UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE *of* ENGINEERING

Senior Design Project Description

Company Name	*NAVAIR*	**Date Submitted**	*12/07/2020*
Project Title	*Harmonic Vibration Feedback System* **(NAV_VIBRATE)**	**Planned Starting Semester**	Spring 2021

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	
Computer		Systems	1
Other ( )			

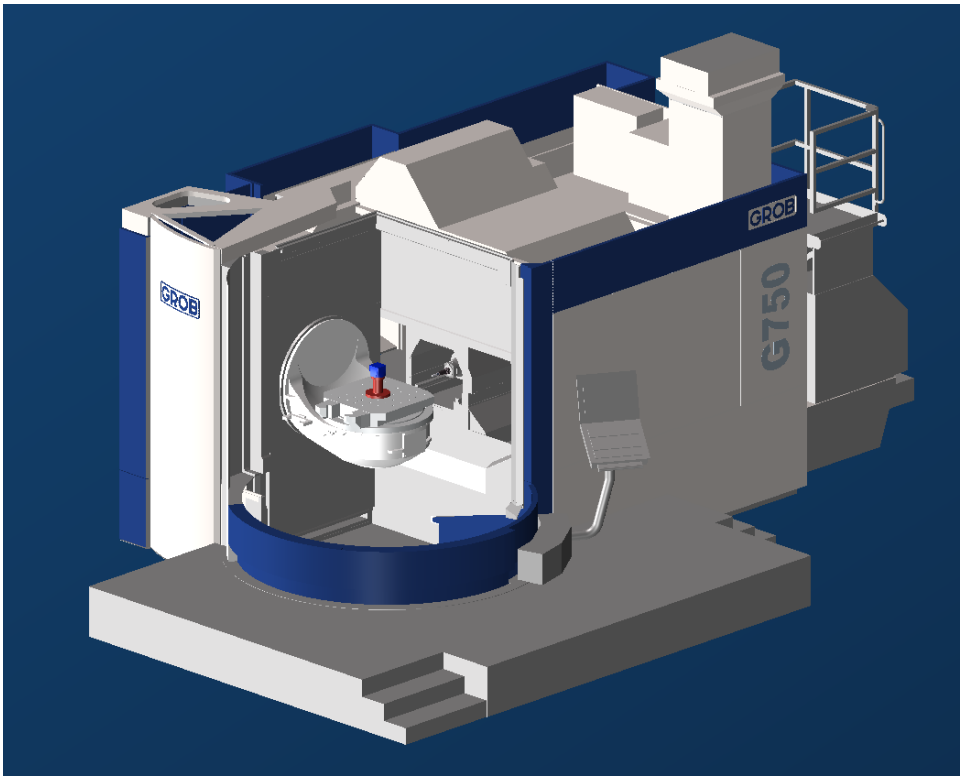
Company and Project Overview:

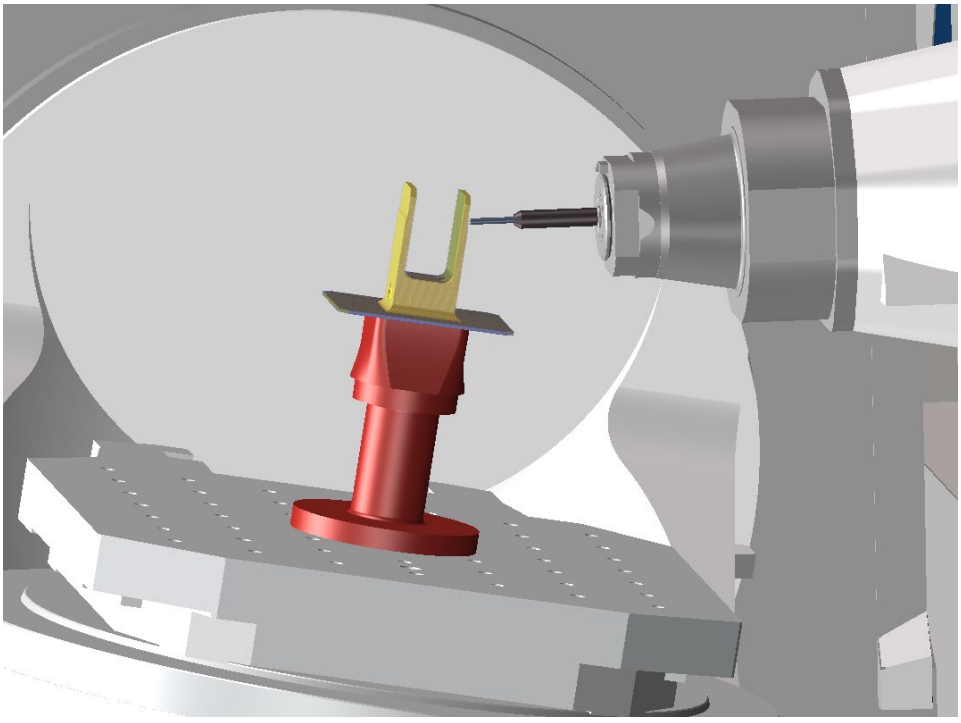
For more than 60 years, Fleet Readiness Center East, at Marine Corps Air Station, Cherry Point, N.C., has played an integral role in our national defense. The facility's In-Service Support Center provides multi-disciplinary, engineering services in both design and maintenance. Our workforce has earned 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 depot is also the depot repair point for the drive and rotary systems of the MQ-8B Fire Scout.

