

Spring 2013

Bucket Angle Sensor System

Caterpillar, Sanford, NC

Faculty Supervisor: Thomas Dow

The goal of this project is to design and demonstrate a sensor configuration that can measure the angle of the bucket with respect to the machine base over the full range of the bucket height. The design must be simple and safe and fit into the current machine configuration. A design acceptable by Caterpillar will be:

- simple,
- mechanically reliable,
- robust,
- safe for the operator, and
- low in cost.



EcoCAR2 Projects

Volvo – Group Trucks Technology, Greensboro, NC

Faculty Supervisor: Eric Klang

Volvo Trucks sponsored the NCSU EcoCAR2 team. Several subsystems of the car were developed:

- Design and manufacture a belt drive and tensioner system between the diesel engine and the electric generator.
- The EcoCAR2 design requires two radiators, a condenser, and an intercooler. Students are to design and package the heat exchangers, pumps, hoses and support structures.
- Modify the suspension of the 2013 Malibu to compensate for the additional weight of the battery pack. Also help the design of the trailer hitch by performing transient FEA simulations.



Spring 2013 (continued)

Automation of Pre-Weld Rail-End Preparation

Norfolk Southern, Charlotte NC

Faculty Advisor: Gracious Ngaile

The goal of this project is to improve railway track maintenance employee safety and efficiency through the design and construction of a portable mechanism to prepare rail ends for flash butt welding. The rail prep mechanism is to meet the following requirements:

- Capable of automatically completing rail end preparation with a minimum of operator intervention.
- Prep the rail from the cut end a prescribed distance of between 18 and 36 inches. The prepped area must be at least 3.75" high and centered on the web of the rail. Must prepare both sides of the rail.
- Minimize rail end preparation cycle time.
- Must be compliant with all applicable safety regulations governing operator
- Be completely portable weighing 72 lbs. or less
- May use any power source (electricity, compressed air, etc.) available in the lab or contained on the unit.
- Must be capable of operating within the physical constraints shown on the provided drawings. May not exceed 24" x 24" x 36 (high)"
- Must observe high standards for design ergonomics.



New and Innovative Shower Curtains

Croscill-Living, Goldsboro, NC

Faculty Supervisor: Mohammad Zikry



Fall 2012

EcoCAR2 Projects

MAE Department, Raleigh, NC

Faculty Supervisor: Eric Klang

The MAE Department sponsored the NCSU EcoCAR2 team. Several subsystems of the car were developed:

- Design and install a mounting solution for the series hybrid drive components. This includes mounting a TM4 electric generator, a Kubota diesel engine as well as the Magna electronic drive motor all within the existing engine bay of the 2013 Chevrolet Malibu.
- Design and construct a complete engine exhaust system so that NVH (Noise, Vibration, and Harshness), weight, and back pressure are minimized. This includes but is not limited to: the exhaust manifold, DPF (Diesel Particulate Filter), an SCR (Selective Catalytic Reduction) system which includes a DEF (Diesel Exhaust Fluid) tank, mufflers/resonators, exhaust pipes, and mounting for the system to the car.
- The battery pack must be installed and removed quickly and safely from the trunk of the Malibu Eco under competition conditions without a shop lift. Hand tools and a standard engine hoist will be available.



Adjustable / Robust Crimper Maintenance Stand

Eastman Chemicals, TN

Faculty Advisor: Gracious Ngaile

The goal of this project is to design a new robust crimper maintenance stand that meets the following design parameters:

- Support a 150 pound load: Provide a list of alterations that need to be conducted to the proposed design to enable a future load of 500 pound max
- Allow the crimper maintenance stand to raise and lower the load from a 34 inch initial working height. Up and down 9 inches for a total range of motion of 18 inches
- Actuate the stand 180° to allow personnel to reach all sides safely and easily



- Implement value engineering ideas where applicable to minimize cost
- Available utility connections: 80 psi air and 120 volt power

Fall 2012 (*continued*)

Extendable Cab Side Fairings

Volvo – Group Trucks Technology, Greensboro, NC

Faculty supervisor: Chau Tran

The primary purpose of this project is to develop extendable side air fairings. Due to the market competition for delivering more fuel efficient vehicles, Volvo focuses on aerodynamics. The new extendable side air fairing must extend from the minimum length of 16 inches to a fully deployed length of 32 inches. While the deploying time is within 10 seconds, the retraction must be within 5 seconds. When retracted and stored, the fairings will not interfere with other equipment on the back of the cab.



Spring 2012

Rotation System for Skid Steer Radiators

Caterpillar, Sanford, NC
Faculty Supervisor: Thomas Dow

The objective of this project is to design and demonstrate a tool-free system to unlock the radiator assembly on a track-type loader and rotate it 10° for access to the engine for maintenance. The current design requires unbolting the front clamps and has no provisions to limit the motion or lock it in its lifted position. A new system need to be designed that will unlock the radiator assembly, allow it to be lifted 10°, lock it in its lifted position and finally release and lock into its operating position. These operations must be done without tools and within the limits of ergonomic force standards.

