MILLSWOOD
engineering

GCS

USER GUIDE

Introduction

This collection of files forms an alternative Ground Control Station (GCS) that is compatible with Attopilot telemetry. It is free and open source. It was written to support the Millswood Engineering Failsafe PTZ, which allows joystick control of pan, tilt, zoom and trigger outputs. Usage of these files is entirely at your own risk; it is up to you to ensure that your UAV operates safely and reliably, and doesn't break too many laws. We have taken a lot of care, but we take absolutely no responsibility.

RoboRealm

This GCS run under RoboRealm, which you'll need to download from http://www.roborealm.com/ – RoboRealm is free for an evaluation period of 30 days. RoboRealm is actually a machine vision & robotics control program, but it also a powerful and flexible environment in which to develop realtime applications real fast. RoboRealm manipulates images beautifully and it's serial handling is very robust.

We've barely scratched the surface of all the really clever stuff that RoboRealm can do. The potential to track objects from a live video feed and perhaps control pan and tilt automatically is an obvious application, but perhaps aircraft stabilisation using optical flow, or vision-assisted sense-and-avoid, who knows? It's easy to use and inexpensive – we sell it from our website (http://www.millswoodeng.com.au/purchase.html) as an electronic download for $80 Australian, but feel free to buy it from whomever you like.

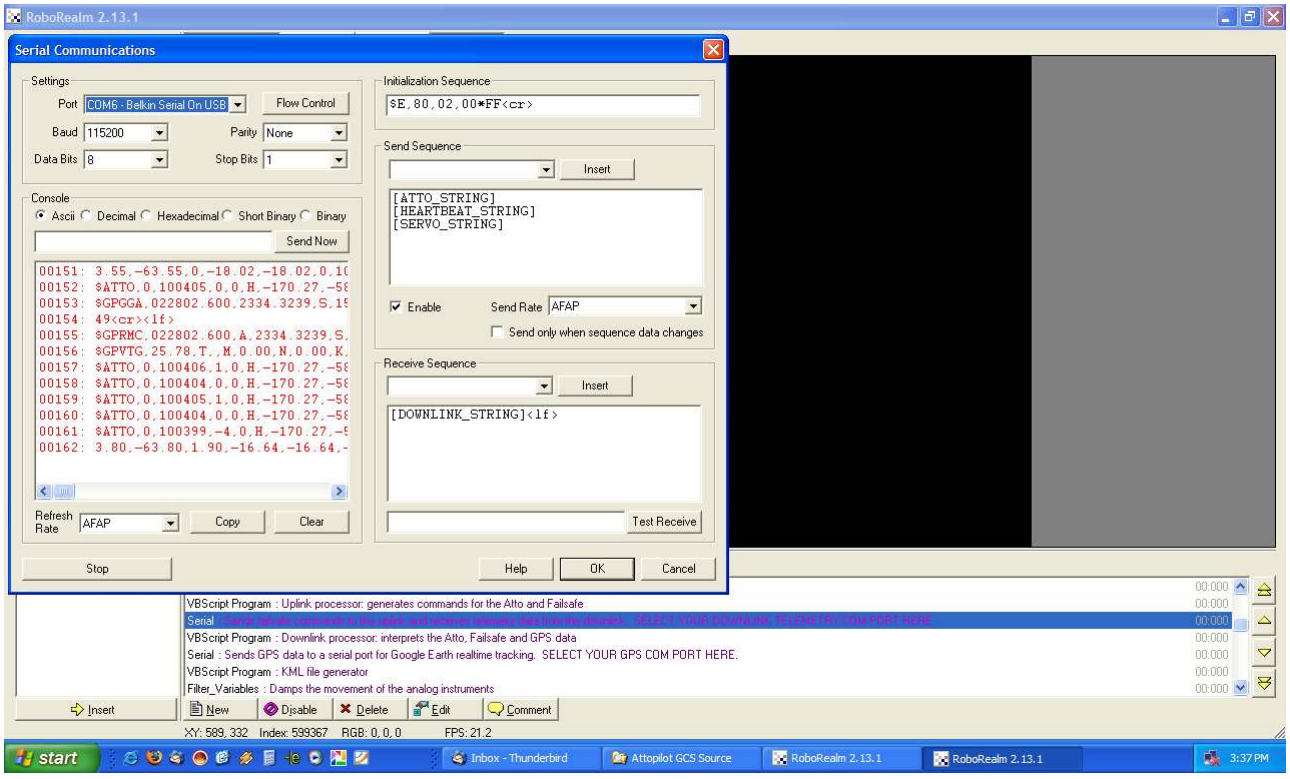
Running and configuring the GCS

Run RoboRealm and open up the me_atto_gcs.robo file.

