Preface

(needs update)

Welcome Aboard your Piper PA28-WarriorII (Navigator)

The purpose of this Flightgear aircraft is to provide you with a selection of resources relevant to aerial navigation. Throughout the documentation we will just refer to to it as - the Navigator.

Next to links to online text, audio and hands on video resources you will also find a collection of hands on navigation practise flights as well as Nav Scenarios.

These practise flights assume a comfortable level of flying your aircraft with or without auto pilot and a basic knowledge of aviation.

No consideration has been given to real world aspects such as communication with ATC, nor restrictions of any other kind or multiplayer environment.

All of the practise flights can be performed offline provided one has access to pen, paper, ruler, copies of charts , etc.

You may need to download additional scenery from Terrasync, alternatively Terragit, as the flights more or less span around the globe.
Furthermore it is assumed that you are familiar with putting together a flightplan, how to calculate ETA and fuel consumption

The instructional material is by no means to be used for real world aviation and no guarantee of completelyness or correctness can be given, the sole purpose being to provide examples of instrument usage within the context of the flight simulator.

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Online links and references are valid at the time of writing, however should a link be broken you may find the relevant info by means of your favourite search engine. If you don't happen to have a dual monitor setup or expierence internet connection problems you might wish to print what is important to you as a fall back position. We certainly recommend to have at least hardcopies of the practise flights handy.

To commence your journey we would recommend a leisurely read of Charles Wood's comprehensive yet easy to read **Flight Simulator Navigation,** www.navfltsm.addr.com or the downloadable pdf at

www.anaspides.net/documents/flight_simulator_documents/Instrument%20course.pdf

The practical side of it leans heavily on Microsoft FS, however most of the practise flights work in FG as well.

For instrument related info and usage here is another comprehensive online FG manual

www.emmerich-j.de/HB/EN/RNAV

You also find topics like pilotage and dead reckoning in there or you may wish to check out www.experimentalaircraft.info/flight-planning/pilotage-dead-reckoning.php

The FG Navigator is based on David Megginson`s original Piper Cherokee Warrior II (1979 model).For relevant details such as technical specification or info on how to fly look up Help and consult the online Wikis. If completely new to the world of aviation you may wish to start with Chapter 8 of the official Flightgear manual titled **A Basic Flight Simulator Tutorial** using the default aircraft a Cessna.

The focus of the Navigator however purely rests on navigational aspects and practical guidance of how to do it.

Topics like flightplanning, ATC comms, pertinent rules and regulations as such form no part of this package.

Enjoy your journey and enjoy the world of Flightgear as much as we do.

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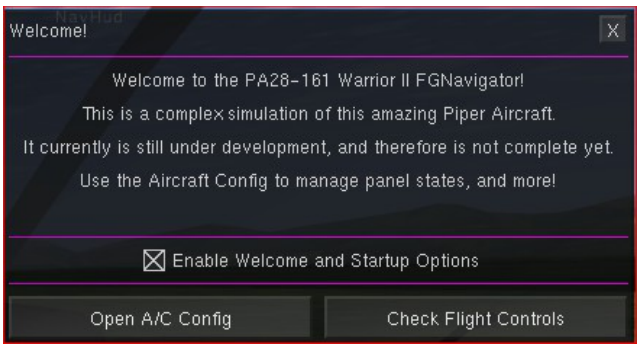
Getting Started

After having nominated your Navigator and generic start-up parameters in your FG Launcher be it QT, FGRUN, FFGO or other, the PA28-Warrior will open with a Welcome Message



Once you select **AC Config** the Configuration dialog will prompt you for your start-up preference

First up you can choose your preferred panel, that is you have a choice between two sets of instrumentation, a panel featuring a standard Digital Gyro (DG) and two VOR s or alternatively a panel featuring a HSI with VOR1 integrated and VOR2 to the right. There is also a Cadet Panel for the inquisitive mind.

(You can switch between panels any time on the ground or in the air by selecting the Warrior menu option, Aircrft Config or by way pressing the letter **w** or clicking the headset.)