Light Weight Concepts for Truck Seat Suspensions

Volvo Trucks, Greensboro, NC
Faculty Supervisor: Eric Klang

Students must design and construct an innovative heavy truck seat suspension which results in lower weight while minimizing system costs. The system should provide the same or better comfort and ensure that rider safety is held paramount. The truck seat suspension should still be applicable to existing Volvo truck cab designs and seat platforms.



Automation of Pre-Weld Rail-End Preparation

Norfolk Southern, Charlotte, NC
Faculty Advisor: Gracious Ngaile

Improve railway track maintenance employee safety and efficiency through the design and construction of a portable mechanism to prepare rail ends for flash butt welding. The current process at Norfolk Southern requires an operator to use a grinder to perform the preparation. The focus of this project is to mechanize and automate the rail end preparation process. The student teams are to design, develop, and demonstrate a mechanism to significantly reduce or eliminate manual rail end preparation.



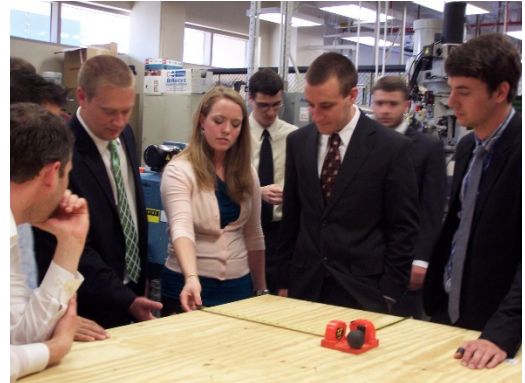
Spring 2012 (*continued*)

Lufkin 'X-Y' Tape Measure

Apex Tool Group, Apex, NC

Faculty supervisor: Chau Tran

The primary purpose of this project is to develop a tool that measures in two dimensions simultaneously. Due to the market need for increasing speed and ease in layout and measuring, such invention will provide Apex Tool Group an advantage over its competitors. The new tool must not be larger than two existing tape measures and meet accuracy of across a 4'x8' board. The secondary constraint is to utilize Apex Tool Group's current manufacturing capability.



Fall 2011

Automatic Fiber Starter Design

Corning Cable Systems, Winston-Salem, NC

Faculty supervisor: Eric Klang

The objective of the project is to design and build a machine to automate the initial feed of 1-12 optical fibers into the buffering process. The fiber should then be released without interfering with the existing processes or damaging the fibers. The intention is to create a safe, controlled, operator-independent system while minimizing manufacturing cost, variability, wasted materials and down time

HMT Half Shaft

United States Army Special Operations Command, Fort Bragg, NC

Faculty supervisor: Chau Tran

The primary purpose of this project is to redesign the half shaft for the HMT vehicle in order to improve robustness. The malfunction of the outer (Rzeppa) and inner (Cross Groove) joints is primarily caused by the rupture of the boots. The requirements for this project are to modify existing components and/or to add new components to the half shaft, and to develop a test rig for demonstrating the performance. The new haft shaft must satisfy the articulation and steering angle requirements and be compatible to all existing parts of the vehicle platform.

Mars Rover Design

Jet Propulsion Laboratory, Pasadena, CA

Faculty supervisor: M.A. Zikry

NASA provided funding to build a minirover that would be a prototype that would simulate conditions on Mars. The following requirements for the design were:

- To Design a small (< 1 kg) minirover to explore a new place on Mars
- To have minimum actuators – control systems
- To be Remote controlled
- To have the Ability to carry a 100 gram payload to simulate video and communications link
- To be Reliable, durable: survive drop, impact, measured
- To be able to demonstrate mobility on an irregular surface - similar to Mars surface

Spring 2011

Circulator Test Fixture

Northrop Grumman, Baltimore, MD
Faculty Supervisor: Thomas Dow

The design challenge is to create a test fixture to verify the performance of RF circulators. These radar components act as switches, allowing radio signals to be sent and received in fighter aircraft such as the F22 and the Joint Strike Fighter. The circulators will be presented to the test fixture by a robot. The test fixture will receive these circulators, deliver them to the test interface and return them to be removed by the robot. The test fixture is the main structure to be designed and built and to have its performance analyzed. It must be capable of grasping and moving the circulators without causing damage and to locate the circulator at the test interface within ± 0.002 inch for repeated operations. Other factors such as support technique, magnitude of the loads imposed, structural integrity, ease of use, overall system size and test cycle time will play important roles in a successful design.

Pharmacy Automation Hopper Redesign

Parata Systems, Durham, NC
Faculty Supervisor: Eric Klang

Parata Systems manufactures retail pharmacy robotic dispensing systems that dispense with 100 percent accuracy for drug dose. Students are to redesign and optimize the current vacuum-system assembly to agitate pills within the hopper of a pharmaceutical dispensing unit. The goal is to improve efficiency reliability, and cost effectiveness.

Spring 2011 (continued)

Portable Rail Anchor Boxing Mechanism

Norfolk Southern Corporation, Charlotte, NC

Faculty Supervisor: James Leach

A rail anchor is an extremely strong spring that grips the base of rails and bears against the sides of cross ties. It is designed to resist motion of the rail in the longitudinal direction due to thermal expansions or passing trains. The MAE 416 students will build a device to be used by railroad maintenance workers who must slide the rail anchors a few inches along the rails when crossties are replaced or when rail is repaired. This requires a force of about 15,000 pounds. The device must be completely portable, weighing 50lbs. or less, and must utilize the strength of the operator or batteries as a power source. It must be compliant with all applicable safety regulations, and must accommodate tall/short, large/small, male/female operators. The operator should not be required to apply more than 120 lbs of force downward, or 60 lbs of force in any other direction to operate the device, or expend more than 200 watts (averaged over 60 seconds).

