

Computational Model of ATV Vehicle for Real-Time Simulation

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Abstract: The paper deals with description of a computational model of ATV vehicle in Simulink software. This computational model is created using the basic elements of own library and represents the main driveline parts for the simulation of longitudinal and lateral vehicle dynamics. The article describes the design and function of the computational model and demonstrates the usage of ATV model in the NI VeriStand software. It can be simulated on the hardware for real-time testing. In conclusion; a simulation of drive is done to verify the functionality of the assembled model.

Introduction

Virtual software are already common instruments for the development of prototype vehicles. It helps to accelerate the testing of vehicle behaviour and cost reduction. The available software libraries are already prepared for various applications in the automotive industry and user only changes the input parameters of the vehicle. If the libraries are not sufficient for users; they can create their own which is also the case here. This paper deals with the creation of computational model of ATV vehicles and the possibility to simulate it in real time by using National Instruments hardware and software.

Computational model of ATV vehicle

The computational model of ATV vehicle is based on vehicle design described in [1]. There is a detailed description of the construction ATV vehicle and its parameters. These parameters are used as input values for the simulation model of ATV. The computational model is created using own library in the Simulink software. This library contains blocks describing the main parts of the powertrain and blocks of the longitudinal and lateral vehicle dynamics that are created and described in [2; 3]. The library contains blocks of computational model of the engine; transmission; brakes; tires and directional dynamics of the vehicle. Each of these blocks contains an interface for entering input parameters. These parameters can be changed by the user. The user can enter the engine torque curve; moments of inertia; gear ratio; shaft torsional stiffness and damping; parameters of disc brakes etc. The block of tire is used for the calculation of longitudinal and lateral force; aligning moment and transient behaviour of the tire. The main block describes the directional dynamics of ATV vehicle and vertical load of tires. The library also contains other blocks for assembling different vehicles and configuration. Here only blocks used to build ATV vehicles are mentioned.

Simulation of ATV vehicle and compiling of the computational model

A simple demonstration of the function of the vehicle computational model is shown in Fig. 1. The vehicle design; computational model; trajectory of the vehicle and graphical interface in the NI VeriStand software are displayed here. The simulation was performed in Simulink software. The vehicle started moving and accelerating. Then the vehicle turned to the left about 360 degrees; and then to the right. After 16 s the vehicle began to brake and then stopped. After 22 s; the vehicle

began to move again. To assess the correct behaviour of the vehicle; a standard driving test and comparison with the real measurement must be done. As it is a prototype; the simulation can be verified only in accordance with theoretical assumptions.

The computational model developed in Simulink software can be used for real-time applications in NI VeriStand software. Combining these two software packages and setting parameters of fixed step; the model can be compiled into dynamically linked library (.dll file). This file can be loaded in the NI VeriStand software and run in real time on the appropriate hardware. The user can create an interface for displaying the output data from the simulation. Inputs data are driven by external user intervention. Another option is to add a graphical interface programmed using VRML and NI Labview. The user can simulate the drive of a prototype vehicle in the real-time by these tools and analyse its behaviour influenced by a real driver.

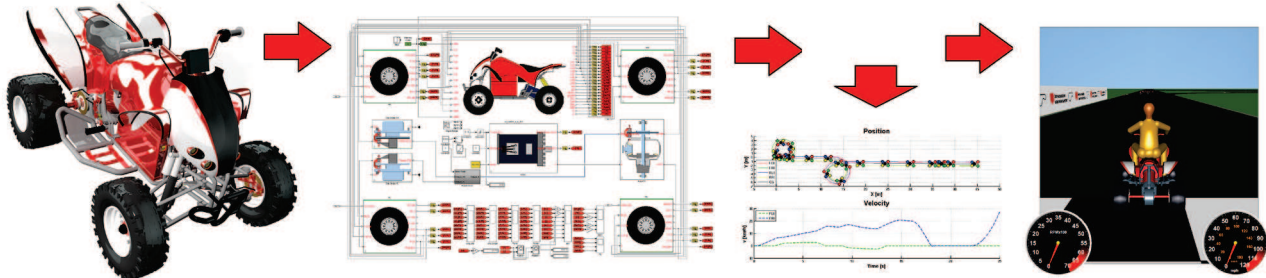


Fig 1: Scheme of development of ATV vehicle

Summary

The paper describes a computational model of ATV vehicle which can be used to simulate different driving modes of vehicles; i.e. acceleration; steering; braking etc. An important factor of this model is the possibility of its use on the device for real-time testing. Developers can test the behaviour of the vehicle before starting its production; which saves time; and the model can be further expanded and used for the development of mechatronic systems.

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