This project will involve manufacturing of thin-walled aircraft components. GROB 750 pictured below:





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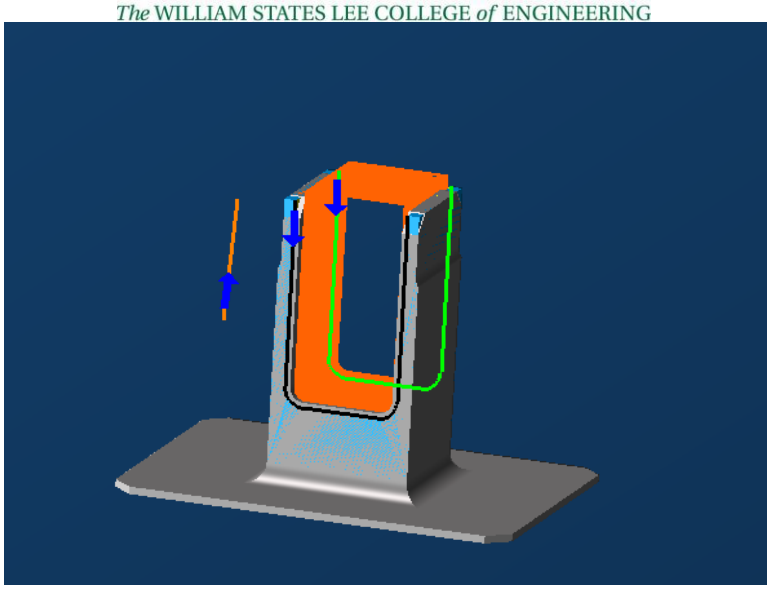

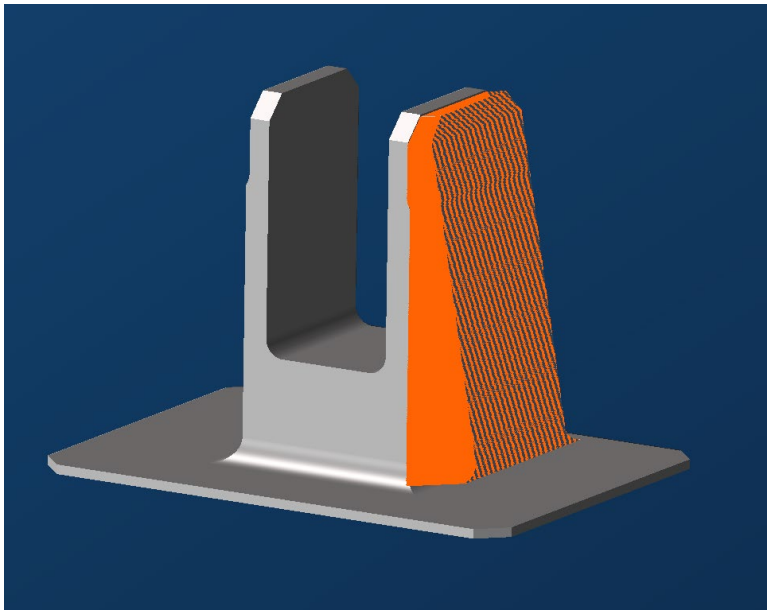

Project Requirements:

The efficiency of our machining processes are very important to NAVAIR. Our process efficiency directly affects our speed to the fleet. NAVAIR is seeking improvements in the ways that they create computer numeric controlled machining programs, which drive mills that produce thin walled critical safety items for various platforms.

Our goal is to design and integration a system into the CNC mill which provides the operator feedback on the change in the part's natural frequency over time. This will allow the operator/programmer to adjust the feed and speed of the program to run outside of +/- 10% of the part's natural frequency at any given stage of the milling process. This is expected to reduce harmonic vibrations and machining process time. The group may use the part geometry and

machining process parameters as a baseline example of a part which is known to experience significant harmonic vibration.

Please find the below reference information. These parameters resulted in harmonic vibration that required the machinist to reduce the feed and speed of the machining operation from the goal speed and feed to the actual speed and feed.

