Vehicle Dynamics

Week 4 - GG Plot

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Agenda

Agenda:

- Sim Racing Series
- Driver Development
- Mock Engineering Challenge
- Coding Projects
- Teaching Session: GG Plot

General updates:

- Fill out team survey and register (in *#announcements*)
- Suspension teaching session this week

Sim Racing Series

The Sim Racing Series is a yearly sim racing challenge using Assetto Corsa.

- 6 rounds, beginning in November
- Practice server opens before race
- Tune the setup of the car
- Set the fastest laptime possible
- Finals held at Williams in July
- *More info on the IMechE website*

Charlie Spence will be leading it this year. Intro meeting at 6pm on Tuesday 21st October on Discord.

Driver Development

8 drivers have been selected for this season. We will be running driver development sessions with them.

I'd like to start training people as race engineers:

- Monitor our drivers' performance
- Analyse data using Race Studio
- Identify issues with the vehicle or driving style
- Gather feedback on vehicle handling

I'll hopefully organise some teaching sessions on using software and analysing data.

Mock Engineering Challenge

The Engineering Challenge is a series of scenarios where you must act as a race engineer to tune the setup and performance of a car.

To prepare for the first challenge (beginning in November), we will run a mock engineering challenge. You will be split into teams (ideally a sim driver + a race engineer).

I will release the details of the challenge next week. You will have 3 weeks to look at the problem, run some test laps with different setups, and create a short report.

Coding Projects

Some coding projects which have been requested by the team:

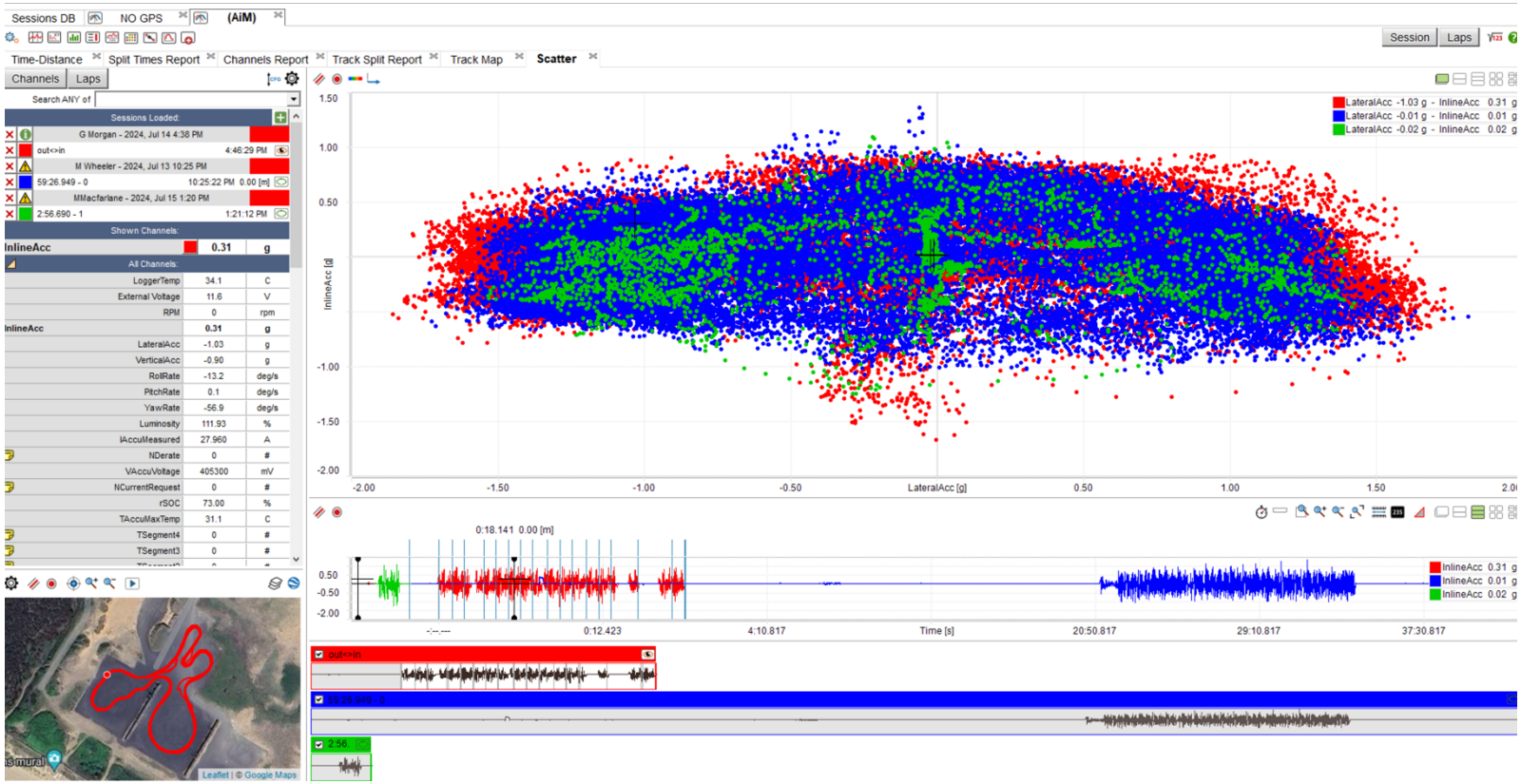
- **Mass distribution calculator:** how does changing the position of a part affect the position of the centre of mass?
- **Suspension compliance model:** how much do the suspension links deform under load?
- **Competitor analysis:** use the competitor database from the new member project to make some graphs of parameters vs performance
- **Setup sheet:** write some code to generate a vehicle setup sheet or read values from it

