ИНТЕЛЛЕКТУАЛЬНЫЕ СИСТЕМЫ УПРАВЛЕНИЯ ТРАНСПОРТНЫМИ СИСТЕМАМИ. СИНЕРГЕТИЧЕСКИЕ СИСТЕМЫ ЭКОМОБИЛЕЙ

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THE IMPLEMENTATION OF ADAPTIVE ALGORITHMS TO OPTIMIZE THE DYNAMIC SYSTEM

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Abstract. *The implementation of adaptive algorithms to optimize the dynamic system by constructing an adaptive control system chassis DCC is consider in the article.*

Keywords: *adaptive control algorithm, control system chassis, vehicle and road environment.*

РЕАЛИЗАЦИЯ АДАПТИВНЫХ АЛГОРИТМОВ ДЛЯ ОПТИМИЗАЦИИ ДИНАМИЧЕСКОЙ СИСТЕМЫ

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Аннотация. *В статье рассматривается задача реализации адаптивных алгоритмов для оптимизации динамической системы на примере построения адаптивной системы управления ходовой части DCC.*

Ключевые слова: *алгоритм адаптивного управления, система управления ходовой части, транспортное средство и среда дороги.*

РЕАЛІЗАЦІЯ АДАПТИВНИХ АЛГОРИТМІВ ДЛЯ ОПТИМІЗАЦІЇ ДИНАМІЧНОЇ СИСТЕМИ

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Анотація. *У статті розглядається задача реалізації адаптивних алгоритмів для оптимізації динамічної системи на прикладі побудови адаптивної системи керування ходової частини DCC.*

Ключові слова: *алгоритм адаптивного управління, система управління ходової частини, транспортний засіб і середовище дороги.*

Introduction

Currently, the use of a car system chassis retains its relevance. In matters of the car chassis it is still a pattern - a marked increase in its sportiness by reducing the comfort, which is a significant drawback of a car system chassis.

This article describes a new control system chassis - adaptive chassis control DCC, in which the chassis is continuously adapted to the parameters of the road situation and the driver intentions.

The advantage of an adaptive control system chassis DCC is that it has improved adaptive electronic control system Adaptive Shift Control with elements of artificial intelligence that simplifies driving. Electronic unit of the system is equipped with two control algorithms: algorithm Optimum Shift Control ("Optimal choice of programs") always selects the ideal gear and the time of its inclusion in all modes of movement for all road conditions, and the algorithm Adaptive Shift Control ("adaptive selection algorithm") it takes into account the individual style and driving style of each driver and adjusts them in line with the shift points. Thus, the automatic transmission can be adapted to the individual driving style of different people, thus providing a smooth ride and maximum compliance with their character and mood.

Content analysis

To perform this adaptation of motion necessary adjustable shock absorbers, which are designed to easily reduce the energy of the bodywork and wheels. Also adjustable dampers prevent uncontrolled body movements and rebound wheels caused by irregularities in the road surface. In addition, due to the efforts of damping provides additional stabilization of the body during dynamic maneuvers [1].

A further increase in efficiency is achieved through the damping adjustable dampers telescopic performance, allowing better take into account the actual situation on the road. The control unit of the electronically controlled damping determines within milliseconds and provides the necessary degree of damping at each wheel.

Adjustable shock control signals obtained from the control unit to regulate the damping in accordance with the developed control algorithm. At the same time, depending on the input signals used by all parametric field adjustable shock absorbers.

Switch from the current algorithm can adjust by selecting the "Sport" or "Comfort" mode "Normal" with the key, adapting thereby damping to customer requests. Adjusting the system is available as when the vehicle is stationary and in movement mode.

Problem statement

The adaptive control system chassis DCC is always active. It is an intelligent, self-regulating system controlling the car shock absorbers, depending on the following factors:
- The quality of the road surface;
- The current situation on the road (such as braking, accelerating or turning movement);
- Requests the driver.

This ensures an optimal adjustment of the chassis.

The input data for the simulation of adaptive control system chassis DCC are the request of the driver, as well as the quality of the road surface and the situation on the road. The output of the reference voltage serves to regulate the damping.

The driver can select the mode of DCC in the system, depending on personal needs by pressing the right of the gearshift lever. The keys must be pressed until the desired mode is selected. You can switch between any number of times. Switching will always occur in the sequence of "Normal", "Sport", "Comfort".