Fixed Parameters
Material: 7075-T73
Grain Direction: Parallel to forks
Ridge Height: 0.00005in

Variable Parameters
Mill: GROB 750
Stock Size:
Stock Preparation Run Time: 15 minutes
Rough Run Time: 6 hours
Finish Run Time: 38 hours
Tool Path Style: 5 Axis Lace Cut
Ball Nose End Mill: DIA.3125in/2 Flute/Ball Nose/Solid Carbide/45 Degree Helix
Length Out of Holder: 2.6in
Contact Angle: 10 Degrees
Actual Speed: 3000rpm
Actual Feed: 20 in/min
Goal Speed: 9000rpm
Goal Feed: 80in/min
Material Depth Removed: 0.01in
Contact Angle: 10 Deg
Cut Direction: Climb Milling

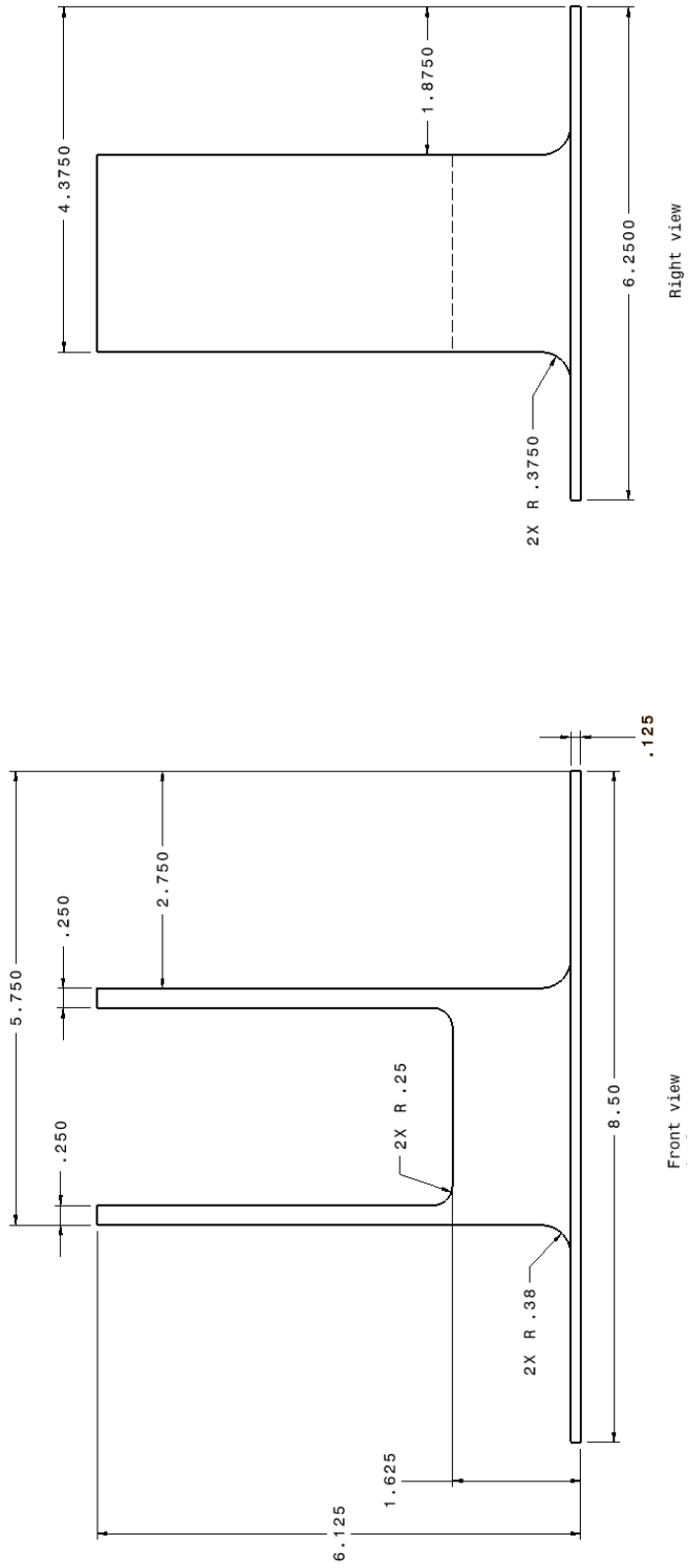

Figure 1: Example Part

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Expected Deliverables/Results:

- Design a feedback system which integrates with the GROB 750 or a universal system which measures and reports the natural frequency of the part as it varies overtime. The design may include, but is not limited to a shaker tables, accelerometer, ball shooter or the like.
- Functional Prototype
- Describe the limitations of the proposed solution.

Disposition of Deliverables at the End of the Project:

Any process and/or process parameters developed are the property of the Industry Supporter. The work product will be displayed at the last Expo then immediately handed over to the supporter unless arrangements have been made to deliver at a future date.

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

- Reference: Bachrathy D, Kiss AK, Kossa A, Berezvai S, Hajdu D, Stepan G. In-Process Monitoring of Changing Dynamics of a Thin-Walled Component During Milling Operation by Ball Shooter Excitation. *Journal of Manufacturing and Materials Processing*. 2020;
- Materials
- Machining Processes
- Vibrations

Reference Article.pdf