Goal of the paper:

* Methods to dial in vehicle dynamics

Project Objectives and Constraints:

* From a large scale perspective, the goal is to win races. This can be further broken down
* I’m focusing on vehicle dynamics [I think this was the right term?], specifically simulations and testing methods.
  + Includes mathematical models and putting the car on a physical apparatus and shaking it
  + Focusing on components that affect vehicle dynamics.
* Within categories of racing, I’m focusing on things that are beneficial for racing in general, rather than a subset of racing.
  + Further down the line, I’ll compare how these two testing methods affect a variation of cars, from off road racing to on tarmac racing.
* Non-technical aspects:
  + We’re using simulation because every motor sport series takes place in a weekend format from Thursday or Friday, when testing happens, to
  + The physical amount of testing time is very small, so pushing it to a computer or testing apparatus before the season starts is good. This can then be extrapolated to racing conditions a few weeks before a race. Having this competitive edge is powerful.
  + Money is another constraint––engineering salaries, multi-million dollar machines, travel. The niche nature of the field means that there are few highly qualified people who can do this.
  + Time constraints: there are an infinite amount of things that can be analyzed and studied. Carol Smith (spelling?), *Tuned to Win*, says that whatever car and driver package make it around the track fastest win; every car is a starting point, so all you can do is tune it to maximize its capabilities. You have to maximize a machine with infinite tweaks. How do you maximize these tweaks?
    - Another paper talks about shaker rigs, but doesn’t look at how to improve the shaker rig itself, but looks at an algorithm that simulates the simulation.
      * Mechanical grip (changeable): springs, shock/damper coupled with a spring that controls the rate at which a spring compresses (ten plus adjustments of each of the following: high speed compression, low speed compression, and rebound), anti roll bar adjustments (decoupled from pitch of the car)
      * Other variables are locked into design and can’t be adjusted easily: things built onto the chassis
  + There’s a relationship between testing methods and what you are able to test, because of the variable amount of things you can look at.
* How do you know whether one method is more successful than another?
  + Need to find a metric or a way to use numbers to evaluate methods.
    - It’s important to use numbers
    - Testing the damper involves a shock dyno with a machine with a mobile arm and a stationery end to plot speed vs. force. In contrast, a shaker rig involves putting the whole car with a pan under each wheel and a linear piston under each pan, with more pistons under different parts of the chassis. The pistons are oscillated to simulate the road, and any part of the car can be analyzed, such as the distribution of force going downwards at each tire.
      * Connection to constraint/objective: the shaker rig seems a lot more advantageous than a shock dyno, but there are too many variables at play.
      * At some point, you need to only focus on one data point to eliminate other variables. However, at the same time, the shock dyno only tests shock, so you can’t make a conclusion about how much the chassis twists or other variables unique to your car and how it was built.
    - Need a quantitative analysis of these methods, including things that aren’t comparable.
  + Available money, time, etc. affects what variables you can look into.
    - Went to racing shop and asked what you would need to do to prepare to do this in a professional setting. They simulate everything, which makes their testing constraints different than a grassroots level racer. This changes what you would need in testing.
* Objective: Identify method or system that will yield the most improvement in terms of time, money, and technology available.