Mode "Normal": if the button is not lit amber inscription "Comfort" or "Sport", means enabled "Normal".

This adjustment provides generally balanced but dynamic movement. This mode is suitable for everyday use. Mode "Sport": enabled, if the key illuminates yellow inscription "Sport". With this adjustment the car gets sporty performance with a rigid base adjustment.

The steering is adapted accordingly becomes sportier damping and stiffer suspension. This mode is primarily provides a more sporty driving style. Mode "Comfort": mode enabled, if the key illuminates yellow inscription "Comfort".

The result of this adjustment is softer basic damping adjustable suspension, providing ride comfort. This mode is suitable, for example, for driving on roads with poor coverage or long distance.

The difference in the modes is expressed in varying rigidity damping adjustment base. At the same time, depending on the situation on the road in the event of special requirements for the damping force adjustment is performed.

The main unit of modeling - a model of the vehicle. This block consists of the following classes:
- Sensors: used to detect other vehicles, which are the output of the distance and relative velocity;
- Communication device: used to communicate with other vehicles and / or expensive. Imprint - position, velocity and acceleration;

- Controller (Manager): is used to control the speed of the vehicle and its orientation. This is an abstract device and output data it is desirable acceleration. ACC and the "human" class driver - a specialty of the controller;
- The delay: this is used to simulate the effect of inertia of the device in the brake system. Output data appears actual acceleration;
- The dynamics of the vehicle: it is used to convert the acceleration in the rate at the output speed of the vehicle;
- Vehicle and road environment (VREP): is used to convert different coordinate frames. Output data are the coordinates of the vehicle;
- Monitor: used to monitor the course of the vehicle. This class is also abstract, and output data it may make the position of the collision, the percentage of the ACC, and the like.

Not all of these classes are required. In our example, we did not use any communication devices. Relations among the classes are shown in Fig.1.

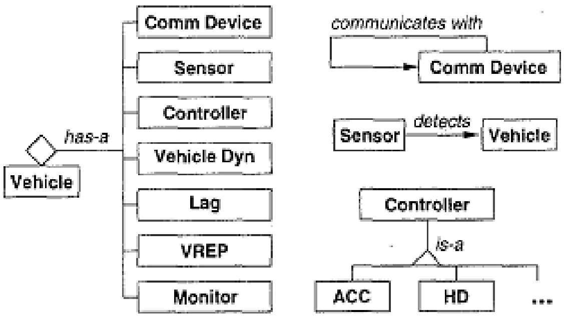

Fig.1. Vehicle: classes and Communications

Class vehicle combines elements of the list in Figure 1 (has-a - relationship). The sensor and the vehicle filleted "Search". The communication devices are connected with each other. Class ACC and the human driver class inherited from the manager (is-a).

The information flow among the components is fixed connections I / O (see. Fig. 2).

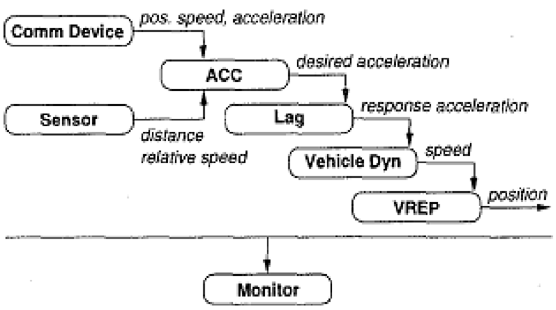

Fig.2. Vehicle: Traffic information

We now consider the collision detection algorithm. The algorithm and its implementation are shown in Fig.3.

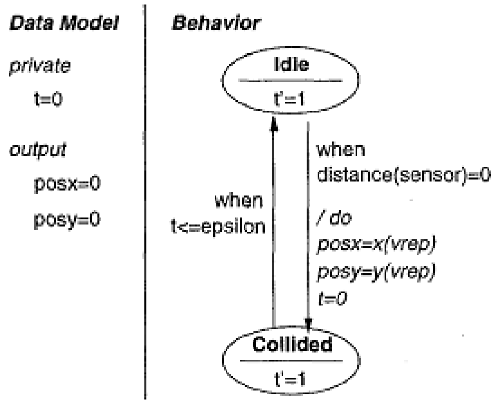

Fig.3. Automatic algorithm for collision detection

The left side of Figure 3 are given basic variables modeling the collision:
t – a local variable, which simulates the flow of time (local value is not available outside the class);
posx and posy – global variables used to store the position at which the collision happened.