Next you can decide on your desired panel state:

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Cold and Dark
as the name implies you will need to start up in accordance to the startup checklist found in the aircraft Help screen or more detailed in the Warrior menu.

Ready to Start Engine
Avionics, Battery, Alternator are on, all you need to do is fire up the engine using the primer and magnetos and the starter after having set Mixture to full and throttle to 20%.

Ready to Taxi
Use this mode to proceed from a parking position to the assigned runway or for practising movement on the ground. You start with park brake set and the engine idling at about 1050 rpm, enough to start moving once the brake is released.

Ready for Take Off
pretty self explanatory, normal take-off roll or ref up prior to releasing the brake with or without flaps depending runway length....

IMPORTANT

Once you select a panel state, a warning message will appear prompting you to wait until configuration is completed, just wait and do not touch keyboard or mouse or joystick.

Prior to choosing the panel state you also can select various options on the right side of the dialogue:

Auto Refuel

By default the Navigator starts up with two full tanks. However its good practise to calculate fuel consumption for each flight as part of the flight plan and carry only what's needed plus reserves for an alternate airport etc. If you refuel at a stopover ideally the fuel load between tanks should be balanced as the aircraft has no cross feed unlike the Cessna.

If Auto Refuel is checked fuel replenishment is up to you in line with your flight requirements.

Auto Mixture

If selected controls the fuel/air mix ratio depending on altitude as the air is less dense, in other words you dont have to worry about the mixture lever or the engine dying because´of too much juice and too little oxygen.

Auto Coordination

invokes automatic co ordination of rudder and ailerons. (An alternative to FG standard auto co-ordination, use one or the other, not combined!) Should be checked in the absence of pedals hardware and or joystick.

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Auto Arm Altitude

If using the Auto Pilot and setting the vertical speed, setting the desired altitude is also useful. However instead of relying on memory to click the Arm button, auto arm will do just that.

GPS slaves Nav

A way of honing those radial intercept and tracking skills. The route manager supplies waypoint info to the gps and the gps in turn provides that info to VOR1. The HUD will display the bearing and you just need to keep the needle centered.
This option will disable Nav and Approach mode of the Auto Pilot.

HUD Display

Will toggle a HUD on or off. State can be overridden by pressing the h key.

Mini Panel

Currently in development, allows access to stuff like moving map(if online), the standard map, keyboard mapping and heading selector dialogue if flying via external view, etc

Show Limit Warnings

If checked , this will display warnings once defined limits are breached like maximum flap extension speed,engine rpms, VNE,VSO,....

Show QNH Alerts

If checked this option will alert you to reset your altimeter on the ground in line with ATIS or the present ground elevation. If altitude reaches more then 7000 feet, the altimeter will reset to the generic AMSL of 29.92.On descend you will get another prompt to reset the altimeter with the correct QNH for landing.

Fuel Status Alerts

Popup displaying info like below:

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Way Point Alerts

Once you have defined your route(flightplan) and you fly this route by means of the auto pilot gps/nav mode or you fly in ap heading mode or perhaps without the aid of the autopilot, then this options will show popups whenever you are near a waypoint, which allows you to prepare for relevant maneuvers.

All of these options can be activated or deactivated at any time from the Config menu, however some will only take effect after a restart like auto refuel.

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Panel Configurations

First up, your cockpit:

Instrumentation: (by row left to right)

- Out of Fuel Warning Light
- Door open Warning Light
- O M I Markers
- Hobbs Meter / also hotspot to initiate a go around
- Glideslope in range Light/also hotspot to reset heading bugs of DG/HSI
- Combined Com1/Nav1 radio
- ELT
- AOA Indicator

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- 

- Combined OAT/Clock/Stopwatch/Flighttimer
- ASI (Airspeed Indicator)
- Attitude Indicator
- Altimeter
- VSI (Vertical Speed Indicator)
- VOR(CDI)1
- Avionics Master Switch with Stall Warning Light below
- Combined Com2/Nav2 radio
- Transponder with KMA20 beneath and Battery Voltmeter to the right.

