

UNC Charlotte – Lee College of Engineering Senior Design Program

Senior Design Project Description

Company Name	NAVAIR	Date Submitted	6/16/2019
Project Title	Automation of APU Compressor Wheel Material Removal Balance Operation NAV_APU	Planned Starting Semester	Fall 2019

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	3	Electrical	1
Computer	1	Systems	
Other (

Company and Project Overview:

For more than 60 years, Fleet Readiness Center East, at Marine Corps Air Station, Cherry Point, N.C., has played an integral role in our national defense. The facility's In-Service Support Center provides multi-disciplinary, engineering services in both design and maintenance. Our workforce has earned a reputation of excellence, providing worldwide support for Navy and Marine Corps aviation.

Fleet Readiness Center East has provided maintenance, repair, and overhaul support to virtually every weapons platform the Marine Corps has flown – from the inverted gull-winged F4U Corsair of World War II fame, to the Corps newest aircraft, the F-35B Lightning II. It is one of eight fleet readiness centers operated by the United States Navy. It is also the Department of Defense Vertical Lift Center of Excellence. FRC East has a workforce of about 3,800 civilian, military, and contractor personnel. It is North Carolina's largest industrial employer east of Interstate 95. NAVAIR is an active employer for UNC Charlotte grad's and has many COE Alum's on their staff.

FRC East artisans perform phased depot maintenance, planned maintenance intervals, integrated maintenance concepts, modernizations, conversions, overhaul or in-service repair on the AV- and TAV-8B Harriers, the V-22 Osprey, the AH-1W Super Cobra, the AH-1Z Viper, the UH-1N Huey, the UH-1Y Venom, the CH-53E Super Stallion, and MH-53E Sea Dragon, the F/A-18 Hornet, the F-35B Lightning II, the H-3 Sea King; the H-60 Seahawk; the EA-6B Prowler; and the C-130 Hercules. The



The WILLIAM STATES LEE COLLEGE of ENGINEERING depot is also the depot repair point for the drive and rotary systems of the MQ-8B Fire Scout.



This project will deal with an Auxiliary Power Unit (APU):



APU's are gas turbine engines used on aircraft to provide power when the aircraft is on the ground to do such things as operating hydraulic and electrical systems to check their operation. This



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project will seek to improve a maintenance action that is required periodically on the unit.

Project Requirements:

A critical component of the APU is the "Compressor Wheel". See picture below:



The Compressor Wheel is attached to the rotor shaft. Due to the high speed operation, it is critical that the assembly is balanced. Checking this balance is one of the critical maintenance operations when the APU's come in for service.

The following pictures show the device that is used to check the balance:





This machine spins the rotor shaft and measures the balance of the unit. When complete, it provides and output which indicates if the unit is in balance or not:



If the unit is not in balance, the output provides a location and amount of material that must be ground away to rebalance the shaft.

Currently, the material removal is done by hand with a hand-held grinder who follows a written instruction process. This process defines exactly where and how much material can be removed to meet the balancing specification. As the removal amounts are small (gram(s)) this can take a human operator multiple passes and measurement iterations to balance to specifications. The goal of this project is to automate the material removal operation so it is more precise which will result in less time and iterations required.

Expected Deliverables/Results:

- Develop and automated grinding system for the Compressor Wheel:
 - o Develop a holding fixture for the Compressor Wheel assembly
 - With the Compressor Wheel in the fixture, program in the instructions for the grinding operation that is provided from the balance measuring machine.
 - Develop an automated grinding machine operation that will grind the prescribed amount and location
- Goal is to achieve balance after 1 grinding cycle.



Disposition of Deliverables at the End of the Project:

Hardware developed is the property of the Industry Supporter. Work product is displayed at the last Expo then immediately handed over to the supporter unless arrangements have been made to deliver at a future date.

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

• Travel to NAVAIR Cherry Point, NC is required. Travel costs will be reimbursed from the team's project budget.