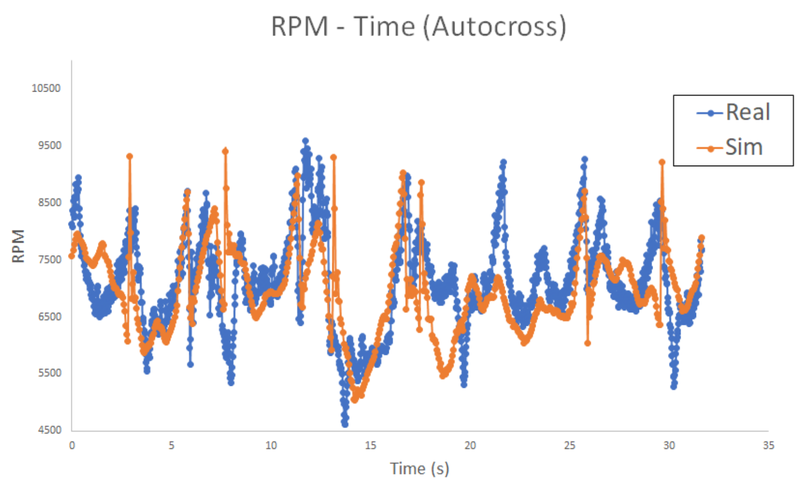
Lateral acceleration gives a good representation of real car

Most likely due to **mismatched** cone layout

longitudinal acceleration **not as accurate** as lateral acceleration

Calibration





Autocross

~26 second lap

Good indicator of gear position for a lap

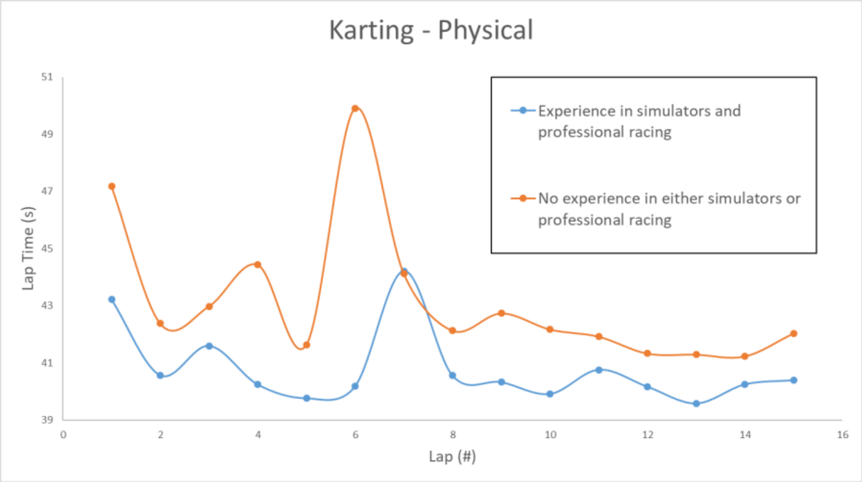
Potentially clutch or short 4th gear period

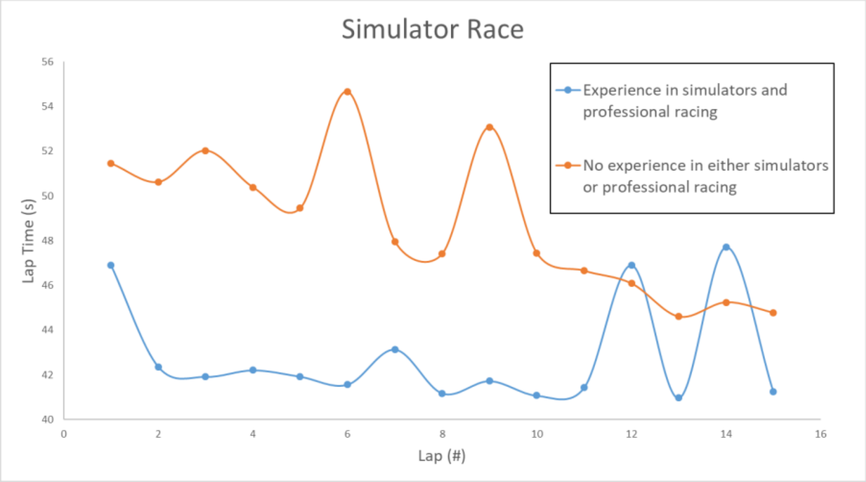
Again longitudinal not as accurate as lateral

Correlation – Team Karting Day

Compare lap times between a **physical karting session**, and a **simulated session** with a similar lap and vehicle for drivers of varying experience.

