Towards Formula One Vehicle Optimization
Machine Learning Group Project Research Proposal

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Summary of the Proposal

Many factors are considered when designing and tuning Formula One racing cars. Currently, machine learning is used to make real-time race predictions, based on driver performance. Our approach is to apply machine learning methods towards the vehicle design and give teams an edge when creating their vehicle.

Background

Motivation

Every year, all of the vehicles in the Formula One racing league are designed and built from scratch. No vehicle is ever used two years in a row. This means that these Formula One teams are constantly reevaluating which design aspects are most important when developing their vehicles. With the vast number of factors involved in racecar design, it can be difficult to determine which of these factors is most important. Machine learning may be able to provide greater insight into this challenge.

Previous Work

In recent news [1], the Formula One Group announced that it will be using Amazon Web Services Inc (AWS) and data analytics to make in-race predictions about which driver seems most likely to win the race. By analyzing current race information, and comparing it to 60 years worth of race results, expected winner predictions are made. While this is a nice application of machine learning that benifits the fans, it does little to help give the Formula One teams an edge on the competition.

Our Contribution

In this work, we intend to utilize vehicle data, collected from an endurance race, to learn which aspects of vehicle design are most influential to its performance. Most likely, we will use some form of reinforcement learning to train a machine on vehicle design. If successful, our work could give unprecidented insight into which aspects of vehicle design have the greatest impact on performance.

Goal and Objectives

The goal of this research is to identify which features of the Formula One cars (breaking, acceleration, handling, etc. . .) has the greatest impact on race performance. Specifically, we intend to use actual vehicle data and determine the ratio of time spent accelerating, breaking, and turning throughout the race. With these ratios, we can weight the importance of those aspects of the vehicle and begin training a machine to "design" a formula one car that will perform optimally on a particular race track.

Data and Methods

We will be using data provided by the Formula One team from the California State Polytechnic University - Pomona (Cal Poly) [2]. This data was collected from their 2017 vehicle during an endurance race. Sensors throughout the vehicle took measurements at a rate of around 1000 samples per second, tracking vehicle statistics. Initially, we will be working with 50MB of throttle, breaking, and lateral acceleration data. As stated in the previous section, our goal is to determine what proportion of the race is spent on each of these activites. Also, given lap times throughout the race, we can create a weighted correspondence to these metrics and lap speed. Finally, we intend to use some form of reinforcement learning to train a machine to try and get an optimal lap time.

Acknowledgements

We will be working closely with Mechanical Engineering gradutate David Martinez. David worked for several years on the Formula One team for California State Polytechnic University - Pomona. David's experience with designing, manufacturing, and racing Formula One cars at the collegiate level will be valuable during this project.

References

[1] Formula 1 selects AWS as Official Cloud and Machine Learning Provider. 29 June 2018
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[2] Bronco Motorsports - Formula SAE team.
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