The panel in the lower section of the screen is called the "pipeline" – this is just a whole bunch of modules that are executed in turn, repeatedly. Highlighting a module in the pipeline (by single-clicking on it) will halt processing at that point. Single-click to unhighlight and allow processing to continue normally. Double-clicking will allow you to edit the selected module.

The entire GCS is visible in the pipeline – it is essentially just a collection of modules that load and manipulate various images, read the joystick, process button clicks, transmit and receive serial data from the com ports, read and write the hard disk, and so on. Most of the clever stuff is in the VBScript modules, which you can edit if you are so inclined. The GCS is effectively open source, but we request that if you do modify the VBScripts you leave the Millswood Engineering name in the headers.

To get the GCS up and running the first thing you need to do is locate the module that configures the telemetry serial port. Scroll down the list of modules in the pipeline until you reach the one that says "SELECT YOUR DOWNLINK TELEMETRY COM PORT HERE", and double-click on it. Choose the serial port that you are using, and select your baud rate. Hit ok and then save your changes. Once you have the right serial port and baud rate and Attopilot telemetry data is coming in, the instruments should all start working.



To neaten up the screen, put RoboRealm into "Kiosk" mode. Hit Control-K to enter kiosk mode. Control-K will also exit from Kiosk mode. In Kiosk mode all the programming stuff is gone and the screen is a lot neater. The main GCS window can be resized to suit your desktop, and the button interface moved around. This is how the GCS should be run once you've got everything configured to your satisfaction. Under Options > Kiosk you can configure RoboRealm to start up in Kiosk mode.

You can increase the text size by double-clicking on the appropriate modules and selecting a different font size. The screen layout will tolerate an increase of 2 points without becoming too crowded. You can also zoom the entire display to 200% if you need extra high visibility in an outdoor environment. Don't forget to save your changes.

Running the log file replay utility

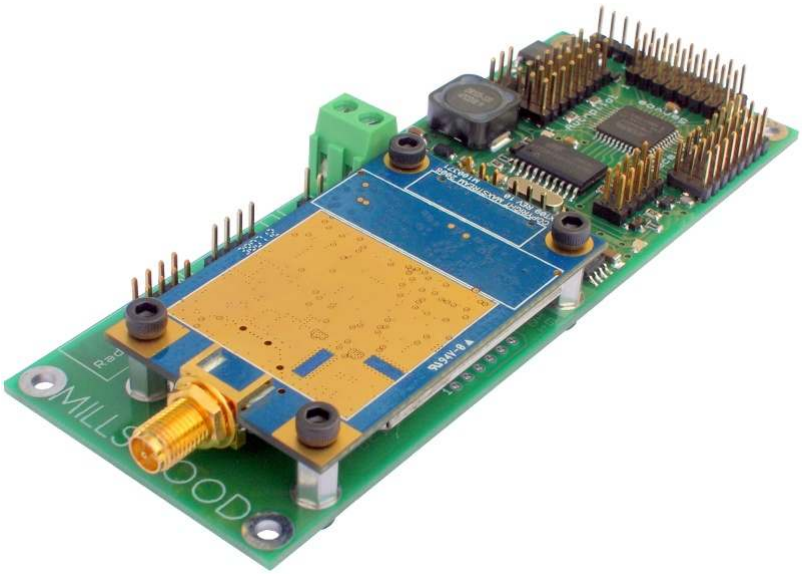
Run RoboRealm and open up the "me_atto_replay.robo" file.

The replay utility will replay Attopilot log files. It expects the log file to be called "log.txt" and to be in the current directory (unless a configuration file is present and specifies otherwise). You can generate KML files from your log files, or even from specific parts of log files. Don't forget to close your KML files nicely (see below) or Google Earth will reject them.

The replay utility can synthesize a GPS data stream to allow realtime tracking in Google Earth. This means that log files can be replayed with instruments synchronised to Google Earth's moving map display. See the Realtime UAV tracking section for details. The only thing to be aware of is that flights must be replayed at approximately realistic speeds or Google Earth will not join the dots.

