

# THE "SMART" BACKHOE LOADER

The Next Generation in Earthmoving

Concepts & features



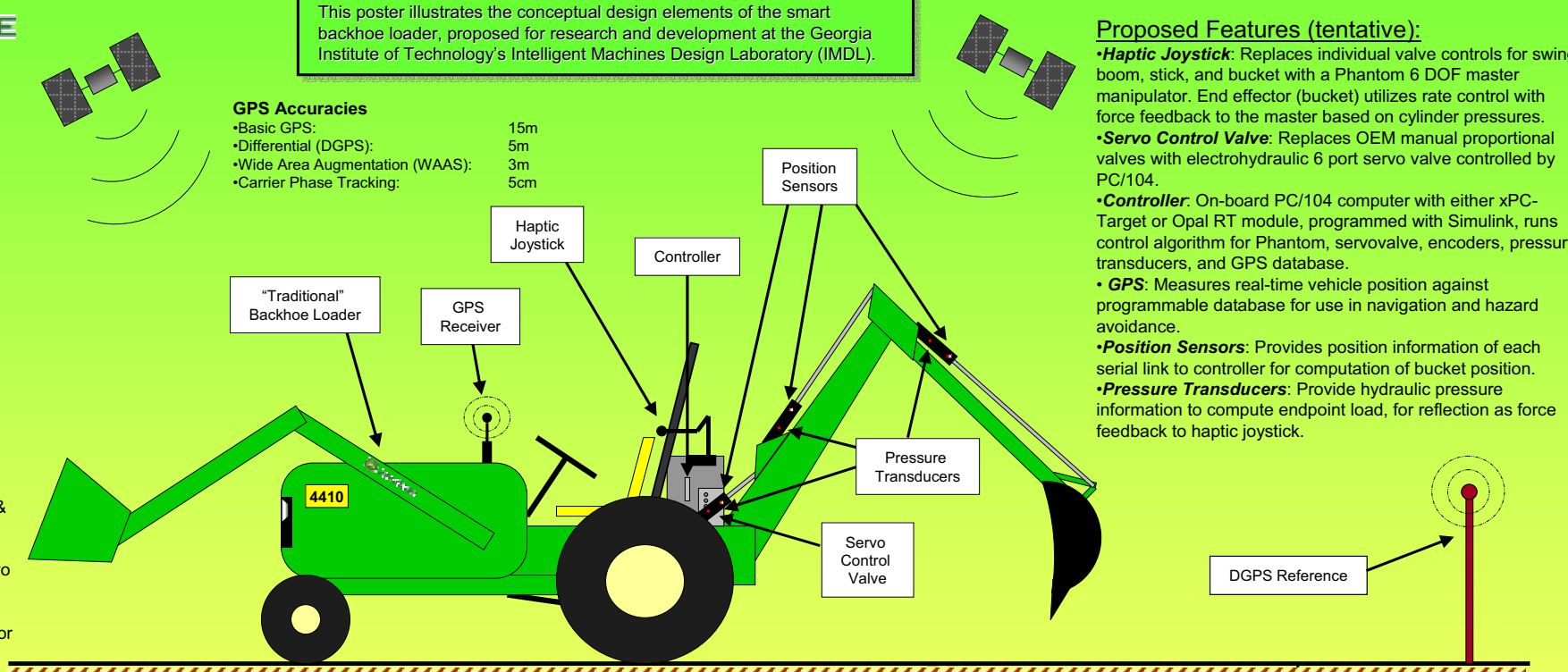
This poster illustrates the conceptual design elements of the smart backhoe loader, proposed for research and development at the Georgia Institute of Technology's Intelligent Machines Design Laboratory (IMDL).