Teardrop Style Ratchet

Apex Tool Group, Apex, NC

Faculty supervisor: Chau Tran

The primary purpose of this project is to redesign the Craftsman teardrop style ratchet in order to minimize dirt infiltration. The malfunction of the ratchet due to dirt infiltration has caused a high return rate over the years. Due to lifetime warranty, customers receive new components for repair or even exchange for a new ratchet. The requirements for this project are to modify existing components and/or to add new components to the ratchet, and to develop a test rig for demonstrating dirt elimination. The secondary purpose of the project is to eliminate the ball-and-spring mechanism inside the ratchet. The ball-and-spring mechanism is simply to support the gear/pawl engagement, however, presents difficulty during assembly.

Fall 2010

Power Assist Mechanism for Strollers

Reliant Power Technologies, Northern Ireland

Faculty Supervisor: Eric Klang

Students are required to design and fabricate an aftermarket electric powered stroller attachment that is safe, affordable, easy to use, easy to manufacture and adaptable to different models that will assist the operator in pushing the stroller and has fail-safe features.

Air Filter Clamping Mechanism

CamfilFarr, Washington NC

Faculty Supervisor: Gracious Ngaile

Filtration housings are an integral part of contamination control in the HVAC, Nuclear and Biological industries with the most critical component of the filtration housing being the air filter. To ensure that the filter can trap and contain any airborne contaminants it is crucial that the filter is 100% completely sealed against the sealing surface within the filtration housing. Currently CamfilFarr uses two different sealing mechanisms: one for a gasket seal filter and one for a fluid seal filter. The gasket seal mechanism requires the use of a tool to actuate the mechanism. The fluid seal mechanism is a tool-free mechanism, however, it does not provide enough clamping force to adequately compress the gasket seal filter against the sealing surface. The objective of this project was therefore to design a tool-free filter clamping mechanism that is capable of clamping a gasket seal filter or a fluid seal filter.

Spring 2010

Safety Lock for Loader Lift Arms

Caterpillar, Inc, Cary, NC

Faculty Supervisor: Thomas Dow

The objective of this project is to develop a new design for a safety lock for the lift arms of a track-type loader vehicle. This lock allows the operator to lift the arms and lock them in place for maintenance. The problem with the current design is that it takes two persons to make the system work. The operator in the machine moves the arms up to clear the cab so it can be rotated to get at the back of the vehicle. A second operator moves the locking bar into place and the first operator drops the arms until the lock is engaged. The goal is to find a mechanism such that a single operator can lock the arms.

V-22 Osprey Tool Design

NAVAIR, Cherry Point, NC

Faculty Supervisor: Eric Klang

The focus of this project is to develop a tool which will reduce the time necessary for a marine to perform a pitch-link adjustment in the field. The pitch-link is used to control the pitch of the blades on the rotor during flight in order to vary the amount of thrust delivered by the blades. Since the upper jam nut is not accessible from the access panel, the rotor-head panel that is situated in front of it must be removed. This is a time consuming process due to all of the little bolts that hold the panel in place. NAVAIR has tasked students with developing a tool which will allow a marine to complete the entire pitch-link adjustment from the available access panel without the need of removing any rotor-head panels.

Spring 2010 (continued)

Improved Adjustable Wrench

Cooper Hand Tools, Apex, NC
Faculty Supervisor: J. W. Leach

The problem is to design, fabricate, and test a prototype of an improved adjustable open ended wrench that can be used to remove a variety of sizes of square or hex head nuts from threaded bolts. The new wrench would serve the same purpose as the well known Crescent Wrench, which has been in service since about 1907, but would have improved features such as less tendency for slippage, or “knuckle busting”, better gripping ability, faster speed of adjustment, and the ability to ratchet, or re-grip without readjustment. The new wrench must meet existing ASME performance standards, and should not cost much more than a commercially available high quality adjustable wrench.

Pneumatic Screwdriver Clutch

Cooper Power Tools, Lexington, SC
Faculty Supervisor: J. W. Leach

The clutch of the pneumatic Cleco brand screwdriver is designed to shut off when a maximum torque, set by the user, is reached. The goal is to insure that all fasteners are tightened sufficiently, but that none are over-tightened. The existing clutch design, which is based on a 1968 patent, is one of the best in the industry. However, Cooper Tools would like to improve upon it so that the shut off torque is always maintained within very tight tolerances, regardless of the speed of operation and the conditions of the fastener. The problem is to design, fabricate, and test a new clutch that has improved operating characteristics. The new clutch must be capable of 1,000,000 tightening cycles, and must satisfy new industry imposed standards set by Boeing Aircraft Company and BMW Automotive. Increased cost can be justified if performance is improved substantially.