Millswood Engineering Failsafe PTZ

The GCS intrinsically supports the Millswood Engineering Failsafe PTZ – sending out heartbeats and reading a joystick to control pan, tilt, zoom and trigger outputs. If you connect up a joystick you'll be able to see the little red squares move around – the hollow ones indicate commands that have been sent on the uplink, and the filled-in ones indicate data that has been received on the downlink. Comparing the positions of the hollow and filled-in red squares gives you a visual guide as to the latency of your telemetry loop.



Generating KML files for Google Earth

The GCS writes standard KML files, viewable from within Google Earth. All data is timestamped, and you can replay your flights within Google Earth by fiddling with the time slider at the top of Google Earth's display window. KML files are saved to the current directory unless a configuration file is present and specifies otherwise.

The "KML: Mark current location" button simply inserts a numbered, timestamped and colour-coded placemarker into the KML file at the current location. The "Atto: Trigger fire" button also writes a placemarker into the KML file (and sends a "trigger fire" command to the autopilot). The various different autopilot modes are also colour coded, and the descriptions tell you when each segment of your flight started.

IMPORTANT: Make sure you close the KML file nicely by releasing the "KML: File generation on/off" button, otherwise the file will just be abandoned by the GCS and Google Earth will reject it.

Sending commands to your UAV

The yellow buttons on the Button Control Interface send commands to your UAV via the telemetry uplink. Descriptions of the commands implemented can be found in the Attopilot Uplink Commands documentation.

New from version 1.27 is the ability to dynamically retask your UAV during flight. In other words waypoint co-ordinates and the current waypoint number can be changed on-the-fly. Data for these commands must be entered in the "Uplink data" panel of the GCS before the button is pressed.

- **Atto: Upload new waypoint** sends a new 3D waypoint to the Attopilot. All fields must be completed. Old waypoint data may be written over or a new waypoint added to the end of the list. Please note that this command does not change the waypoint number that the UAV is currently heading for – "Set waypoint number" does that.
- **Atto: Set waypoint number** changes the waypoint that the Attopilot is currently heading for. Only the waypoint number field needs to be valid.

Units for altitude are the same as those shown in the downlink data panel. To select a field for editing simply click on it. Tab, shift-tab and enter keys will move between fields. Co-ordinate data may be pasted in from other applications using control-v.

Speech synthesis

The GCS can be configured to announce the current destination, altitude and airspeed at user-defined intervals. This relieves the UAV operator from constantly referring to the display, improving situational awareness and safety. The speech synthesizer will also announce significant changes in altitude. Altitudes can be either relative to launch (AGL) or absolute (AMSL).

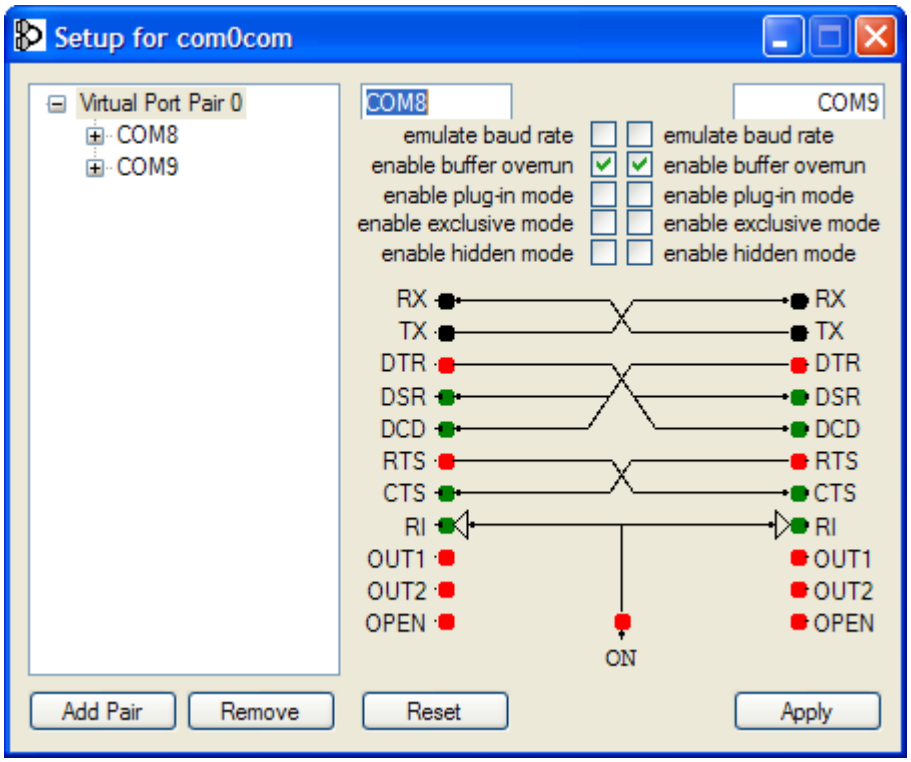
The speech synthesizer is enabled and configured by including the appropriate entries in the configuration file (see below).