- Nav Source Switch
- RMI Config Switch and RMI (Radio Magnetic Indicator)
- TC (Turn Coordinator)
- Digital Gyro
- VSI Vertical Speed Indicator/also hotspot to throttle back 25 %
- VOR(CDI)2
- White Light/hotspot to switch panel Blue Light = Flaps are extended
- Autopilot (Custom KAP140) with ADF below and DMI on the right

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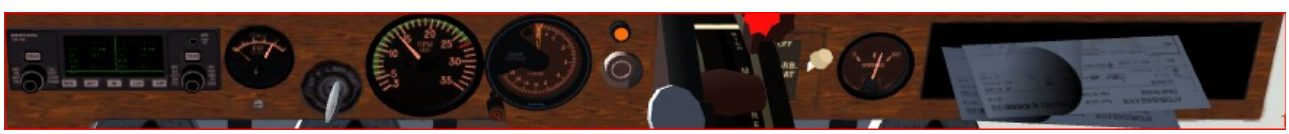
- Windrose
- Combined Vacuum and AMP Meter
- Fuel & Oil Gauges
- Switch Panel
- CO2 pad/hotspot to route mnager
- Flaps Lever



- KLN90B GPS/hotspot to open gps dialog
- EGT/hotspot to apply full mixture
- Combined Magneto/Starter switch
- Tacho(RPM)/hotspot to apply full throttle
- Radio Altimeter
- Parkbrake Light with Primer Pump below
- Parkbrake Lever
- Throttle/Mixture and Carbureto Heat Levers
- Amps Meter/hotspot to invoke 0 VS and Alt Hold
- Chart/hotspot to open map dialog

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- Other gauges are found on the HSI Panel. For general information refer to http://wiki.flightgear.org/Avionics_and_instruments , and for more specific info on navigation instrument usage we recommend the reading of www.emmerich-j.de/HB/EN/RNAV

TIPS: *- knobs work in both directions using scroll or left mousebutton*
- mouse buttons on knobs advance or regress one degree or unit at a time
- mouse wheel depending on instrument between 3 and ten degrees
- to match the Compass with HI/DG heading look at the tooltips

about your Navigation Instruments

Some screenshots may differ from the actual cockpit due to many changes to the design yet you will recognise the various instruments

Hotspots in general are used to make an object clickable for some action to occur. If you want to see what is clickable on any aircraft within Flightgear simply press <CTRL> C (toggle)

Hotspots & Digital Readouts(Tooltips)

Most of the hotspots are used to display instrument related properties such as speeds, rpm, radials, bearings etc. A select few however will invoke some action such as opening a dialog, turning knobs, pushing buttons and so forth.

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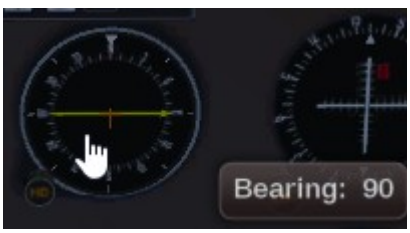
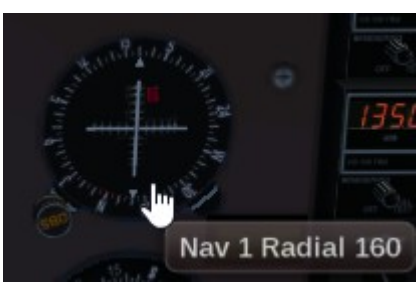
Hotspots for displaying static or dynamic information are:

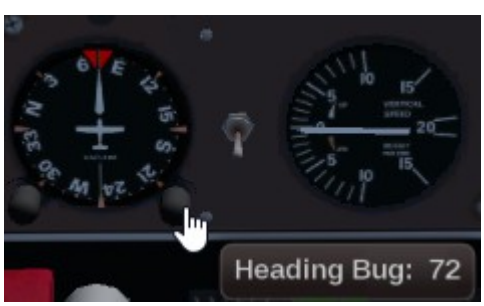
http://www.angelflightne.org/images/Docs/the_altimeter.pdf