Spring 2010 (*continued*)

Design of a Spike Setting Device

Norfolk Southern, Charlotte NC

Faculty supervisor: Gracious Ngaile

One of Norfolk Southern company's main operations involves railway maintenance. When sections of track are replaced after maintenance activities, retaining spikes must be driven into wooden crossties to secure the rails. Special machines are primarily used to drive spikes, but the spikes must be initially set a short distance into the crosstie. Currently, workers perform this task manually using a spike maul. Manual spike setting poses several safety risks. Workers may injure themselves from misplaced hammer blows. Glancing hits may cause the spike to pop out of its place and strike a worker. Additionally, repetitive motion injuries may result due to the lack of ergonomics. Given these safety issues, it is desirable to create a mechanism that can reduce or eliminate the manual spike setting process.

Fall 2009

Design of a Mechanical Lifting Arm

Saint-Gobain Containers, Henderson, NC

Faculty Supervisor: Eric Klang

Saint-Gobain Containers currently uses unassisted manual labor to remove and change out mould hangers. Mould hangers are articulating claws designed to attach to and open and close the moulds. This current process to change out a mould hanger is inefficient and hazardous. The job change process causes health problems associated with the awkward, difficult process of lifting the mould hanger. The current process is for an associate to maneuver over a conveyer belt, which is transferring hot bottles, and remove the claw by hand while avoiding damaging the machinery. Students are asked to design a mechanical lifting arm which is to be used in a more ergonomic procedure. This arm will be designed to lift the mould hanger off of its mounting post and allow the associate to replace the mould hanger safely, without straining the associate.

Electronic Cabinet Assess System

Northrop Grumman Electronic Systems, Baltimore, MD

Faculty Supervisor: J.W. Leach

The challenge of this project is to create an access system for the support electronics of a ground-based radar system employed by the USMC. The access system should be operational while the radar is deployed and should be designed to minimize weight and volume while maintaining structural integrity and reliability. Some of the design constraints include, no loose hardware that could fall and damage the enclosed electronics, removable door panels for depot repairs, non-by passable safety interlocks, weight less than 150 lbs, wind loads corresponding to 80-knot winds when the doors are closed, specified shock loads during transportation, shielding against electromagnetic interference of 60 dB ,and operating temperatures in the range of -40°C to 71°C. The prototype to be constructed and tested will be a ½ scale model of the actual electronics enclosure.

Spring 2009

Slipper Clutch Actuation Design

Caterpillar, Inc, Cary, NC

Faculty Supervisor: Thomas Dow

The goal of the project will be to develop an actuation device that will improve the delivery of engine torque to the wheels without exceeding the friction coefficient. This friction coefficient is a function of the atmospheric and track condition at the time of the run. The success of the race is dominated by an accurate estimate of the friction and controlling the clutch slip to avoid loss of traction early in the run. Centrifugal clutches with timed air counterbalance are the dominant technique for current top fuel dragsters. The objective of this project is to explore other techniques that can provide better control of the torque transfer to the track.

H-53 Auxiliary Fuel Tank Support Sling

NAVAIR, Cherry Point, NC

Faculty Supervisor: Eric Klang

Currently there is no method for removal and transportation of the CH-53 Batwing aside from multiple military personnel lifting the equipment. Our sponsor, NAVAIR, has assigned the task of designing a sling-like apparatus that would allow removal of the Batwing from a CH-53 helicopter with limited human involvement. An overhead hoist will be used along with the sling in order to remove and install the Batwing onto the helicopter and transportation dolly. The designed sling shall provide a safe and stable method of handling the Batwing. It will also be used to transport the Batwing through the storage depot.

Spring 2009 (continued)

Automated Self Unloading, Leveling, and Loading Platform

Northrop Grumman Electronics, Baltimore, MD

Faculty Supervisor: J. W. Leach

Northrop Grumman Electronics specializes in radar technologies that are placed on stationary land platforms, mobilized trucks, ships, aircraft, and even in orbit around the planet. Ground based radar systems generally provide surveillance, data acquisition, tracking, discrimination, fire control support, and kill assessment. The ground based radar systems are unloaded from trucks or trailers at strategic locations in the field, and must be leveled before they can function properly. At present, they are deployed manually. The MAE 416 class is challenged to design, fabricate, and test a 1/10 scale model of a fully automated self unloading, leveling and loading platform for ground based radar systems. The prototype must successfully unload, level, and load the radar system within 6 minutes when the truck or trailer is parked on a 10° incline, and the antenna must be leveled to within +/- 0.1 degrees. The weight of the full scale antenna is about 4000 pounds, and the power that is available to deploy it is 50 kW. A platform with four legs is desirable for increased stability in cross winds.

Fall 2008

Tape Measure Standout Improvement

Cooper Tools, Apex, NC

Faculty supervisor: Eric Klang

The problem is to design a new tape measure blade with increased stand-out. Stand-out refers to the distance that the extended tape blade can support itself. The challenge is to maximize the stand-out (more than 10 feet), while minimizing the blade width and package size. The tape blade should remain a standard 25 foot length. Care should be taken to avoid intellectual property or patent infringements.