You can choose which language you use (MATLAB or Python recommended). I'll review the code with you, then it can be used by the team.

Semester 1 Teaching Schedule

Week	Date	Topic
Week 2	30/09/2025	System introduction
Week 3	06/10/2025	Velocity-Acceleration plot
Week 4	**13/10/2025**	**GG plot**
Week 5	20/10/2025	Balance
Week 6	27/10/2025	Load transfer
Week 7	03/11/2025	Introduction to laptime simulation
Week 8	10/11/2025	Tyres
Week 9	17/11/2025	Advanced laptime simulation
Week 10	24/11/2025	Advanced tyres

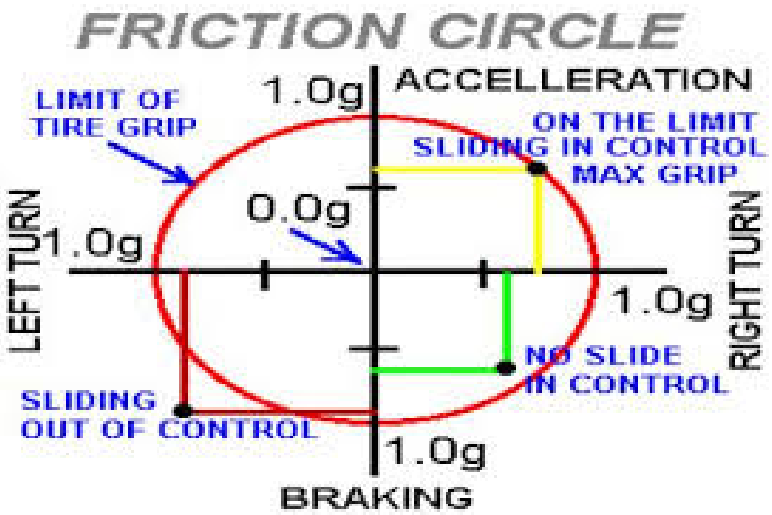
If we create a scatter plot with lateral acceleration on the *x*-axis, and longitudinal acceleration on the *y*-axis, the points all fall within an ellipse.



Based on this diagram, which driver will set the fastest laptime?

The Friction Ellipse

The friction ellipse gives the limits of the tyre's grip. In order to produce lateral force during a turn, the tyre must trade off longitudinal force. The characteristics of the tyre will affect the shape and size of the friction ellipse.

