Flight Gear Aviation Training Device (FGATD)

This manual documents a Training Device configuration comprising a computer, user controls and software. This manual also includes the Pilot Operating Handbook for the student and the Instructor Operating Handbook for the teaching instructor. It is intended to meet the PCATD requirements that are defined by the Federal Aviation Administration in Advisory Circular 61-120.

Alexander Perry, August 21, 2001

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1 Release Version and License

This manual is automatically assembled from a collection of LaTeX source files. These are available from the `fgatd.sourceforge.net` website, subject to the terms of the *General Public License*. This copy of the document used versions:

`alpha.tex` is Up-to-date 1.2

`begin.tex` is Up-to-date 1.3

`end.tex` is Up-to-date 1.1

`ch.tex` is Up-to-date 1.1

`instructor.tex` is Up-to-date 1.1

`kmyf.tex` is Up-to-date 1.1

`kokb.tex` is Up-to-date 1.1

`pilot.tex` is Up-to-date 1.3

`postland.tex` is Up-to-date 1.2

`preto.tex` is Up-to-date 1.2

`fgfs.tex` is Up-to-date 1.1

Not all these files are used to create this version; please read them for details.

2 Pilot's Physical Controls

The FGATD requires the following three products to be installed and working:

CH products - Pro Yoke LE USB - (P/N 200-608) `http://www.chproducts.com/usb/fsy-le-usb.html`

CH products - Pro Pedals USB - (P/N 300-111) `http://www.chproducts.com/usb/proped-usb.html`

CH products - Pro Avionics USB - (P/N TBD)

Pulling back the yoke provides a continuous range of Elevator and (in general) increases aircraft pitch attitude upward. And vice versa.

¡li¿ Rotating the yoke to the right provides a continuous range of Aileron and (in general) increases aircraft roll attitude to the right. And vice versa.

¡li¿ Pushing the large handle on top of the enclosure away provides a continuous range of Throttle settings and (in general) causes the aircraft to fly faster and/or to climb. And vice versa.

¡li¿ Pushing the rightmost spring-loaded switch on the enclosure down gradually lowers the flaps through a continuous range of positions. And vice versa.

¡li¿ Pushing the leftmost spring-loaded switch on the enclosure up or down will toggle the position of the carburetor heat engine control.

¡li¿ On the right horn of the yoke, the sideways toggle switch would provide an electric rudder trim capability for FGFS configurations whose aircraft implement it. The FGATD does not use this control.

¡li¿ On the right horn of the yoke, the circular button specifies the direction of view from the cockpit and is generally set to forward. For traffic scanning and other VMC activities, the pilot utilizes this control in equivalence to rotating the head around the neck. Although present and functional, it is not needed for FGATD training.

¡li¿ On the left horn of the yoke, pressing the upper red button once quickly will enrich the mixture one turn of the knob and holding it down moves the mixture to full rich. And vice versa for the lower red button.

¡li¿ On the left horn of the yoke, the pressing the upper end of the grey toggle switch provides a gradual nose-down change in the elevator trim, as though the aircraft has been upgraded with motorized electric elevator trim (as has occasionally been done). And vice versa.

¡li¿ The upper button on the left horn of the yoke, not visible in the picture, is the push-to-talk button for communications radios.

¡li¿ The lower button on the left horn of the yoke, not visible in the picture, is defined as being unassigned for the FGATD configuration. Its purpose is under instructor control; it can be tied to a wide variety of features within the simulation by the instructor, in order to assist in the training goals of specific scenarios. All PCATD tasks can be completed without using this button.

¡li¿ Pushing the right pedal away brings the left pedal towards you, since they are linked. This provides provides a continuous range of Rudder and (in general) will yaw the nose of the aircraft to the right. In common with the C172 aircraft, it also operates the nose wheel steering and (in general) will steer the nose to the right on the ground. And vice versa.

¡li¿ Pushing the top of the right pedal (without moving the pedal) provides a continous range of right main wheel brake activation. This will (in general) will slow the aircraft if moving on the ground and/or provides a right turning tendency.

¡li¿ The top of the left pedal controls the left main while brake similarly.

The panel has a four-line LCD display and four

¡li¿ The upper portion of the panel contains four drawn rectangles, labelled "RADIO1" through "RADIO4". These rectangles (and their contents) are otherwise identical. They are intended to support COM, NAV, ADF radios or a panel GPS ... depending on the instruments that the instructor is making available to the pilot for the specific flight. Each rectangle contains a power-on style rotating knob in the lower left corner, a two position switch in the lower right corner, a pushbutton center left and two rotary stepping knobs center right.

¡li¿ A rectangle that is configured by the instructor as a COM radio uses these as power, selected, flipflop (if enabled by instructor), MHz, kHz.

¡li¿ A rectangle that is configured by the instructor as a NAV radio uses these as power, identify, flipflop (if enabled by instructor), MHz, kHz.