Innovative Concepts for the Protection of Mobile Phones

Sony Ericsson, RTP, NC

Faculty supervisor: Gracious Ngaile

Sony Ericsson Mobile Communications, Inc. designs numerous models of mobile phones that are categorized by their form factor; stick, clamshell, or slider. The slider form factor has phone halves that slide relative to each other to expose the keypad. Slider phones are very popular with users and are in high demand. The movable housings, however, pose a problem of vulnerability to water entering the phone if the phone is dropped in water or used in the rain.

In this project, we are asked to explore ways to protect the phone from the effects of water ingress.

Spring 2008

Mobile Ground-Based Radar Antenna Array Lifting Mechanism

Northrop Grumman Corporation, Baltimore, MD

Faculty supervisor: Eric Klang

Northrop Grumman Corporation (NGC) is designing and constructing a mobile, ground-based radar antenna array. The radar antenna system will be used in the field by the United States Marine Corps as a critical element of their communication network. The mobile system relies on a two-wheel trailer rig which is designed to be towed by military vehicles with standard towing capabilities. Once located the radar system will be deployed indefinitely as part of a greater radar communication network. Like all equipment designed for military field use, this radar system must be robust and rugged--capable of operating reliably in harsh conditions and withstanding particularly stressful means of transportation including drops from helicopters. To aid in the design of the radar, NC State University is in charge of designing a system and building a scale prototype to deploy and stow the radar array.

Improved Hand Shears for Sheet Metal Cutting

Cooper Hand Tools, Apex, NC

Faculty supervisor: James W. Leach

Aviation type metal cutting shears with a compound lever mechanism are widely used by sheet metal workmen around the world. The shears sold by different manufacturers are all very similar in design, and all are constructed in accordance with detailed standards established by the ASME. Cooper Hand Tools wishes to improve their Wiss brand shear so that it requires less hand force to cut standard 18 gage cold rolled steel, or can be adjusted by the worker to cut stainless steel or heavy gage sheet metal. The overall goal is to make the tool easier to use and more versatile. However, the improved design must satisfy the standard ASME requirements, and must not cost significantly more than the existing shear. The student teams fabricated six different prototypes based on concepts such as high gear / low gear designs, cams and rollers to level out the required hand force, ratchet mechanisms, and lead screw mechanisms. They calculated the stresses in key members using CAD software, and employed statistical analyses to study fatigue in springs and bearing surfaces.

Spring 08 (continued)

Design of a Broom Element Installation Tool for Railway Track Maintenance

Norfolk Southern, Charlotte NC

Faculty Supervisor: Gracious Ngaile

During railroad truck maintenance a common task is the removal of ballast from the tracks and surrounding areas using a track broom machine. Replacement of worn broom elements in the machine is a challenge as operators have to use manual hammers. These hammers are heavy, awkward, and are prone to back injury. The objective of this project was to improve railway track maintenance employee safety and efficiency by designing a new tool capable of installing broom element safely and easily. Besides being efficient the new tool should accommodate operators of all sizes and cannot subject operators to awkward positions or repetitive motion injuries.

Design of LCD Protection Systems for Cell Phones

Sony Ericsson, RTP, NC

Faculty supervisor: M. K. Ramasubramanian

The objective of this project is to design, analyze, and demonstrate with a prototype construction and testing, innovative concepts for the protection of LCD displays within thin phone packages. The concepts may involve new ways of mounting the displays, innovative protection deployment when a phone is dropped, or combinations thereof. The protection system should not in any way affecting the aesthetics of the phone. The protection system should be resettable (in other words, once you drop the phone, you don't have to take it back to the store to reassemble the deployed systems back to a normal looking phone except for extreme cases. The solution should add minimal weight to the phone and be cost effective. Students developed unique designs, built prototypes, using conventional manufacturing, and stereolithography processes, and tested them in a real drop on a concrete surface. Student designs survived the drop test.

Fall 2007

Design of an Automatic Sifter Inserting Machine

Harmony Labs, Landis, NC
Faculty supervisor: Eric Klang

Harmony Labs is a full service contract developer and manufacturer of topical prescription, pharmaceutical, and cosmetic liquids, semi-liquids, semi-solids, and powders. The filling and capping system used by Harmony Labs is not fully automated. There is no practical piece of equipment that can autonomously insert sifters into the cosmetic jars. Students are required to design and fabricate automatic sifter insertion machines to satisfy this need.

Design a Self-Leveling and Return-to-Dig Feature for the Caterpillar 420E Backhoe Loader

Caterpillar, Clayton NC
Faculty Supervisor: Gracious Ngaile

The current design for auto-leveling and return-to-dig has several flaws that have prompted the need for an entire new design. The current design uses a complicated system of push rods and levers to release fluid from a hydraulic valve. Assembling of the system is thus time consuming and requires frequent maintenance. During operation the return-to-dig feature occasionally interfere with the auto-leveling system. The objective of this project is therefore to better integrate the auto-leveling and the return-to-dig feature into a single consistent design.

Spring 2007

Design of a Pan Retention System

Turkington APV, Goldsboro, NC

Faculty supervisor: Eric Klang

The conveyor's baking pan retention method currently used by Turkington APV USA is inadequate for certain pan types. Competition within the industry has pressured Turkington APV USA to redesign their pan retention system. Six solutions were presented by the student teams. The designs ranged from traditional magnetic devices to leaf spring and deflecting finger devices.