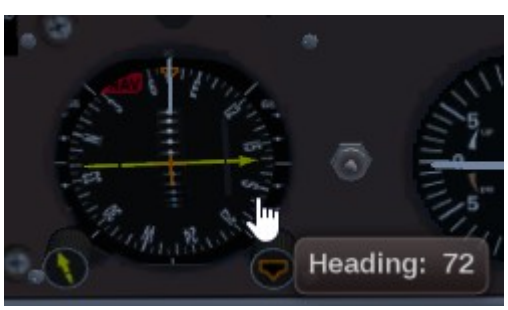
The **ASI** - air speed indicators needle shows **IAS**, whereas the tool tip on the face shows **TAS**



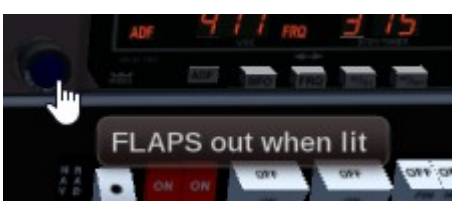


Lags in update, can use standard Hud as an alternative

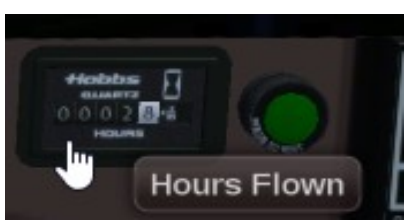




Heading bug = current heading, Knob + or -



The blue light will be lit when flaps are not retracted.



The Hobbs displays total accumulated flying time based

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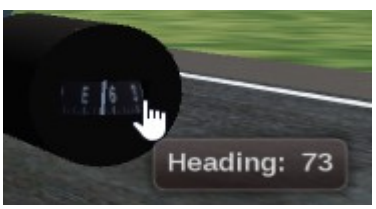
on when the wheels are not on the ground.

Actions can be invoked by means of using the menu, shortcut (hotkeys) or alternatively hotspots

Hotspots for displaying static or dynamic information are:

Resets the current view to default after moving around with the mouse or changes to zoom level

If the stopwatch gets into the way use the timer of the ADF instead for timing legs, procedure turns..



Use the readout for adjustment of DG and or HSI

Opens the Radio Settings dialog

Opens the FG internal GPS Dialog

In addition clicking the altimeter will pop up the QNH dialog, the hotspot on the chart underneath the right hand side yoke opens up the map.

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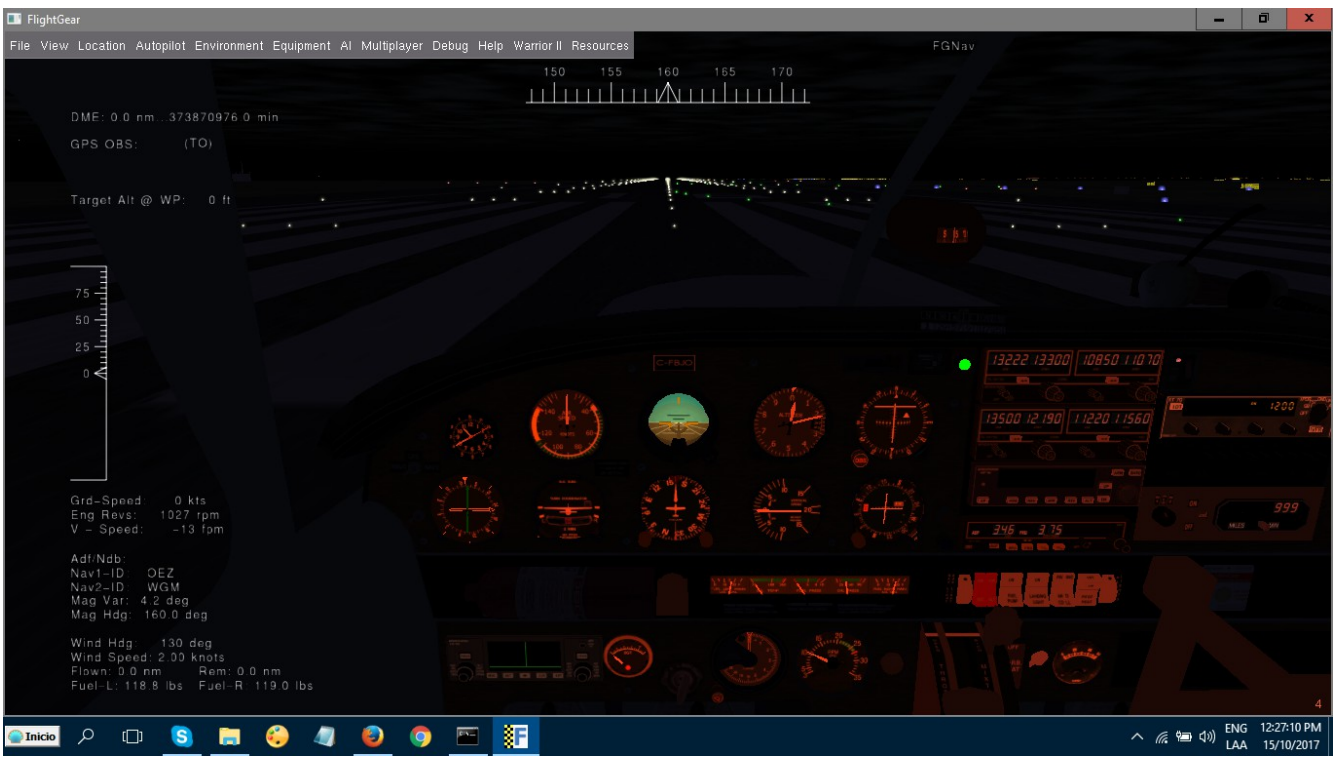
HUD – Head up Display