¡li¿ A rectangle that is configured by the instructor as a ADF radio uses these as power, tracking, test, 100s of kHz, 10s of kHz.

¡li¿ A rectangle that is configured by the instructor as a GPS panel unit has the power switch in common with the radios. The rest of the functions are context-specific with the instrument indications shown on the computer display. Note that this GPS option is a FGFS feature, not a FGATD capability.

¡li¿ A drawn rectangle at the lower edge of the panel contains six knobs. The leftmost has five positions labelled "off", "stby", "on", "alt", "test", the next is a pushbutton which is labelled "ID". The other four are in a row, all mechanically register into successive positions but can rotate freely in both directions.

¡li¿ The "Kollsman" setting of the altimeter is adjusted by the leftmost knob, capable of rotating through many turns. Clockwise turning of the knob provides a continuous range of increasing altimeter settings and (in general) causes altimeter hands to show correspondingly higher altitudes. And vice versa.

¡li¿ On the side of the Avionics panel is a connector socket, compatible with most of the push-to-record switch connectors of handheld microphones.

Most rental C172 only provide the minimum timepiece needed to pass the IFR aircraft requirements, namely an analog or digital clock that has seconds dis-

played but is unable to operate like a stopwatch. The FGATD implements this minimum as an instrument drawn on the computer display. The instructor has the option of assigning the spare button, so that it provides a stopwatch capability on this clock display.

¡p¿ Many pilots fly their aircraft using a headset. ¡ol¿ ¡li¿ If choosing to operate FGATD in this manner, they must actually wear the headset. A cable is required, that feeds the computer output sound to the earphones and that feeds the boom microphone into the computer input sound. ¡li¿ The recommended training uses a conventional handheld microphone that plugs into the computer input sound connector. The microphone must have a switch attached to it, plugged into the appropriate receptacle on the Avionics. ¡li¿ Headset users need to be aware that one of the failures available to the instructor is that the yoke-mounted push-to-talk button becomes inoperable. They will then either continue the flight with reduced radio capability, or need to switch to using the handheld microphone, in accordance with the training scenario and/or accepted IFR lost-comm procedures. ¡/ol¿

¡p¿ Several common aircraft controls are not implemented in FGATD because they absent in the simulated aircraft. ¡ul¿

¡li¿No propeller control since the C172 has a fixed pitch propeller.

¡li¿ No gear control is provided by FGATD for the gear, since the standard C172 is a fixed gear aircraft. Several FGFS configurations implement retractable gear aircraft (including the C172-RG), and generally redefine the carburetor heat control to be the gear.

¡li¿ No cowl flaps control is provided by FGATD, since the standard C172 does not have them.

3 Software

This manual documents a specific configuration of hardware and software for use in accordance with PCATD purposes. We refer to this configuration by the name FGATD, replicating a generic Cessna 172 with 160 hp engine and standard propeller.

The FGATD configuration is a special case of the family of Flight Gear Flight Simulator (FGFS) configurations. These other configurations are not being submitted for approval; any discussion of FGFS features in this manual is purely to assist the reader in understanding the document. Such a feature is neither implied to be present, or to be absent, in the FGATD configuration unless explicitly stated otherwise in the relevant section of the document.

3.1 Computer system

The computer shall provide sufficient services through the PLIB portability libraries, such that an unmodified release of FlightGear source code will compile and run as normally expected. There is no Operating System constraint imposed, other than the availability of the PLIB services for that environment.

The installed software being executed shall be Version TBD of Flight Gear. This can be retrieved from the software's website `http://www.flightgear.org`. The software will only prompt for the required instructor's certificate number when it has passed self-tests for FGATD operations. If that prompt is not seen, the flight time cannot be logged under PCATD regulations.

4 Pilot's Operating Handbook

This section explains how to operate the simulator to perform a flight under Instrument Flight Rules (IFR). Only the lesson components *after* turning to the initial clearance heading until before reaching the decision height (DH) or minimum descent altitude (MDA), as applicable, are eligible to be counted towards PCATD time. The other elements are included because they are essential to the safe and consistent completion of an IFR flight.

4.1 Weather Briefing

Students should practice retrieving and interpreting briefings using the DUATS servers, such as `duats.gtefsd.com`, on a regular basis. This is especially appropriate if the weather is marginal VFR, irrespective of whether an actual training flight is planned. Such weather briefings should be recorded on the computer, for later discussion with other pilots and instructors to ensure that a maximum amount of understanding is derived from the raw data that is provided by the National Weather Service.

FlightGear users, who do not already have an account, may wish to apply to their local Flight Standards District Office (FSDO) to request a Student Pilot License, which forms the basis of being issued an account on DUATS. There is generally no fee associated with either issuance for US residents.