Material Handling Arm Design

Caterpillar Inc., Clayton, NC

Faculty supervisor: M. K. Ramasubramanian

The objective of this project is to design a new material handling arm that is compatible with standard and high-lift 924G and 930G small wheel loaders. The newly designed arm should have three adjustable extended positions that are easy to extend and secure with clear visibility of the hook in all three positions. The weight of the material handling arm cannot exceed 460 Kilograms. Load capacities to design for are 2363 Kg in retracted position; 1890 Kg in middle position; and 1576 Kg in fully extended position. Fully extended length of the arm should match current design, namely, 3939 mm. Students designed using CAD and carried out detailed analysis using ANSYS finite element software.

Spring 07 (*continued*)

Design of a Spike Setting Mechanism

Norfolk Southern, Charlotte, NC

Faculty supervisor: Gracious Ngaile

This project is to concentrate upon the steel spike insertion segment of the maintenance cycle. The vast majority of spikes are inserted (driven) using modern automated machinery. However, for spot maintenance or physically restrictive track structure, spikes are frequently installed in a largely manual process. This requires a railway employee to start (or set) the spike into the wooden crosstie with a few well placed hammer blows. Following the setting of the spike, the same or another employee will finish driving the spike using a hydraulically powered hammer or a conventional spike maul (hammer). Occasionally during the setting process, a misplaced hammer blow may result in the spike dislodging and becoming airborne. This undesirable event exposes railway employees to injury.

The objective of this project is therefore to design and fabricate a portable device that will be used to set spikes on wooded crossties.

AN/SPQ-9B Phase Shifter Assembly and Test

Northrop Grumman Corp, Baltimore, MD

Faculty supervisor: Chau Tran

The AN/SPQ-9B antenna installed on the USS Reagan carrier is composed of several phase shifter/RF launch assemblies. For each assembly, one phase shifter and four RF launch components are currently assembled manually. The students are required to automate two processes: the assembly of the phase shifter and its RF launch components, and the quality control of the overall length and electrical connection. Prior to designing the automation processes, the students manufacture their own mock phase shifters in accordance with specified tolerances.

Fall 2006

Design of an Engine Test Facility

Cummins Inc., Whitakers, NC
Faculty supervisor: Eric Klang

The Mechanical and Aerospace Engineering Department has inadequate engine test facilities. The previous engine dynamometer rig was inaccurate and illegal. NC State University needed new dynamometer facilities to enhance undergraduate education and help investigate alternative fuels. Cummins Inc. supplied an engine and dynamometer for the project and gave advice to the students. Three working systems were developed and tested.

Design and Fabricate a Backhoe Loader Side Shifting Assembly

Caterpillar, Clayton, NC
Faculty supervisor: Gracious Ngaile

The backhoe loaders in the United States utilize a design that pivots at the base of the hoe, called the Center Pivot backhoe loader. The advantage of this type of backhoe loader is that it is very stable and can lift relatively heavy loads compared to other designs. However, these backhoes have a large footprint when parked with the stabilizers down. A large amount of construction in the United States and other industrialized nations has shifted from developing open spaces to renovating highly populated and developed areas. A Side Shift backhoe loader would be the optimal choice for these areas.

The objective of this project is therefore to create a new design for the Caterpillar Backhoe Loader that encompasses the features and versatility of the Side Shift and Center Pivot backhoe loaders while maintaining the simplicity of design and cost of the Center Pivot model.

Spring 2006

Design of a Gimbaled Radar System

Northrop Grumman Corp, Baltimore, MD

Faculty supervisor: Eric Klang

During normal operating conditions such as tactical flying in an aircraft, riding over rough terrain in a land vehicle, or hitting waves on a naval vessel, a radar antenna system encounters severe loading. This can cause slight deflections in the antenna face, which can result in inaccurate radar readings. Students are required to design and construct a radar system that is capable of handling the antenna and support structure without yielding under various loads. It must also be capable of meeting strict precision requirements, it must have an acceptable speed, and it must be lightweight.

Design of an Automatic Climate Control System for Small Wheel Loader Cabs

Caterpillar Inc., Clayton, NC

Faculty supervisor: M. K. Ramasubramanian

Current Caterpillar Wheel Loader Cabs offer a standard AC system. There is a market need for an automatic temperature controlled AC system that can maintain an operator determined temperature setting. Design project would be to concept a HVAC system that develops the current system to include an appropriately located single temperature sensor in the cab, an electronically controlled water valve to control system temperature, and an operator interface. Design considerations: Temperature accuracy, Temperature sensor location, Operator interaction with the system or user interface, and Cost.

Spring 2006 (*continued*)

Design of Autonomous Tie Plate Insertion Machine

Norfolk Southern, Charlotte, NC

Faculty supervisor: Gracious Ngaile

Large amounts of manpower are currently required to provide railroad track maintenance across the country. One of the tedious maintenance processes is the placement of the tie plate to the correct location under the rails. This is accomplished by using a rail puller to lift the rail up and manually pushing the tie plate into position. In order for the rail to fit correctly onto the tie plate, its placement must meet very tight tolerances.

The main objective of this project is to devise a mechanism that can be connected to an existing railway maintenance machine to improve the method and efficiency of inserting the tie plate between a wooden crosstie and steel railway rail base.