Realistically GA crafts don't come equipped with HUDS, but because the Navigator was designed also taking the needs of the visually and hearing impaired into consideration we have included a set of Huds that can be easily turned on or off as desired.

At times given the size of monitors instruments may be hard to read, on other occasions a view may be zoomed to a degree hiding a specific instrument like for example the DME.

As such important data is displayed in the HUD which also allows to fly the aircraft from the outside.



Pressing the letter **h** will toggle between colours as at times the outside may be too bright or to dark. **h** will also switch between colours and turn it on or off.

Pressing **Shift I** will toggle between the available HUD versions

The check box within Acconfig will allow to toggle the Huds on/off.

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Keyboard

The standard Flightgear keys apply in addition to the aircraft specific shortcut keys. These are listed in the Help Menu or can be looked at by pressing Shift K

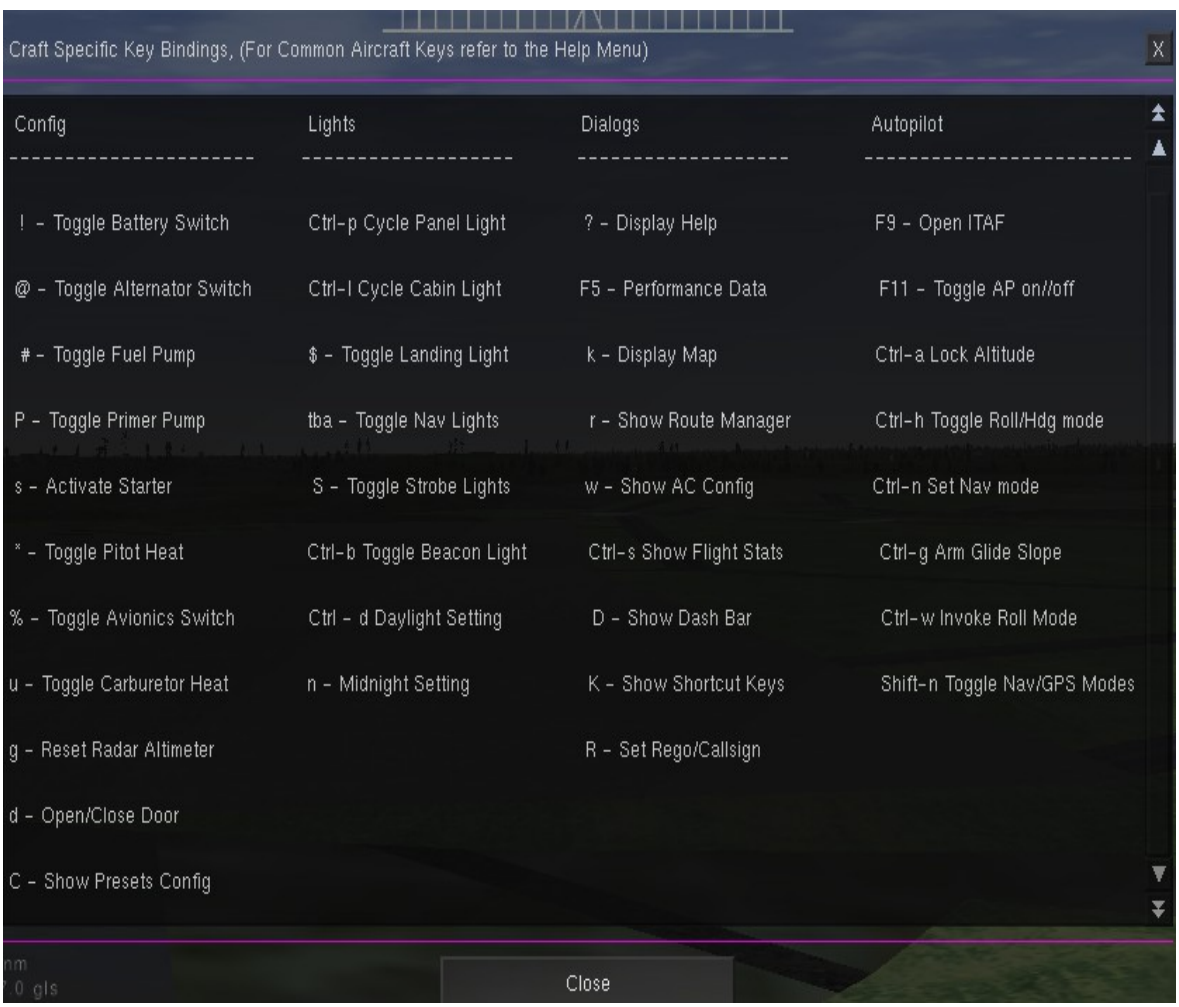
Most of the custom key bindings are identical with the original Piper Cherokee Warrior. So for instance

h calls up the Hud toggle

