COMPARISON OF ENERGY BALANCE OF SPRING SUPPORTED OR NOT SPRING SUPPORTED FRONT BRIDGED TRACTORS

by Zoltan Kovacs[1] – Dr. Lajos Laib[2] – Dr. Mark Szente[3]

1 – College assistant of Nyíregyhaza College, Faculty of Engineering and Agriculture

2 – University Professor, Faculty Engineering of Szent Istvan University, Gödöllő

3 – Engineer, FVMMI Machine Testing LTD.

Introduction

With the increase of engine power and the speed of agricultural machines, to study the dynamic effects on the tyres, thus on the whole tractor are of great importance.

Studying and designing of running gears from the aspect of vibration go back to the times, when automobiles were not invented yet. Spring supported railway carriages and coaches were used before vehicles appeared on the roads. Universal power machines in agriculture mean a special load on the running gear, because they have to possess a big pull force under the extreme climatic conditions. What is more, ergonomical requirements are becoming stricter. When Hungary joins the EU, agricultural power machines have to cope with further strict requirements.

The great tractor manufacturing companies have introduced a lot of technical novelties including spring supported front bridges, which are applied in the agricultural practices. A number of tractor manufacturing companies adapted it on their tractors of mass production (e. g. New Holland, John Deere, Fendt, etc.). According to the manufacturers by using a spring supported front bridge not only does driving become convenient, but also there is an increase in the pull force of the tractor and the tractor are more stabile on the road. Due to a greater pull force the efficiency of the aggregate will be greater.

The conditions and methods of the tests

A John Deere 6920S tractor with a spring supported front bridge was tested, which the KITE share holding company put at our disposal. During our tests on the arable land according to a shedule, made before the tests, the following data were measured:

- measurements time (sec),
- number of motor revolutions (n^{-1}),
- the revolutions of the back wheel (n^{-1}),
- torque of the left back wheel (kNm),
- torque of right back wheel (kNm),
- torque of the front driving shaft (kNm),
- velocity (m/s),
- left front wheel revolutions (n^{-1}),
- right front wheel revolutions (n^{-1}),
- pull force (kN),
- tractor frame acceleration (m/s^2),
- left front bridge acceleration (m/s^2),
- right front bridge acceleration (m/s^2),

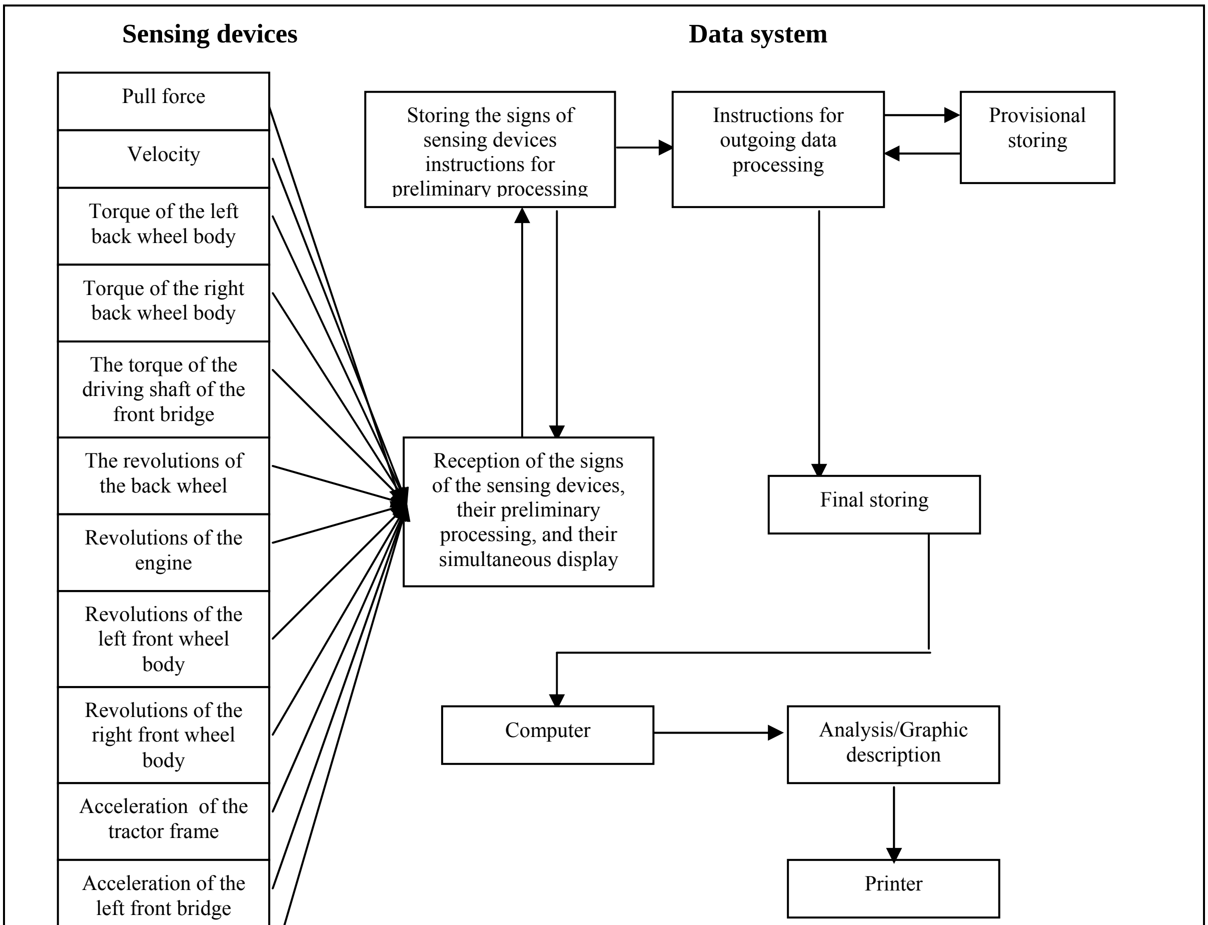

Figure 1.
The process of measuring and data system

The tests were on arable land in a plain on loomy soil. To measure the back wheel shaft torque, an auxiliary wheel body with a gauge measuring pin was fitted to the back wheel body, then it was fixed to the back wheel of the tractor. Extensometers were fixed on the gauge measuring pins calibrated to the torque.