Realtime UAV tracking using Google Earth

The GCS interfaces with Google Earth (version 5.1 or later) to provide realtime UAV tracking. This requires an additional 2 serial ports connected together via a null-modem cable. Most computers don't have 2 spare serial ports, so a software approach is usually used. Programs such as com0com provide the perfect solution: a pair of internally connected virtual serial ports.

Download com0com from http://sourceforge.net/projects/com0com/files and install. Run the setup program and rename the ports to be (say) COM8 and COM9.

IMPORTANT: In the com0com setup program you must tick the "enable buffer overrun" boxes. Failing to do this will result in the GCS running incredibly slowly. You only need to enable buffer overrun at the Google Earth end of the connection, but it is easiest to enable both to avoid confusion later on.



In the GCS pipeline find the module that says "SELECT YOUR GPS COM PORT HERE" and double-click to edit it. Choose one of the newly created com0com serial ports, hit ok, and save your changes. Fire up Google Earth (version 5.1 or later) and turn on GPS realtime tracking. After a moment or two Google Earth will find the right com port and begin tracking your UAV.

Configuration file

The file "me_atto_config.txt" may be used to override the default settings, and also to enable additional features such as speech synthesis. Using any plain text editor add the lines that you need from the table below, and then save the file as "me_atto_gcs.txt" into the folder where the GCS is stored. Text must be entered exactly as shown (case must be correct and spaces are not permitted), but lines may appear in any order.

Text to enter	Effect
Gauge_Units,Metric	Changes the gauges to metric.
Nav_Panel_Units,Metric	Changes the downlink and uplink panels to metric.
Speech_Units,Metric	Changes the speech synthesizer to metric.
Speech_Altitude,AGL	Enables speech synthesis with all altitudes quoted as relative to launch (i.e. barometric).
Speech_Altitude,AMSL	Enables speech synthesis with all altitudes quoted as absolute (i.e. GPS).
Speech_Interval,[seconds]	Enables status updates (destination, altitude and airspeed), and sets the interval between updates. Zero (or omit the entry altogether) to disable.
LOG_Folder,[path]	Changes where the GCS will look for "log.txt".
KML_Folder,[path]	Changes where the GCS will write KML files.
Pan_Speed,[value]	Sets the rate at which the pan servo will move for a given joystick deflection. 0 for maximum speed, default 10, higher values for slower panning.
Pan_Min,[value]	Pan servo lower limit, default 1250 (corresponds to 1.0ms). To reverse the direction of travel, swap the min and max values (enter a higher value for min than max).
Pan_Max,[value]	Pan servo upper limit, default 2500 (corresponds to 2.0ms)
Tilt_Speed,[value]	Sets the rate at which the tilt servo will move for a given joystick deflection. 0 for maximum speed, default 10, higher values for slower tilting.
Tilt_Min,[value]	Tilt servo lower limit, default 1250 (corresponds to 1.0ms). To reverse the direction of travel, swap the min and max values (enter a higher value for min than max).
Tilt_Max,[value]	Tilt servo upper limit, default 2500 (corresponds to 2.0ms).
Zoom_Min,[value]	Zoom servo lower limit, default 1250 (corresponds to 1.0ms). To reverse the direction of travel, swap the min and max values (enter a higher value for min than max). Joystick controller will automatically scale to the range selected.
Zoom_Max,[value]	Zoom servo upper limit, default 2500 (corresponds to 2.0ms).
Trigger_Off,[value]	Trigger servo position when the fire button is released, default 1875 (corresponds to 1.5ms).
Trigger_On,[value]	Trigger servo position when the fire button is pressed, default 2500 (corresponds to 2.0ms).

[path] is any valid path such as "c:\logfiles", "..\logfiles", "c:.", etc. If the specified path does not exist then the current directory will be used.

To enable speech synthesis set Speech_Altitude to either AGL or AMSL. Status updates, if enabled, will also use this setting.

Further Information

Visit us on the web at www.millswoodeng.com.au

Didn't find what you wanted? Send us an email or give us a call – contact details are on our website.

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