Digital Twins Technology in Formula 1

Formula 1 is a sport that relies heavily on data and computing power. Over the years, the sport has progressed from having a couple of sensors performing simple tasks, up to fully-fledged mechatronic systems with hundreds of sensors transmitting data continuously throughout a session.

What data is being sent/types of data?

With help from over 300 sensors on each car, McLaren’s F1 ECU deals with over 1000 input parameters.

Tyre Degradation:

Optical slip sensors are used a lot around the cars due to their high accuracy and low latency. They are used inside tyres to measure: sidewall deformation, tread deformation, footprint contact pressure, and footprint length. These measurements are transmitted and joined with the tyre pressures, carcass, surface, ambient and track temperatures. Correlating these data will lead to a predicted wear percentage.

Suspension:

* Use of load cells to determine stress/strain
* Can predict track surface quality and grip levels

How is the data being sent?

In the 2021 rules, all cars must be fitted with a telemetry system which has been manufactured by the FIA designated supplier to a specification determined by the FIA. Pit-to-car telemetry is prohibited; therefore, all data must first pass through the FIA’s servers. This data is sent over RF with some reports of speeds of 60GHz on the start/finish straight.

Collecting high-resolution data is key to understanding how the car changes throughout a race and predicting what will happen to the car in future races. Up to 3GB of data is transmitted during a practice session, with up to 3TB of data over a race, with the ECU receiving and sending over 750 million data points.

Data management providers?

At Red Bull, the heart of their production software lies in Siemens NX and Teamcenter. This allows the team to continually refine the car, sometimes making up to 1000 changes per week between races.

For the data processing side of racing, teams heavily rely on cloud-computing based solutions. McLaren has a partnership with Dell and Mercedes with Amazon AWS.

How are they processing the data?

Machine Learning?