Automobile Research Institute, Inc./Japan), pp. 99–104, 10 figs., 1 table, 4 refs.

As the first step of motion system realization, we have developed a motion algorithm which can convert vehicle behavior into simulator motion. Particularly focusing on acceleration realization, some simulator experiments in comparison with field tests were examined, and results show that, 1) simulated variables showed close agreement with actual vehicle behavior, 2) full generation of accelerations was not necessary but less generation was sufficient for a similar level of ride feel, and 3) it was needless to consider compensation within the provided offset length.

9438105 Real-Time Vehicle Dynamic Simulation Woon-Sung Lee, Sang-Sup Kim (Kookmin University/Korea), pp. 105–109, 6 figs., 0 tables, 7 refs.

The multibody vehicle models have been developed for real-time simulation on a DSP. The variational approach on relative generalized coordinates has been adopted to develop dynamic equations of the vehicle models. The symbolic expression of the equations has been obtained using MAPLE and converted into a C code for implementation on a DSP. The third order Adams method has been chosen as a best candidate for real-time integration. The developed models have been implemented and benchmarked.

9438114 Analysis of Root Loci on Two-wheeled Vehicles in Control Free Ryo Saito, Yasuhiro Endo, Taro Sekine, Hiroyasu Nagae (Nihon University/Japan), pp. 110–115, 5 figs., 3 tables, 5 refs.

For analyzing the control free stability on two-wheeled vehicles, the classification researches of root loci versus running speeds have been performed for the vehicles in market use. As a result, it has been revealed that only three kinds of types of root loci are existed in the present time. In this paper, the study of the equations of motion which have minimum numbers of degrees of freedom and appropriately express the essential characteristics has performed, and finally the dominant design parameters which contribute to characterize the types of root loci are also discussed.

9438123 Identification of Fuzzy-Control Systems by Evolution Strategy S. Presser, A. Vikas, A. Woehler, H-P. Willumeit (Technische Universität Berlin/Germany), pp. 116–121, 10 figs., 7 refs.

This article describes the design and optimization of fuzzy-controllers in vehicle dynamics by means of the evolution strategy.

Both, optimizations of a control loop with the aim of an unchanging ratio of input and output data and optimized fuzzy control systems for controlling a dynamic vehicle model are presented.

The first controller to be discussed is designed to compensate the vehicle's roll-angle. The goal of the second controller is to minimize the wheel load changes and the vehicle's lateral acceleration at the same time by a controlled vehicle-body damping.

In this paper are shown the potential of an automatic adaptation of the parameters of a fuzzy-controller.

The investigation engages the simulation of the dynamic vehicle behavior by using a three-mass-oscillator. The optimization was carried out with the so-called evolution strategy, a simple approach to describe the biological process.

9438132 Torque Split Control for Electric Vehicle with 4-Wheel Direct-Drive Motors Takehiko Fujioka, Naoto Yanase (The University of Tokyo/Japan), pp. 122–127, 15 figs.

This paper investigates torque split control (TS-control) and its application to electric vehicle IZA, equipped with Direct-Drive motors (DD-motors). Numerical simulation is used to study the dynamics of TS-controlled electric vehicles.

Firstly, this paper introduces new laws of TS-control to improve the handling and stability of the electric vehicle with 4 wheel DD-motors. Secondly, the new laws of TS-control are applied and simulations are conducted using an electric vehicle model. Ramp-step response and frequency response of the yaw rate under the normal road conditions are calculated, and vehicle motion on low friction road are calculated. The results of calculations show that TS-control improves the performance of the vehicle compared to the vehicle without control.

9438141 Development of Possible Procedures for Testing and Rating of Traction and Stability Control Systems Tilo F. Schweers, Henning Wallentowitz (RWTH Aachen/Germany), pp. 128–134, 9 figs., 2 tables, 11 refs.

Function and object of existing control systems for traction and stability are described. The problem of rating and objective evaluation of the influence of such slip control systems on vehicle dynamics is demonstrated. Closed-loop manoeuvres with subjective assessment and open-loop tests with measured data are shown. Analysis of correlation results in characteristic values which allow assessment of dynamic performance of slip control systems. Tests with two passenger cars, equipped with different slip control systems, demonstrate the objective test method and show their results.

9438150 Stabilization of Passenger car-Trailer System at High Speed Ichiro Kageyama, Rena Nagai (Nihon University/Japan), pp. 135–140, 9 figs., 1 table, 5 refs.

This study aims to stabilize the trailer at high speed. The way used in passenger cars with a four wheel steering system, and a control for rear wheel steering corresponds with the behavior of trailer and passenger car. This is regarded as an optimal regulator problem with linear equation of motion, and a state variable feedback control system is adopted. The problem of stability at high speed on a straight course can be solved. Therefore, the passenger car-trailer system can be stabilized. Furthermore, this study indicates the way forward to stabilize a passenger car-trailer system.

9438169 Stabilization of a Car-Caravan Combination Using Active Unilateral Brake Control László Palkovics (Technical University of Budapest/Hungary), József Bokor (Hungarian Academy of Sciences/Hungary), pp. 141–146, 7 figs., 1 table, 11 refs.

In the paper a fairly new concept called Active Unilateral Brake Control (AUBC) is applied for a single passenger car and as well as for a car-caravan combination. The AUBC system generates an active yaw torque stabilizing the vehicle's directional behaviour with the selective operation of the car's rear wheel brakes. In the paper the AUBC is applied also for the towed vehicle part showing considerable improvement in the lateral stability. The controller of the AUBC system is designed by means of the combined RLQR/H_∞ design methodology based on the sensitivity analysis results. The robustness of this controller in the presence of both internal (including parametric uncertainties, non-linear dynamics) and external disturbances (such as road irregularities and side wind) allows its implementation with confidence to a non-linear vehicle model. The controlled vehicle combination is tested on a variety of road surfaces: on dry surface and partly wet road. The results are compared to those given by both passive and active 4WS vehicles.

9438178 Non-linear Robust Control for an Integrated System of 4WS and 4WD Yutaka Hirano (Toyota Motor Corp./Japan), Eiichi Ono (Toyota Central R&D Labs/Japan), pp. 147–152, 11 figs., 5 refs.

An improved control law for integrating 4WS and 4WD systems is presented. It is based upon a non-linear vehicle model in which the lateral force acting on the tires changes according to the tire slip angle and slip ratio. The purpose of the system is to make the actual yaw rate follow the desired yaw rate. A strict linearization method and μ synthesis which ensures not only robust stability but also robust control performance, despite changes in the plant's parameters, are used to design the feedback compensator. Actual experiments prove that the system greatly improves stability and maneuverability.

9438187 Integration of Linear Systems and Neural Networks for the Design of Nonlinear Four-Wheel-Steering Systems Masao Nagai, Et-