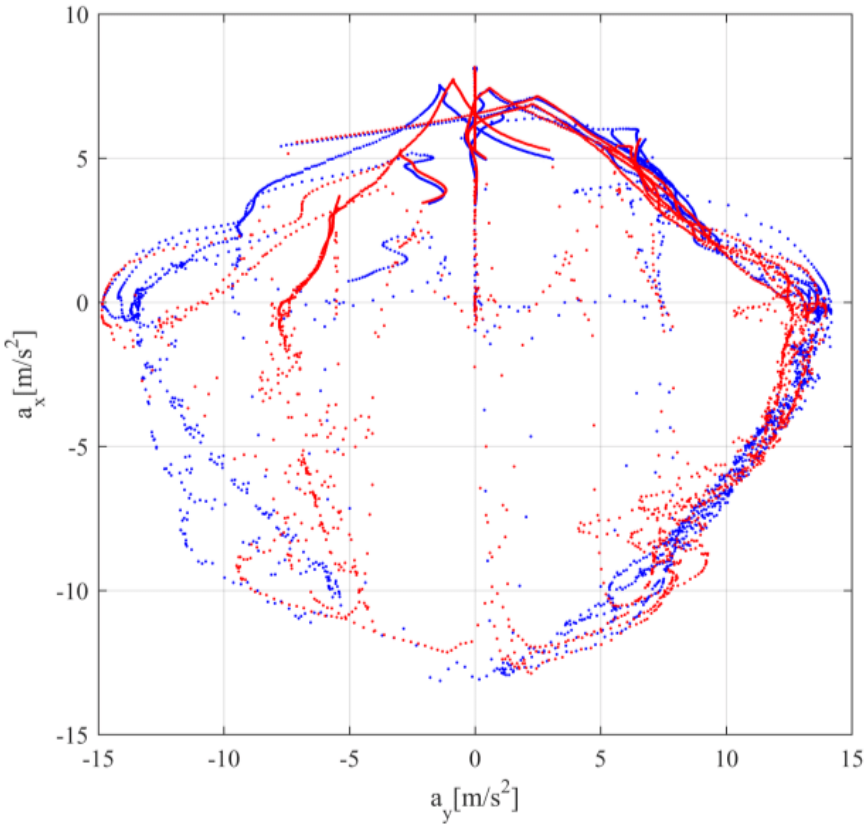


What will the differences be between the friction ellipses of the different Formula 1 tyres?

The GG Plot

The friction ellipse of the tyres leads directly to the circular shape of the GG plot.

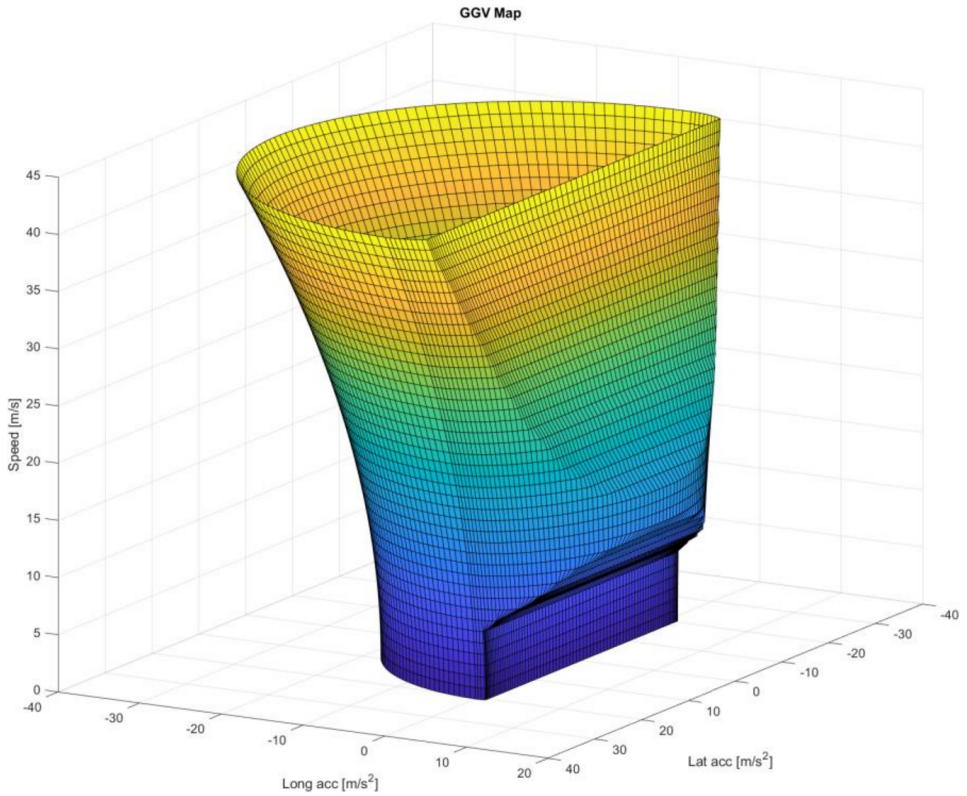
A fast driver will stay as close to the limits of the GG plot as possible.



When looking at the GG plot of the whole car, it is skewed towards the braking side. Why is this?

The GGV Plot

The limits of the GG plot are influenced by the aerodynamics of the car, which is dependent on the car's speed. We can add velocity as a third axis.



If we took a vertical slice of this diagram where lateral acceleration is zero, we would obtain the velocity-acceleration plot that we looked at last week.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