2014 Rose Grand Prix Engineering

Adams Car Model Case Study

ROSE-HULMAN
INSTITUTE OF TECHNOLOGY

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Rose-Hulman Institute of Technology Grand Prix Engineering

Rose Grand Prix Engineering, Rose GPE, is a small team that prides itself on manufacturing a Formula Society of Automotive Engineers (SAE) car fully designed and fabricated by undergraduate students. The design goal for Rose GPE is to build on past success by constructing a well-balanced car that focuses on the fundamentals of robust engineering, utilizing simulation software, and real-world testing to validate design decisions.

Having an accurate Adams Car model would benefit Rose GPE in various ways. The most significant way that Adams Car will benefit Rose GPE is that we will be able to run dynamic simulations on the car rather than the quasi-static simulations that the team is currently able to do with WinGeo. By running dynamic simulations on the car before fabrication occurs the team will be able to design a better tuned suspension and cut down on testing time necessary to properly dial in the suspension on the car.

This is the first year Rose GPE has utilized the Adams Car program, therefore only basic vehicle modeling has occurred. The team began by altering the provide Formula SAE database so that the vehicle hard points and parameters matched that of the current car, RGP-003, in production. After the database had been altered, basic suspension simulations (e.g. parallel wheel travel, opposite wheel travel, and steering) were performed to ensure that the results from Adams Car matched the results from WinGeo's ride, roll and steering iterations. By performing this comparison we ensured the front and rear suspension assemblies in Adams Car are performed as we had expected.

After establishing that the separate suspension assemblies performed similarly to the WinGeo models, a full vehicle model was created. The full vehicle model utilized the front and rear suspensions previously mentioned along with a chassis, drivetrain, and engine assemblies which came from the Formula SAE database. Full vehicle dynamic simulations were performed on this model to predict the dynamic behavior of RGP-003.

In order to determine how weight could be reduced in the suspension, rigid bodies in the model were replaced with flexible bodies. Currently, all of the control arms for the front and rear suspension assemblies have flexible files associated with them and the team is working on constructing flexible files of the uprights and spindles.

The next step for Rose GPE is to collect data from RGP-003 and compare it to the results from Adams Car and alter the model respectively to match the model to the collected data. While altering the model to better fit the data collected the engine and drivetrain parameters will be altered to create assemblies that accurately model Rose GPE's Formula SAE car. Additionally, we would like to model the chassis as a steel tube space frame rather than the provide center of gravity location.

Rose GPE would like to thank MSC Software for their support in the 2013-2014 Formula SAE series. Their donation makes it possible for the team to better understand the dynamics of the car before constructing the car. We still have a lot of work to do to create an accurate model of our Formula SAE car, but the initial model that was created this year is a great start and allows for the team to create improvements in future years.