Literature Review

1. Introduction to literature review

* List off what the section contains
* Make a disclosure statement about how UAVs is a broad category of crafts and that the methods applied herein could be applied to multi-rotor craft

1. Fixed Wing UAV
   1. (Introduction to fixed wing uavs)
   * Definition of fixed wing UAV
     + 6DOF system under actuated with 4 degrees of control (pitch, roll, yaw, and thrust)
   * Uses (civilian and military)
   1. Modeling
   * Complete kinematic models consisting of position and velocity result in a 12 state model that is non-linear and complicated to implement
   * To carry out mission objectives and maintain stability
   * When developing low level control systems for these aircraft, complex kinematic systems may be used after being linearized. For high level guidance, it is often assumed that there exists a low level autopilot control loop
   * Minimum forward velocity constraint, minimum turning radius constraint and reasons
   1. Autopilot / Flight Controller
   * Autopilot has several functions
     + Maintain vehicle stability
     + Turn high level commands into low level control effort
     + Record and transmit data to ground stations
   * Autopilots will do this through several layers of instruction referred to navigation, guidance, and control
2. Navigation, Guidance, and Control
   1. (Introduction to NGC)
   * Traditionally NGC can be thought of separate but equally important layers of instruction
   * Navigation is the study of sensing the state of the vehicle
   * Guidance produces a commanded state based on high level requests from a path planner or user
   * Control maintains vehicle stability while attempting to achieve guidance’s requested state
   * Lately, the lines between guidance and control have become less clear as they become more integrated with each other. The work presented will continue with this trend
   1. Navigation
   * (Introduction to navigation)
   * Localization and attitude (6DOF), gyroscopes, accelerometers, etc IMU
   * Measurements are inheritably noisy and are often filtered
   * Common autopilots use extended kalman filter, a statistical method for providing a more accurate estimate of the systems states
   * Information from navigation is used in both guidance and control systems
   1. Guidance and Control
   * (Introduction to guidance and control)
   * Traditional control performs well for simple tasks
   * More complicated tasks such as following moving paths need complicated control laws (Olivera)
   * Instead of relying on complex control laws there has been much research on methods that combine guidance and control
   * Two categories will be discussed, potential field and vector field methods
   * Potential field will be referenced as a gradient potential converging to a global minimum
   * Vector field will be referenced to a space of vectors whose integral lines converge and follow a path
   * It can be argued that vector fields are essentially a potential field, but for organizational purposes they will be referred to as completely different methods
   1. Potential Field
   * (Introduction to potential field)
   * Use material already written
   1. Vector Field
   * (Introduction to vector fields)
   * Unlike potential field, ideal for converging to and following a path
   * A number of ways can be used to generate the vector field
   * In general, there are two different methods
   * Lyapunov
     + Use current material
   * Intersection of surfaces
     + Goncalves method description
     + Example!!!!
     + Fields added together (Example!!!!)
     + Use current material
     + The Goncalves vector field has two weakeness that should be addressed
       - Weakness of any vector field, and that the guidance is simply that, guidance. There is no guarantee the vehicle will not enter a given space
       - Singularity when summing fields
     + Modification of vector field
   1. Literature Review summary
   * Fixed wing UAVs are complex systems that have been traditionally flown using several layers of instruction
   * Modern autopilot systems have become inexpensive and applications for UAVs are increasing
   * Tasks have been increasing in complexity and NGC systems have had to adapt to keep up
   * Combination of guidance and control has been successful with traditional robotic systems doing point-to-point navigation, but is not ideal for fixed wing UAVs
   * Vector field is particularly attractive due to its ability to asymptotically converge to a path
   * Vector field can be generated in a number of ways
   * Goncalves method is convenient
     + Obstacle avoidance
     + Circulation term
     + Time varying
     + All aspects that can be weighted without risk of loss of convergence