The right side of Figure 3 shows the algorithm. Synchronization of data and implementation of the process is shown in Fig.4.

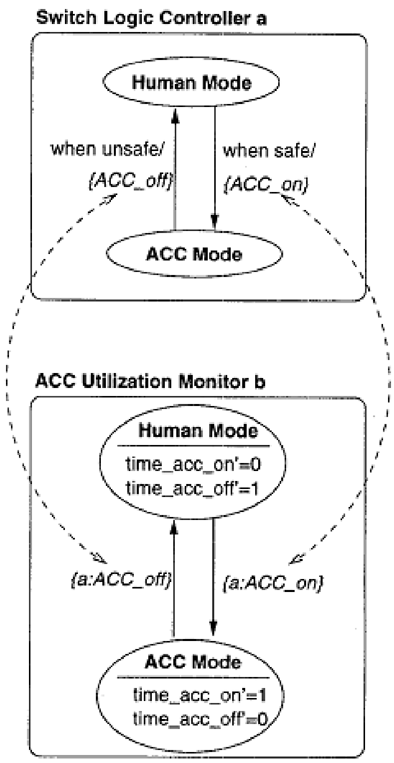

Fig.4. Example of synchronizing data between the controller and monitor

ACC monitor used to record information about how long the ACC was active and how long there. Figure synchronization dotted arrows represent connections. As a monitor and a controller have two states: one for the ACC mode, and the mode for one driver.

They switch from one state to the other synchronously (event ACCon and ACCoff). This means that the transitions occur in two components.

"Save" and "save" - only placeholders for complex mathematical expressions.

Research results

The simulation results: a program to simulate the programming language C#. The simulation results are shown in Fig. 5-10.

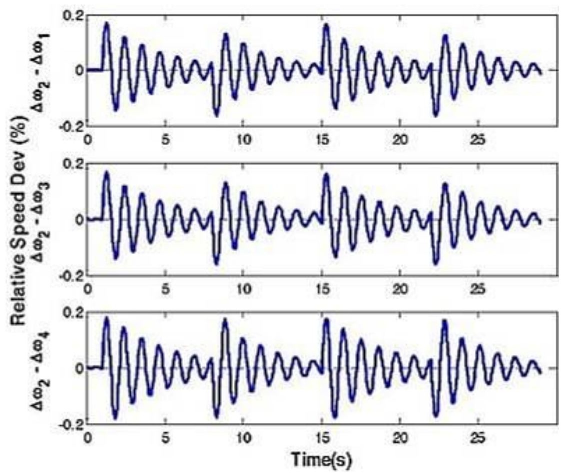

Fig.5. Change the speed of the generator (without adaptive control)

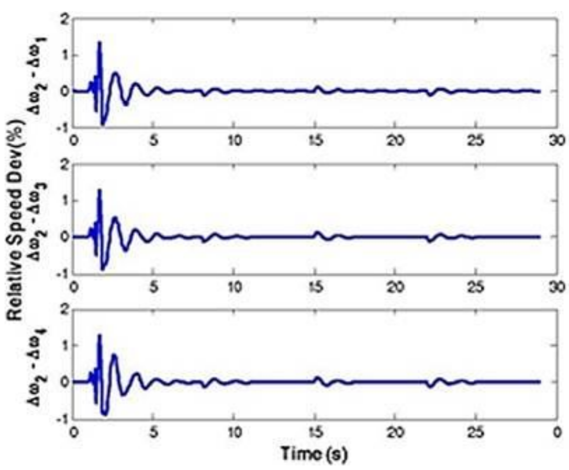

Fig.6. Change the speed of the generator (including adaptive control)

