## ABSTRACT

The primary function of an agricultural tractor is to provide a platform for agricultural tillage implements. Three-point hitch (TPH) linkages are the most common means of attaching agricultural tools to tractors. Mechanical linkages regulate position and draft in the existing mechanical three-point hitch system, which has various drawbacks. Hence to overcome those disadvantages an embedded electro-hydraulic hitch control system has been developed for automatic depth and draft control, with additional Quick lift-low and slip control system.

In the past, control systems were predominantly designed using a trial-and-error method. This takes valuable time and resources, although nowadays it is much more scientific with the use of numerous design tools and simulation software that forecast how our system will operate in real conditions before heading to actual field testing. MATLAB is a modelling software application that can be used to undertake analysis, simulation, and problem solving in mathematics and engineering. In this thesis, The electro-hydraulic system for tractor was simulated in the MATLAB Simulink environment and validated with laboratory test results. An embedded electro-hydraulic control system has been designed for on-the-go digital display of set and dynamic feedback value of position, draft and slip control with real time mode of operation indicator of tractor.

The dynamic behavior of electronic control valve was tested under laboratory condition and compared with actual test results. For electronic hydraulic hitch (EHH) control valve, PC valve maintain 4 bar constant pressure drop across lift solenoid valve. Lift solenoid valve has threshold current 1.1 A and saturation flow 37 lpm. Low solenoid has threshold current 1.25 A and saturation flow rate 57 lpm. Cracking pressure value of check valve is 2.5 bar. Simulation and the actual test results of lifting time lowering time of TPH and were found to be in agreement with deviation of less than 4 % and 12.5 %, respectively. The quick lift-low, position, draft control mode of operation of developed embedded control system with developed laboratory model was tested for 50 to 250 kg weight with 50 kg increment.

The field performance of developed embedded control system were performed for quick lift-low, position, Draft and slip control mode with different implements namely cultivator, off-set disc harrow, rotavator, disc plough and MB plough. Quick lift time of implement was found to be varied from 3.5 to 4 sec, however quick low time varied from 1.69 to 2.03 sec. Position control mode of operation was tested with cultivator and offset disc harrow at 5, 10 and 15 cm operating depths; and with rotavator at 5, 10 and 13 cm operating depths. The field results showed that the depth varied from the set value by ± 0.9 cm at all depths of operation. Draft control mode of operation was tested with cultivator, disc plough and MB plough at three different levels of set draft -2000, -4000 and -6000 N. Slip control mode of operation under field condition was tested for 10, 15 and 20% slip values with the cultivator. The feedback slip of the tractor was found to vary from the set value by ±2.5 %.



***Key words**:* Draft control; Embedded control systems; Electro-hydraulic hitch control; MATLAB; Position control; Proportional control valve; Quick lift-low; SimMechanics; Simulink; SimHydraulic; Slip control; Three-point hitch