Fall 2005

Design of a Lubricator for Use in Industrial Oven Conveyor Systems

Turkington APV, Goldsboro NC

Faculty supervisor: Eric Klang

Industrial ovens use chain drives to transfer bread pans from one location to another. At present the chain coupling/bearings are being lubricated manually. To allow for better temperature control and minimal heat losses, the oven is sealed leaving very small openings for applying lubrication to the chains. Thus, it is very difficult for the operator to access the chains. As a consequence the lubricant may not be evenly applied to the bearings resulting in rapid wearing of the bearings. Over utilization of the lubricant is also possible as the process depends on the experience of the operator.

Turkington APV would like NCSU to develop an automatic lubricator that will address the above mentioned problem.

Design and Fabricate a Coupler Adaptor for Small Wheel Loaders

Caterpillar, Clayton, NC

Faculty supervisor: Gracious Ngaile

Caterpillar BCP is currently in the process of designing and developing a new line of Small Wheel Loaders called the X-Series. The X-Series encompasses a large number of performance, structural and functionality improvements over its predecessor, the G-Series SWL line. One of the most significant changes made to the X-Series is the way the machine interfaces with the work-tools. With the introduction of this new interface the existing IT compatible work tools in the field will thus not be compatible with the X-series SWL line. Therefore, there is a need to provide existing Caterpillar customers with a cost effective and efficient way to use these IT tools with the new X-Series machine interface.

The main objective of this project is to design a mechanical adapter that can provide CAT customers who purchase X-Series SWL's the ability to interface with existing IT compatible work tools; buckets, fork carriages, brooms, etc.

Spring 2005

Design of a Granular Material Spreader Attachment for Skid Steer and Multi-Terrain Loaders

Caterpillar, Inc., Sanford, NC

Faculty supervisor: M. K. Ramasubramanian

Currently, Caterpillar does not make a granular material spreader for skid-steer and multi-terrain loaders. The objective of this project was to design, develop, test, and deliver a working prototype a granular spreader. The following parameters were considered in the design: size, capacity, range, weight, spreading width and spreading pattern. Material handling versatility, corrosion resistance, power requirements, and the projected cost of manufacture were also considered.

Design of Tobacco Packaging System

Dimon International, Inc., Farmville, NC

Faculty supervisor: Gracious Ngaile

During the packaging process tobacco leaves are conveyed by a belt conveyor to the 33-tall filling charge. After a predetermined weight of leaves has been filled in, a ram is activated to compress the leaves which are then put in boxes. Slight variations in the density of the packed tobacco may affect the quality of the final product. The main objective of this project was to design a system for conveying and filling tobacco leaves into the filling charge such that tobacco leaves are more evenly distributed.

Design Project for Locking Spring Removal Tooling

Global Nuclear Fuel, Wilmington, NC

Faculty supervisor: Eric Klang

GNF produces nuclear fuel rods for various companies around the world. Fuel pellets are held in place inside the fuel rods by press-fit retaining springs. Automating the spring insertion/removal is a problem with the current spring design. The project required students to adhere to the following constraints from GNF: easy to operate, operable without damaging the fuel rod, compatible with the current fuel rod, cost effective and comprised of nuclear-grade materials.

Fall 2004

Bus Bar Insulator Reconfiguration

GE Industrial Systems, Mebane, NC

Faculty supervisor: Eric Klang

Currently, the GE facility uses preformed bus boots to insulate the unprotected portions of the bus bars in their medium voltage breaker box systems. The different shapes of bus bar connections require several different geometries for the bus boots. The facility currently stocks over 200 different configurations of bus boot, which causes a strain on inventory. Students are to find a method for reducing the number of different configurations subject to the following constraints:

- Withstand 60kV surge (lightning strike)
- Dielectric Strength – 500 Volts RMS/MIL
- Continuous Temp – 105° C
- Wall Thickness - ≤ 0.08 in.

Design of a Wheel Loader Side-Door Hinge Assembly

Caterpillar, Clayton, NC

Faculty supervisor: Gracious Ngaile

The current side door hinge assembly for the wheel loader is too costly and limits the size of the tire that can be fitted while still allowing engine access. The main objectives of this project are a) to design a side-door hinge assembly such the largest tire can be cleared and b) to reduce the cost of the current hinge assembly by 35%.

Spring 2004

Automated Test Fixture for Antenna Segments

Northrop Grumman, Baltimore, MD
Faculty supervisor: Tom Dow

The objective of this project is to develop an automated system to test individual RF antenna elements that have been assembled into an array. This test system will support the antenna segment, find an individual antenna element, connect the input source to the RF port, connect the electronic input to the test connector, wait for the test to be completed and move to the next element.

Design of a Nuclear Fuel Rod Assembly Mechanism

Global Nuclear Fuel, Wilmington, NC
Faculty supervisor: Eric Klang

The method currently used to assemble and disassemble nuclear fuel bundles is extremely inefficient and difficult to implement in the field. Repairing a damaged fuel bundle requires the entire reactor to be shut down until the assembly is repaired. The objective of this project is to improve the mounting mechanism for the upper tie plate of a nuclear fuel rod bundle.