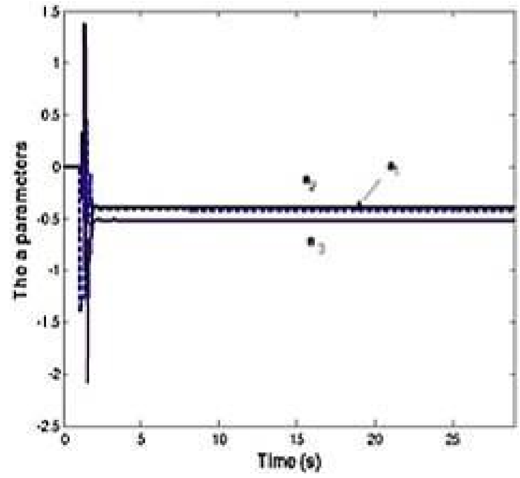

Fig.7. Change of a-parameters

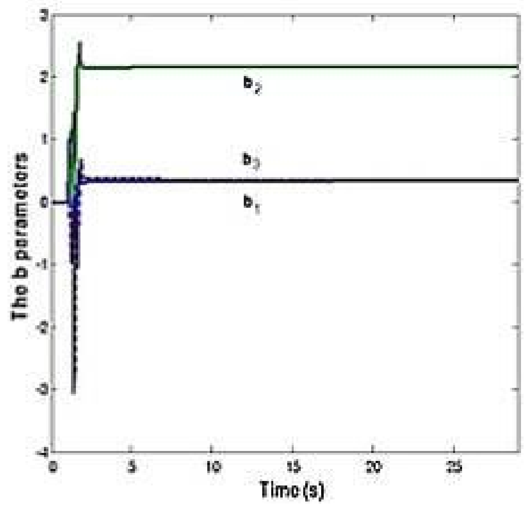

Fig.8. Change of b-parameters

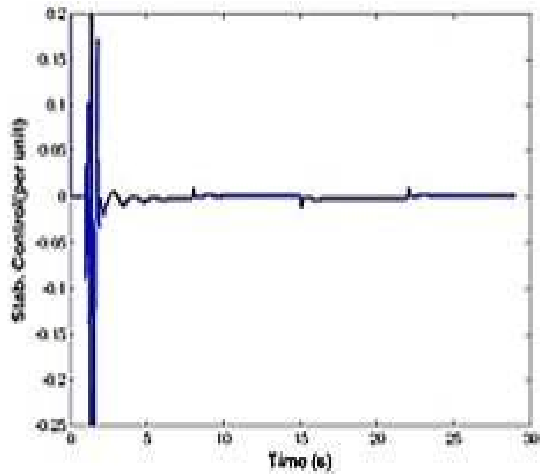

Fig.9. Stabilization of b-parameters

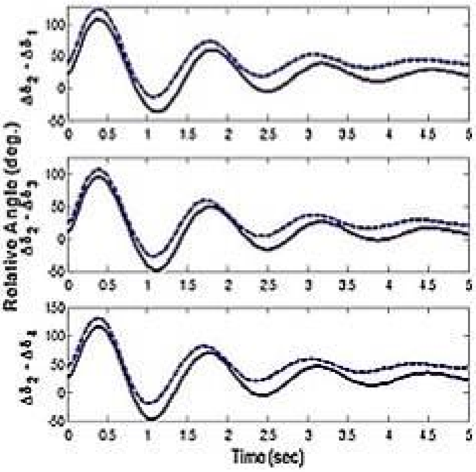

Fig.10. Angle variation (given control) for two different initial conditions

In order to assess the accuracy of the results that we have obtained with the help of software tools created in C#, compare them with the results, written with the help of SHIFT / Smart-AHS (Automated Highway System) (Fig. 11 - 1: C#, 2: SHIFT / Smart-AHS) [1].

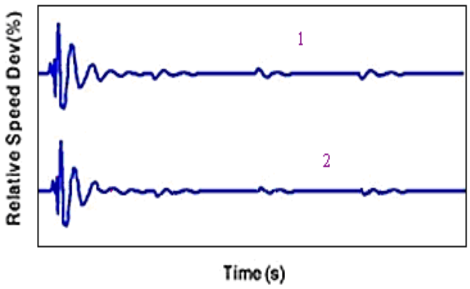

Fig.11. Comparison of the results

Conclusions

Write a program in C# programming language for the implementation of the functionality of the scheme. To perform such an adaptation movement used adjustable shock absorbers, which are designed for the rapid reduction of the oscillation energy of the body and wheels, telescopic shock absorbers and performance, to better take into account the actual situation on the road.

Literature

1. Antoniotti M. Microsimulation Analysis of a Hybrid System Model of Multiple Merge Junction Highways and Semi-Automated Vehicles / M. Antoniotti, A. Deshpande, A. Girault // *IEEE International Conference on Systems, Man and Cybernetics, SMC'97*, IEEE press, Orlando, FL, USA, October 1997.

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