NORTHERN ARIZONA UNIVERSITY

To: *Dr. Oman and whom it may concern*

From: *Team D1: Kalli Albright, Kaitlyn Barr, Dustin Branges, Daniel Johnson*

Date: *October 13, 2017*

Re: *Analytical Analysis Team Memo*

Introduction

This memo will discuss four analytical analysis tasks for the D1: UAV Antenna team. Each section will describe an engineering characteristic vital to the operation of the antenna gimbal along with calculations to be performed and the individual in charge of each calculation. The four calculations for consideration are deflection, torque, strength of materials, and vibrations.

Deflection (Daniel Johnson):

One of the most important factors that need to be considered when designing cantilevered parts is deflection. Every part will bend, or deflect, under its own weight. This is important to consider because certain materials will deflect more than others leading to inaccuracy in angle readouts and other data. Also with high deflection parts will wear at a greater rate which will affect our customer need for durability. By calculating the deflection in the system the team will be able to account for this in relaying the angle which will lead to greater accuracy.

Torque (Kalli Albright):

The antenna gimbal system will be subjected to torque when the UAV is in use. The weight of the attached antenna will be at the antenna's center of gravity at a horizontal distance away from where it will be connected to the UAV. This distance will change as the angle of the antenna is changed as the team's main concern is with the torque in the vertical direction since gravity is the only external force acting on the system. The motor will need to have enough power to overcome this torque and still accurately angle the antenna to the users specifications. By analyzing this characteristic, the team will be able to determine the maximum torque required by the motor, allowing better knowledge when deciding which lightweight motor to utilize.

Strength of Materials (Dustin Branges):

The strength of materials used in the construction of the gimbal is crucial to the success of the system. Since the antenna gimbal will be attached to the bottom plate of the UAV housing, it could potentially need to withstand drops from 200 ft with the weight of the the entire UAV system on top of it. It is important to analyze the stress that the frame of the gimbal will be subjected to, to correctly identify the material to construct it out of by comparing the necessary strength requirements to the mechanical properties of a variety of materials. All components of the system will need to be lightweight, yet just strong enough to not fail during

operation. By calculating the required strength of materials that our system will consist of, the team will gain more knowledge on the qualities needed when further developing the design.

Vibrations (Kaitlyn Barr):

This section will discuss the vibrations the antenna may experience during flight and angle rotation. Since the antenna has dipoles that act as cantilever beams, and will be attached to a UAV, which is subject to turbulence during flight, it will experience vibrations. Even with perfect weather conditions, the antenna will experience vibrations during angle rotation from the gimal while collecting data. Vibrations are normal and usually cannot be completely removed from a system, so it is important to understand how the vibrations of the antenna may affect the data collection process. One important factor to take into consideration is when resonance occurs. If the frequency of the system matches the natural frequency of the antenna, resonance will occur, causing a large oscillatory motion, making data collection nearly impossible. To avoid resonance, the frequency caused by the rotation of the gimbal or movement of the UAV base should be much smaller or larger than the natural frequency to avoid this phenomena. Therefore, the team needs to calculate the natural frequency of the antenna to ensure that their device does not promote resonance.