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DEVELOPMENT AND INVESTIGATION OF A COMPLETELY SEMI-ACTIVE SUSPENSION SYSTEM FOR FULL SPRING MOUNTED TRACTORS

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FINAL ABSTRACT

Not only the driving and operating speed of agricultural tractors but also the ratio of transport is increasing constantly. Because of that, higher driving safety and improved driving comfort are required. To achieve this, tractor chassis suspension has to be matched.

Conventional agricultural tractors have no suspension system. Since usage of such a system has improved the ride comfort and dynamics behavior of tractors, modern agricultural tractors are equipped with different suspension systems such as seat, cabin or chassis suspension. The last one is divided into front axle suspension and full suspension. On the one hand, full spring mounted tractors deliver more advantages than conventional tractors. On the other hand, they cause higher production costs. Especially for hydro-pneumatically suspended chassis the technical and financial input is very high. This paper will present the capability of a semi-active suspension system for full spring mounted tractors.

Based on a tractor with conventional rigid axles a new hydro-pneumatic chassis suspension for front and rear axle was developed, including a set of sensors, hydraulic actuators and an electronic controller. Multi-body simulation and control engineering models were used to design the controller of the semi-active suspension system, which rests upon the continuous Skyhook algorithm. Consequently, the chassis suspension can be adjusted to any kind of road and speed. In addition, it features an automatic level control system and a compensation of slope, roll and pitch movement. After that, the modified tractor was tested on the hydraulic roadway simulator of the University to verify and validate simulation and controller. The experiments have been carried out with passively and semi-actively controlled front and rear axle suspension and in addition to that with on/off and continuously control. In the course of the experiments significant acceleration values, speeds and ways have been recorded. These data were analyzed to obtain the time and frequency domain results of body accelerations and dynamic tire forces in order to evaluate ride comfort and handling ability of the tractor. Furthermore, road tests were carried out to research the drivability of the trac by using well-defined vertical excitations and driving maneuvers.

The results of both tests and simulation demonstrated a reduction of tractor body accelerations, that means significant improvement in ride comfort of the trac. Although tractor dynamic tire forces were reduced, the handling could be improved significantly. In conclusion, overall performance of tractor's suspension was increased by using the new suspension system.