Autonomous Mission Execution

This document will explain the series of steps taken to execute a pre-determined automated mission. Using the UxV/35 Sturnus, a number of different approaches to autonomous mission execution are possible and these are expanded below. While this manual is adaptable to similar platforms, the Sturnus will be the specific target for this document.

Required Elements

Item	Status
UxV/35 Sturnus	Flight Ready - Preflight Checklist Passed
Mission Planner Capable Device: Laptop Tablet	Successful Telemetry Connection with Target Aircraft has been Demonstrated

Optional / Safety Case Elements

Item	Status
Taranis Controller	Taranis Controller bound to Target Aircraft, Manual Test Flight Performed
Warder/Warden	Warden System Behavior Test Completed with target aircraft.

Mission Execution – Minimal Viable Solution

Automated Mission execution using the minimal number of components only requires a Sturnus aircraft and a telemetry radio base station connected to a device capable of hosting the Mission Planner software.

1. **Power the Sturnus** and wait for initialization to finish
2. **Connect the Sturnus to the Laptop** or Tablet using telemetry radio.
3. Take the planned mission and **write the mission to the Sturnus.**
4. **Read the file back** to ensure proper file has been loaded.
5. **Inspect telemetry data** for any deviations from the expected values (attitude, altitude, compass heading and speed).
6. **Mission Planner**:
    a. Navigate to Home/**Data Screen**, In the bottom left, select **Actions**
    b. Press the **LOITER** button: Drone flight mode displays Loiter.
    c. Press the **ARM / DISARM** button, props begin spinning, no gain in altitude
    d. **Wait 10 Seconds**: Monitor the data for deviations from expected values.
    e. Press the **AUTO** button, uploaded mission begins executing.

If deviant behavior that does not coincide with the planned mission occurs, initiating a RTL command from the actions menu in mission planner will order the drone to attempt a return to where if was first launched. If GPS signal is lost the drone will then attempt the next best available option and land in the position it is currently in.

Deviation From Expected Behavior – Minimal Viable Solution

The following series of steps are provided as sequentially more drastic measures of regaining control over aircraft behavior.

1. Press the **RTL** button
2. Press the **LOITER** button
3. Set Mode: **LAND**
4. Press the **ARM / DISARM** button

The execution of automated missions in the minimal viable solution configuration represents the acceptation of risk associated with using only one method of data link. The above list summarizes the rapidly deployable solutions to unexpected aircraft behavior. It is the user's responsibility to assess if the operational environment allows for autonomous operation in the minimal viable solution arrangement, provided that additional safety cases are available for use.

Mission Execution – Taranis Controller Present

The presence of the Taranis Controller during Automated Mission introduces one main difference when compared to the minimal viable solution. Namely, at any moment the aircraft can be rapidly returned to a manual flight mode. This acts as a dependable safety case for the execution of automated missions.

The modified series of steps for automated mission execution, with the Taranis controller present are listed below.

1. Power the Sturnus and wait for initialization to finish.
2. Power on the associated Taranis and connect the Sturnus to Laptop or tablet.
3. Take the planned mission and write the mission to the Sturnus
4. Read the file back to ensure proper file has been loaded
5. Inspect telemetry data for any unexpected deviations from expected values (attitude, altitude, compass heading, and speed.)
6. Arm the drone using the Taranis controller allowing the drone to spin on the ground.
7. Change the flight mode to loiter at zero throttle and observe the flight mode on the computer, making sure that the drone has not increased in lift.
8. Increase the throttle to fifty percent and allow the drone to idle, it should be spinning but no increase in lift should occur.
9. Observe all telemetry is stable.
10. On mission planner push the auto button in the actions section and watch the drone attempt the mission.

If any strange behavior that does not coincide with the mission occurs manual take over can be achieved by making a quick switch of the flight modes. This should put the drone back into a manual flight mode allowing the pilot to have control of the drone.

Mission Execution – Warder/Warden System Present

With Warder/warden system present the pilot will have the capability to have control of terminating the drone at all times. A stable heartbeat will need to be maintained in order for the drone to continue to operate. That being said setup and operations with a installed Warder/Warden system will follow a similar but modified order of operations as follows.

1. Power on the Warden and Sturnus.
2. Send the run command to the Warden by pushing and holding the smaller button on the Warden device.
3. Pull the safety (red tag) from the Sturnus and ensure that the drone has remained on.
4. Connect the Sturnus to the Laptop or tablet.
5. Take the planned mission and write the mission to the Sturnus
6. Read the file back to ensure proper file has been loaded.
7. Inspect telemetry data for any unexpected deviations from the expected values (attitude, altitude, compass heading and speed).
8. In mission planner on the actions menu, push Loiter and observe that the Drone has entered Loiter.
9. In the actions menu push the arm button and ensure drone spins idle, no lift should occur.
10. On mission planner push the auto button in the actions section and watch the drone attempt the mission.

If any abnormality occurs the pilot will have the ability to hold the larger button down on the warden issuing a stop command which will terminate the drone. It is important to note that since a consistent heartbeat needs to be maintained, flight range capability will be limited to 100 meters. This is most effective for shorter ranged more safety emphasized missions.

Version History

Name	Date/Version	Description	Reason