

Steer-By-Wire Control System for Electrohydraulic Powered Articulated Vehicles

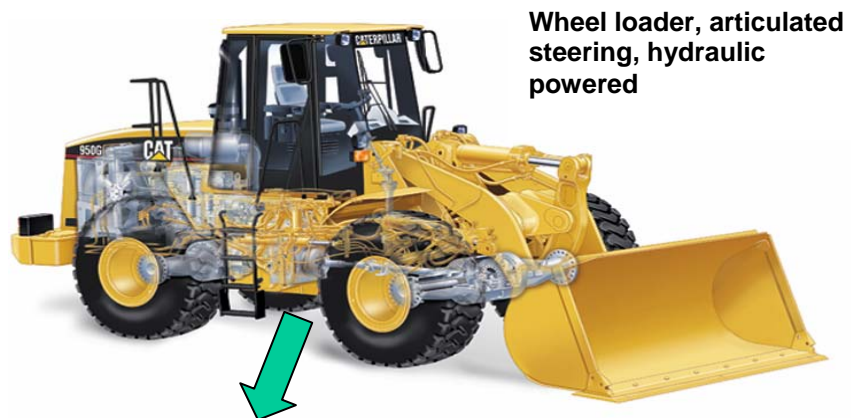
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Automotive and earth moving equipment industry has been developing “by-wire” systems for steering, brake, and engine throttle control. These systems are expected to appear in the car market and offered to consumers by the year 2007. “By-wire” systems refer to the physical connection between operator command devices and the controlled sub-system, such as the connection between the steering wheel and the steering mechanism, the connection between the brake pedal and the brake actuators, the connection between the accelerator pedal and engine controller. This project focuses on “by-wire steering system”, also called “steer-by-wire” system, for articulated machines such as wheel loader type earth moving equipment. The main different between the conventional steering systems and the “steer-by-wire” systems is at the connection between the steering wheel (or steering lever) and the steering control valve. We can view the steering system as having two main sub-systems: 1. Command input subsystem (steering wheel and/or steering lever), 2. Steering power circuit (i.e in the case of electro-hydraulic power steering, this sub-system includes the pump, cylinder, and valves). The conventional systems include different forms of mechanical and hydraulic connections between the steering wheel and the steering valve. In simplest terms, the steering wheel rotation is proportionally amplified by the steering valve to obtain a proportional articulation angle. Since the two systems (steering wheel and steering power system) are mechanically coupled, there is a built in inherent force feedback to the operator at the steering wheel proportional to the steering conditions.

A “steer-by-wire” system has only electrical signal connection between the steering wheel sub-system and the steering power sub-systems. This approach has both advantages and disadvantages compared to conventional steering systems. Steer-by-wire advantages:

- Modular steering sub-system design, simplifies the assembly, lower manufacturing cost
- Software customizable to fit different machine needs
- The injury risk caused by the steering column in accident will be diminished.

The main disadvantage of SBW system is that there is no direct mechanical feedback to the operator about the steering conditions, which must be emulated by an active control system.



Wheel loader, articulated steering, hydraulic powered



Enlarged view: steering hinge joint and hydraulic cylinder (a pair)