Correlation



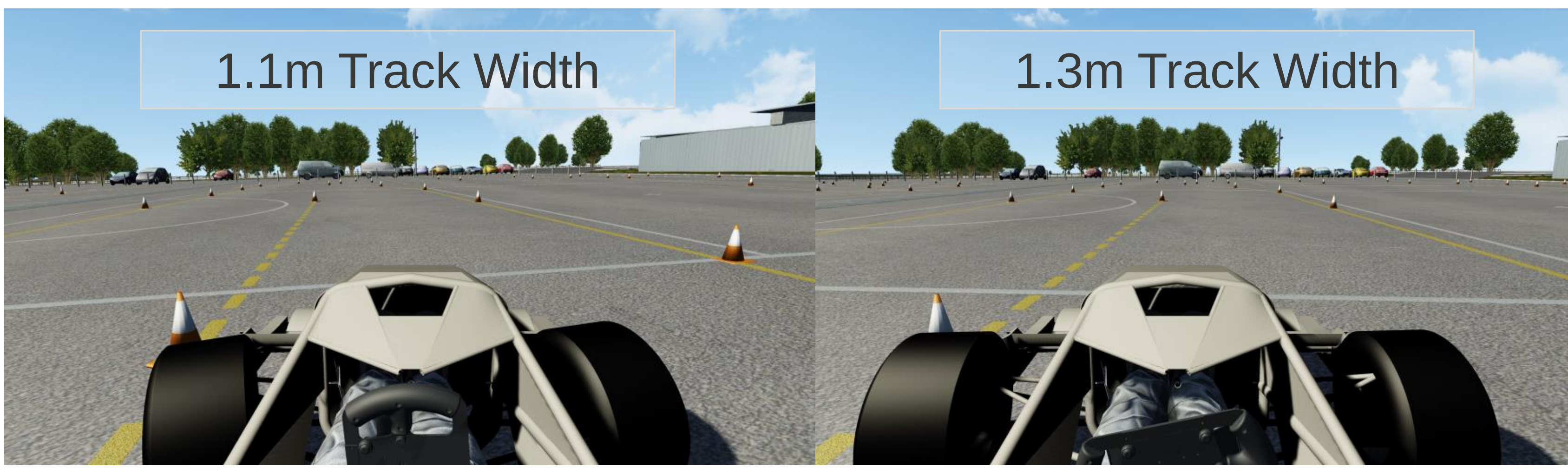


The **fastest times** at both the karting and driving simulation tests were by the **same person** who had significant experience in both

It shows the **importance of training drivers** to extract the most potential out of a **driving simulator**

Assisting Concept Level Design

Any physical parameters can be changed **instantly**, introducing the idea of driving simulators **aiding concept generation**

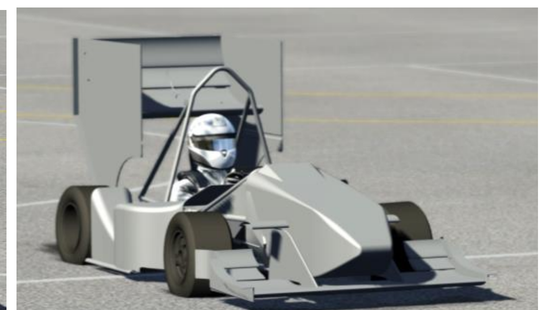


Collaboration

These teams **expressed interest** in the project and **shared content** to assist in developing driving simulators in Formula Student