### GPS Accuracies

- Basic GPS: 15m
- Differential (DGPS): 5m
- Wide Area Augmentation (WAAS): 3m
- Carrier Phase Tracking: 5cm

### Steps to be taken:

1. Develop Simulink model of dynamic system
2. Design tracking control and haptic force feedback
3. Obtain backhoe from John Deere and mount to 4410 tractor
4. Obtain and mount position and pressure sensors
5. Configure PC/104 with sensors and test
6. Obtain servo control valve & integrate into existing hydraulics
7. Configure PC/104 with servo control valve and test
8. Configure PC/104 with Phantom master manipulator and test
9. Develop GPS functions

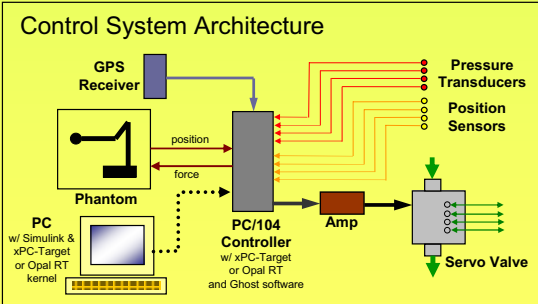


### Proposed Features (tentative):

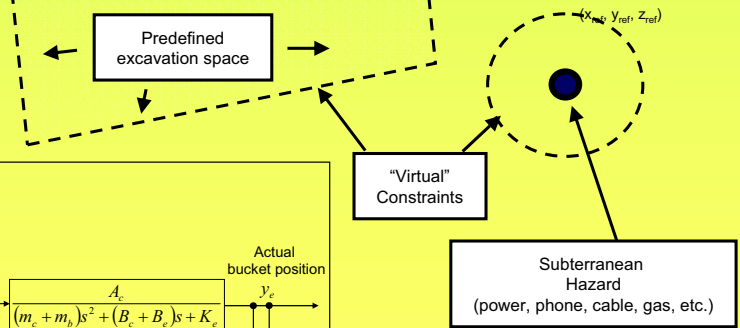
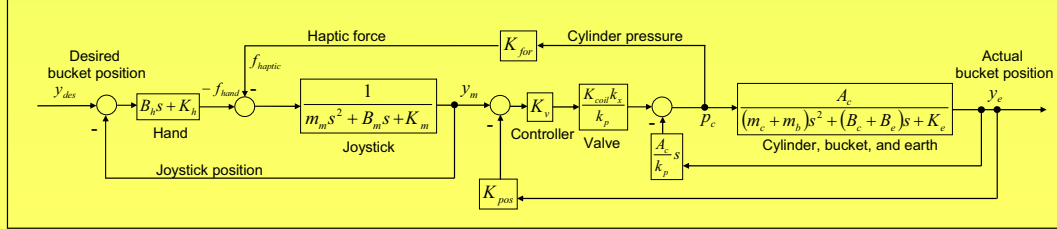
- Haptic Joystick:** Replaces individual valve controls for swing, boom, stick, and bucket with a Phantom 6 DOF master manipulator. End effector (bucket) utilizes rate control with force feedback to the master based on cylinder pressures.
- Servo Control Valve:** Replaces OEM manual proportional valves with electrohydraulic 6 port servo valve controlled by PC/104.
- Controller:** On-board PC/104 computer with either xPC-Target or Opal RT module, programmed with Simulink, runs control algorithm for Phantom, servovalve, encoders, pressure transducers, and GPS database.
- GPS:** Measures real-time vehicle position against programmable database for use in navigation and hazard avoidance.
- Position Sensors:** Provides position information of each serial link to controller for computation of bucket position.
- Pressure Transducers:** Provide hydraulic pressure information to compute endpoint load, for reflection as force feedback to haptic joystick.

### Robotics and Mechatronics on the Farm

- Single joystick manipulates backhoe, intuitive feel, easier to learn
- Force feedback through joystick lets user feel resistance when digging
- Predefined digging spaces guide bucket where it needs to go
- Predefined hazards keep bucket away from where it shouldn't go



### Backhoe Position Control with Force Feedback



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