ABSTRACT

Agricultural tractor is a major power source on the farm. Utilization of the tractor power has not been at its maximum level with any given implement under any field conditions due to non-matching implement size. A study was proposed to develop embedded systems for on-the-go digital display of different field performance parameters of any given implement attached to the tractor with a high degree of accuracy.

A dynamic wheel axle torque transducer was developed to fit to both the half axles of a tractor and simulated using ANSYS software with various twisting and bending moments. An embedded system for on-the-go digital display of dynamic wheel axle torque was developed for transmitting the torque signals from revolving wheels to the stationary onboard data logging system. Various instrumentation systems were used and developed to measure the field performance parameters. An embedded system was also developed for on-the-go digital display of traction parameters such as draft force, wheel slip, depth and actual speed of operation with audible and visible warnings to the operator. The embedded systems were validated on tarmac surface and actual field condition using Radar sensor and instrumented three point linkages. A Visual Basic programme was developed for predicting the field performance of tractor-implement combination.

The results indicated that, the transducer was able to withstand more than 30 kN-m twisting moment and 20 kN-m bending moment. The embedded system for wheel axle torque was able to communicate the signals up to 100 m distance. The performance of the torque transducer with developed embedded system was found efficient, accurate with a variation of $\pm$ 7.6% and $\pm$ 15% between the theoretical and experimental values on road and field, respectively. The performance of the wheel slip measurement system was accurate with maximum variation of 5.45% and 6.14% on road and field condition as compared to manual method of measurement. Also the performance of the dynamometer with embedded system was found accurate with maximum variation of $\pm$ 9.24%, $\pm$ 7.3%, and $\pm$ 7.8% as compared to instrumented linkages during tillage operation with MB plough, cultivator and harrow, respectively. A maximum variation of 35% was observed between torque transducer values and the theoretical calculated values using Brixius (1987) and Wismer and Luth model (1973), whereas the maximum variation of $\pm$14% with the Tiwari and Pandey model (2009). The variation in drawbar power of the tractor with different implements measured using torque transducer and dynamometer were $\pm$11.74%, $\pm$11.48% and $\pm$12.36% during field tillage with MB plough, cultivator and disc harrow, respectively.

***Key words**:* Embedded systems, Axle torque, Drawbar power, Dynamometer, Radar sensor, Hall effect sensor, Wheel slip measurement, Strain gauges.