

UNC Charlotte – Lee College of Engineering Senior Design Program

Senior Design Project Description

Company Name	<i>Caterpillar Corporation</i>	Date Submitted	<i>11/19/2019</i>
Project Title	<i>Re-design of Remotely Enabled Crane Lifting Mechanism for Front End Loader (CAT_LIFT)</i>	Planned Starting Semester	<i>Spring 2020</i>

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills:

Discipline	Number	Discipline	Number
Mechanical	4	Electrical	1
Computer	1	Systems	
Other ()			

Company and Project Overview:

Caterpillar is the world's leading manufacturer of construction and mining equipment, diesel and natural gas engines, industrial gas turbines and diesel-electric locomotives. We are a leader and proudly have the largest global presence in the industries we serve. For more than 90 years, Caterpillar Inc. has been making sustainable progress possible and driving positive change on every continent. Customers turn to Caterpillar to help them develop infrastructure, energy and natural resource assets. With 2017 sales and revenues of \$45.462 billion, Caterpillar is the world's leading manufacturer of construction and mining equipment, diesel and natural gas engines, industrial gas turbines and diesel-electric locomotives.



This project will be with the Clayton (NC) Machine Development Center (CMDC), where more than 200 engineers, prototype technicians and expert operators work to design, build and test machines in one location. The CMDC has dedicated 150 acres for machine development and features a half-mile, high-speed machine track, 10 test and demonstration areas and seven machine operation areas to prove machine reliability and durability. The Clayton facility manufactures small wheel loaders and serves as a product distribution center for backhoe loaders. This project will be associated with a particular front end loader model that is used in barge unloading operations.

Project Requirements:

The Cat 938M Small Wheel Loader sets the standard for productivity, fuel efficiency and operator comfort. See the photo below:



This loader is extremely versatile and is used in many applications. One application is to unload granular material from river barges.



In the picture above, a river barge is being unloaded and the load transferred into a larger ocean going vessel using an overhead crane with a large scoop mechanism. After a certain amount of material is removed from the barge, a Caterpillar front end loader is actually placed inside the barge. The loader moves remaining material into piles that the crane scoop can pick-up. This is repeated until the barge is emptied.

To improve the safety of the loader operator, Caterpillar has developed a remote drive capability and the operator is actually on-shore driving via video links.



To further protect workers, a device has been developed that will allow the crane operator to grasp the loader and lower it into (and out of) the barge without having a person make the coupling between the crane and the loader.



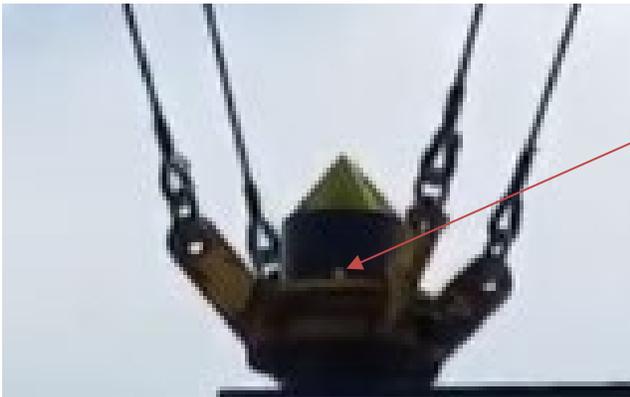


UNC CHARLOTTE

The WILLIAM STATES LEE COLLEGE of ENGINEERING



These photos show a lifting frame that Caterpillar developed to allow the crane to pick-up the loader and place it in and out of a barge. The crane lowers the collar device onto the vertical guide pole. When lowered sufficiently, the crane operator remotely actuates pins (see arrow below) that project outward from the pole and retain the lifting collar during the lifting operation. This actuation is done by an air compressor driven actuator.



This current design works, but Caterpillar is interested in exploring a re-design of this functionality that maintains the functionality, but ties into the wheel loader's hydraulic and/or electrical systems to actuate the retaining pins. The redesign will have a wireless remote actuation and release capability and a mechanical device that can grasp and lift the loader safely, and without an operator involved (other than the crane operator). The actuation motive force should be provided from the loaders existing hydraulic/electronic systems, ideally without the loader being powered on. For example, a hydraulic solution could use accumulators and an electric system can use the battery power.

Expected Deliverables/Results:

- Fully documented design for replacement system
- Testing and verification of the design to validate performance
- Prototype of the new design for the wireless system and actuator. Given the size and weight



UNC CHARLOTTE

The WILLIAM STATES LEE COLLEGE of ENGINEERING

of the collar/guide design, a scale model/demonstration is allowable and the full-size version would be design only.

Disposition of Deliverables at the End of the Project:

Provide prototype to the industry supporter at the conclusion of the Expo. Supporter will retain any IP created.

List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):

- Student team may need to travel to Clayton NC Caterpillar on occasion, all students must be able to make this trip as agreed between team and Caterpillar.