For the proposed flight, the weather briefing is assumed to be for 500 ft ceilings, with stable cloud in a solid layer to 5000 ft, at the destination airports for the intended period of this flight. No rain, thunderstorms or advisories are expected, freezing level will be above 6000ft and or navigation system outages are in effect or planned.

It would be nice to have that formatted as a DUATS briefing and/or a recorded voice briefing from an AFSS specialist.

4.2 Flight Plan - Clearance

The proposed flight is from KMYF to KOKB. This is within the airspace for the Southern California Terminal Radar Approach Control (SoCal TRACON), so a simple Terminal Enroute Clearance (TEC) will suffice. You need to make a call on the Clearance Delivery (CD) frequency at Montgomery Field airport 127.45 such as:

Pilot: **Montgomery Clearance, Cessna six four six three delta, IFR request**
Ctlr: **C 6463D, Montgomery Clearance, go ahead**
Pilot: **63D is a Cessna one seventy two slant alpha, request terminal enroute to Oceanside**
Ctlr: **C 6463D is cleared to Oceanside airport, on departure turn left heading two seven zero, radar vectors to the Oceanside VOR. Maintain three thousand, expect four thousand one zero minutes after departure. Departure frequency is one one nine point six, squawk four one two three.**
Pilot: **63D is cleared to Oceanside airport via left two seven zero and vectors to Oceanside VOR. Three thousand, expect four thousand after ten, one nineteen six, squawk four one two three.**
Ctlr: **63D readback correct. Notify tower on initial contact that you are IFR.**
Pilot: **Wilco.**

4.3 Aircraft preflight

An independent program is recommended to practice preflight skills, because that program simulates aircraft that have important and dangerous flaws that you will hopefully never encounter in real life. If you use the program and become proficient in recognizing these flaws, you are less likely to take off with them. In this way, you may avoid the fatal accidents that regularly occur and are blamed by the investigators on poor pilot preflight.
This program is not written, because the necessary photo database has not been generated yet. If you are interested in assisting with this database (or the program), please contact the FGATD developers.
Once the external preflight is completed, start the FGATD program running by clicking on the icon that is visible on the desktop. The cockpit checklist, which needs to be performed, is:

4.4 Cockpit preparation

As you settle yourself into a chair in front of the simulator, arrange everything you expect to need for the next two hours either on your lap, in your pockets, or attached to the flight yoke. It is unsafe to leave items on the floor and your

passenger will not appreciate holding on to your gear for several hours. Once the flight takes off, as the only pilot on board you will be unable to leave the controls to retrieve something.
It is important to practice cockpit organization on the simulator, in order to build reliable and safe habits for when you are in the aircraft. Skimping on this stage will encourage lax pre-taxi organization in future, which will cause distraction while taxiing (often causing a collision) and loss of situational awareness and/or aircraft control while inflight (usually resulting in a fatal accident). All of these are worth avoiding.

4.5 Engine start

Not yet written.

4.6 Taxi at a Class D

Not yet written.

4.7 Runup, final checks

Not yet written.

4.8 Takeoff

Call on the tower frequency radio, with a request like **"Montgomery Tower, Cessna one two foxtrot holding short two eight right for IFR release"**. Expect a response like **"Montgomery Tower, Cessna one two foxtrot holding short two eight right for IFR release"**. **"One two foxtrot holding short two eight right.**

4.9 Departure

Not written yet.

4.10 Missing an approach

Not written yet.

4.11 Flare and landing

To be written.

4.12 Taxi to parking

To be written.

4.13 Shutdown and postflight

To be written.

4.14 Debrief

Your instructor will likely wish to discuss your performance in detail.
This instrument flight started with the intention of visiting a friend in another town, Oceanside. Due to the low cloud ceiling, the goal was modified to be a nearby airport with better minimums. When this was also impossible, the new goal was to simply return home. Due to the combination of poor visibility and the inherently-inaccurate NDB approach technology, there was a significant chance of having to miss. Instead of visiting a friend, as originally intended, you almost ended up spending the night unexpectedly in an airport hotel far from home.
The need to adapt goals to the situation is critical in making IFR flight for General Aviation aircraft safe enough to be practical. You do not have the dual pilot crew, equipment, avionics and rigid operations rules to assist you in achieving a reliable form of transportation. An attempt to treat a Cessna 172 like a scheduled airline will statistically result in a lethal accident in the NTSB archives.
In this flight, the weather was as forecast, the aircraft suffered neither avionics nor engine problems, radio communications with air traffic control were nominal and the pilot presumably flew well. Despite all these positive factors, the flight exhibited many dangers, failed to complete the original goal and turned out completely unexpectedly.
Imagine how much more exciting it would be with some failures thrown in. Actually, "imagine" will probably be the wrong word, given all the features that are specially provided in the instructor interface to FlightGear.

5 Instructor's Operating Handbook

To be written.