The signs by the signallers were received by a Spider Mobil, with 16 channels measuring and data collecting system. Figure 1. shows the process of measuring and data processing.

During the tests in the measurement phases the differential locking device of the tractor was always switched on to ensure, that the wheels on the shaft revolve with the same revolution number. According to the Hungarian standard the revolutions of the wheels are considered free from slipping if the tractor is moving without using a pull force. Therefore the measurements in all gears were started from zero pull force.

The achievements of the tests and their evaluations

The following characteristic were determined from our measurements:

- wheel slip (%),
- traction power (kW),
- the energy loss of the perpendicular swing (power loss).

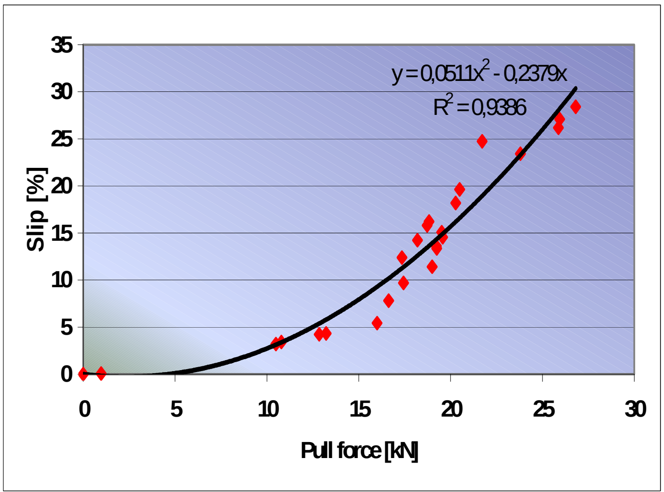

Figure 2.
Wheel slip in function of pull force

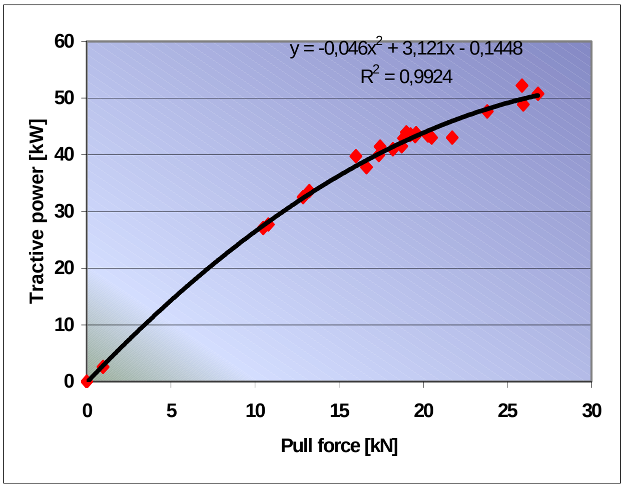

Figure 3.
Tractive power in function of pull force

For instance, the characteristics, measured in the 1b4h gear, are presented. The wheel slip values and the traction power in function of the pull force are presented in figures 2 and 3. The vehicle on the terrain is affected by impressed force, which results in perpendicular swing. These swings are stochastic as the impressed and free swings are superimposed on each other. The perpendicular accelerations impress mass forces, which create additional soil and tires deformation. The deformation means labour, which is a loss in the system. The swing accelerations causing deformation can be reduced considerably by adapting an adequate spring system.

The future objectives of the research work are to determine the various deformations and the power losses caused by the perpendicular swings.

LITERATURE

[1] Kiss, Zs. P. – Szőllősi, I.: The examinations of the interactions between the agricultural tiers and the soil within the system of soil types and tyre sizes. The Day of Hungarian Science. Sz.-Sz.-B. county Publishing of the county public foundation. Nyíregyháza, 5 Nov. 1999. (Edited by Vass Lajosné, pp. 156-157).

[2] Laib, L. – Gedeon, F.: The analysis of the vehicles of the field. Vehicles, Agricultural Machines, 1989. 8. Issue

[3] Laib, L.: Tests of cross-country vehicles on the terrain. A research report 1985-1993. GATE, 1993.

[4] Laib, L.: The modelling of the soil and tyres interaction especially in relation to the impact of the soil profile on the vehicles. Building and Agricultural machines, 1995, 42. yrs. 8^{th} issue.

[5] Szente, M. – Füzesi, M.: The effect of spring supported front bridge on New Holland TM 165 tractor. Agricultural Techniques, Jan. 2001.

[6] Szente, M. et al.: The examinations and optimalisation of the vibration characteristic of tractors, equipped with driving cabins, the effect of spring supported front bridges on the tractive force of tractors. Agricultural Techniques, May. 2001.

[7] Szente, M.: The traction characteristic of tractors, driven by auxiliary front wheel. Agricultural Techniques, Jan. 2002.