Superpac 8411 Noise Reduction

SPONSOR: Volvo Construction Equipment
FACULTY: Gracious Ngaile

The objective of this project is to reduce the sound power of the Superpac 8411 by at least 2dB below the 2006 EU regulations 107 dB. This will be achieved by redesigning the hood and ensuring that the cooling system of the machine is not affected.

Spring 2004 (*continued*)

Rollover Protection System (ROPS) for a Skid Steer Loader

SPONSOR: Caterpillar, Sanford, NC

FACULTY: M. Ramasubramanian

The project is ongoing in Spring 2004 to develop full functional specifications and develop a cab with a new look for the future, not necessarily, reduce cost, but meet marketing needs.

Fall 2003

Foreign Material Removal from Tobacco Picking Line

DIMON International, Farmville, NC

Faculty supervisor: Tom Dow

The objective of this project is to develop a system to identify and eliminate foreign material in chopped tobacco leaves using an electrostatic precipitator. The concept to be tested is whether electrostatic techniques can separate the moist tobacco leaves (~20% moisture) from paper, plastic and rubber products.

Design of Forklift Height Sensing Systems

NACCO Materials Handling Group (NMHG), Greenville, NC

Faculty supervisor: Eric Klang

Lift truck operators have difficulty picking and placing loads safely and reliably when loads are at high elevations. NMHG currently has a height sensing option for their fork trucks to help operators with this problem but it is too costly to be competitive. The objective is to design a system that is not only beneficial to the operators, but economically sensible as well.

Design and Fabricate an Automatic Chipboard Feeder

SPONSOR: Carastar Mill Group

FACULTY: Gracious Ngaile

The objective of this project is to improve the operation of the sheet pasting machine by automating the sheet feed process. By eliminating the manual feed aspect of the process, the work force needed, for each glue machine, will be cut by a third.

Fall 2003 (*continued*)

Rollover Protection System (ROPS) for a Skid Steer Loader

SPONSOR: Caterpillar, Sanford, NC

FACULTY: M. Ramasubramanian

The objective of this project is to design an SSL ROPS that; meets all regulatory/safety requirements, has the ability to function as an opened or closed ROPS, maintain or decrease the total visibility obstruction compared to current design, provides for the maximum utilization of space to facilitate a roomy feel in the cab, at reduced cost compared to present ROPS.

Spring 2003

Application of Damping Material to Dishwasher Tubs

Bosch Home Appliances, New Bern, NC

Faculty supervisor: Tom Dow

The objective of this project is to develop a system to speed up the process of applying sheets of sound deadening material to the external surfaces of the dishwasher tub. The sound deadening material (bitumen) is supplied with a temperature sensitive adhesive layer and the tub is passed through an oven to adhere the material. This process is the bottleneck in the production line and needs to be redesigned to reduce the application time.

Automatic Rewind of Photographic Film

Konica Manufacturing U.S.A., Inc

Faculty supervisor: E. C. Klang

Slit rolls of photographic paper produced by the Konica Corporation sometimes have imperfections such as roll projections, offset cores, and loose windings. These problems with pre-delivered rolls necessitate the inspection and occasional adjustment of problematic rolls before shipment. The current process of roll adjustment involves the use of a wheel and an operator to loosen, adjust, and then retighten the faulty rolls. The objective of this project is to build automated equipment that will recover spliced rolls, co-product rolls, and other nonconforming rolls to an acceptable roll tension and build.

Design of the Pedal Group for Track Type Loaders

Vermont American Corporation

Faculty supervisor: M. Ramasubramanian

The objective of this project is to redesign, analyze, and develop prototypes for the adjustable pedals for the D5G Track-type Tractor. Redesigning the relevant portion of the cab floor to accommodate the new adjustable pedals and the design of the pedals themselves are within the scope of the project. The pedals are to be adjustable so that the controls are operable by operators of sizes in the range of 5th percentile female to taller 95th percentile taller male, as per the specifications to be provided and analyzed to be durable, cost effective, and simple to use.

Fall 2002

Drying Glass Bottles to Enhance Label Adherence

Abbott Labs, Rocky Mount, NC

Faculty supervisor: T. A. Dow

The objective of this project is to develop a system to remove the moisture from the outside of medicine bottles so that pressure-sensitive labels will stick to their faces. The system must fit into the current packaging line and dry the bottles at normal production speed (9 bottles per second). It must also be cost effective and efficient with respect to energy usage.

Assembling Power-Change Hole Saws

Vermont American Corporation

Faculty supervisor: E. C. Klang

Vermont American produces a standard hole saw set with a special quick-connect shaft already screwed into the top of the saw. Assembly labor required for this product must be kept to a minimum since there are likely to be hundreds of thousands of these built during the tool's lifecycle. The company had each group in MAE 416 design and build a prototype "Power Change application station" that could simplify the assembly process.

Skid Steer Loader Noise Reduction to meet ISO Standards

Caterpillar, Sanford, NC

Faculty supervisor: M. Ramasubramanian

The objective of this project is to investigate the sources of noise and vibration through testing and measurement and identify noise reduction strategies for both the operator and the external observer and meet the new ISO standards. The solution should result in noise reduction, should be reliable, low cost, easy to install, and can be retrofitted. The constraints include maintaining cooling capacity of fans, engine performance, hydraulic components performance, and safety specifications.