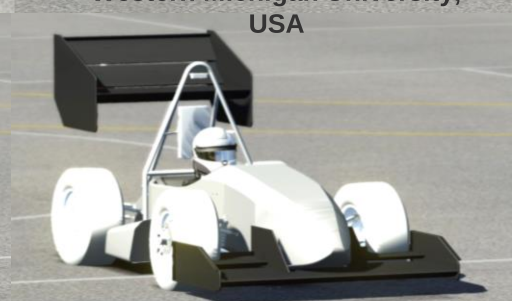
NTNU Trondheim, Norway

Western Michigan University, USA



Monash University (2017)

University of Cantebury, New Zealand

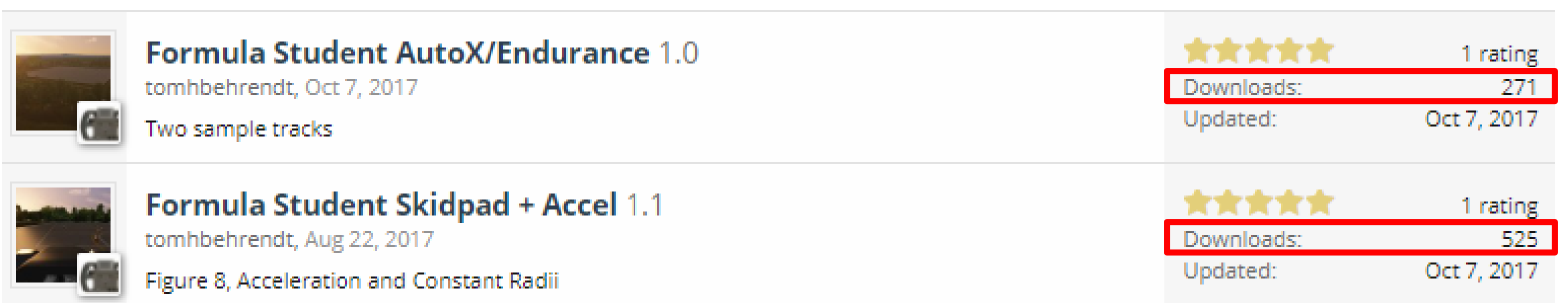


RMIT University, Australia

Monash University (2012)

Collaboration

Basic content was **released publicly** to invite other teams to use driving simulators and **begin creating their own vehicles models**



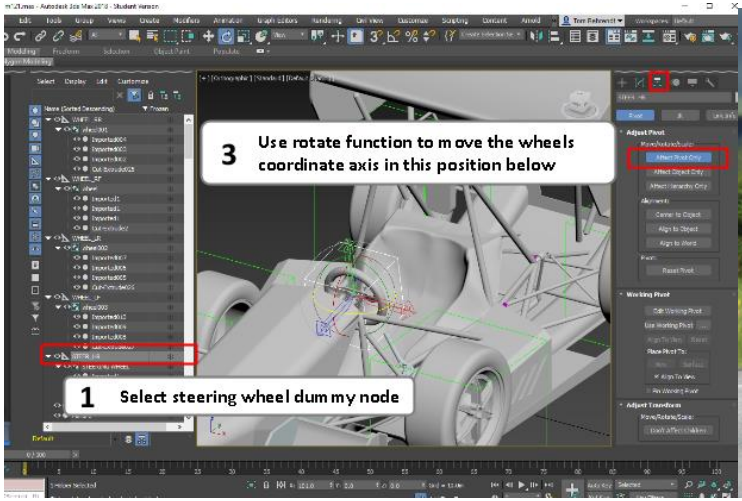
Marketing

The simulator was displayed with Monash Motorsport at various events including the **Australian Gran Prix**, **Sandown 500** and the **Melbourne Technology and Gadget Expo**

We were the first team **in Australia** to **publicly display a virtual reality driving simulator** made from an FSAE chassis.

Conclusions

We can now prepare drivers for competition by **creating the environment** as well as **track layout** to assist in memorisation. Drivers can also drive the competition track with an approximate vehicle model, providing estimates of both **speed** and **gear position**.



Questions