* toggles Carburator Heat

k opens the map dialog

r opens the Route Manager Dialog



Nb, working the throttle from the keyboard can be a little slow, clicking the Lever will increase the RPMS by 25%, clicking the VSI will decrease the throttle by 25% while clicking the Tacho will give you full throttle.

Alternatively you can also use the Presets bar.

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Auto Pilot(s)

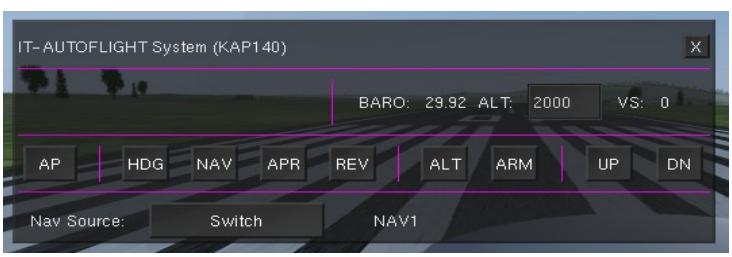
The Navigator comes equipped with an auto pilot namely a modified version of the Bendix King KAP140.

Whilst the unit looks the same as the standard version, its core functionality has been modified and extended by the seemless integration of the more sophisticated IT_Autoflight (ITAF) Autopilot developed by Joshua Davidson.

This means the Hybrid now supports waypoint navigation via Route Manager/GPS resulting in two NAV modes, one to follow the Route Manager and one for the original VOR Lock mode.

The auto pilot can be activated from either the panel embedded KAP140 unit as shown below

or alteratively from the ITAF dialog



which provides both more functionality and a much friendlier interface. By default the dialog will open at the bottom left corner thus not obscuring the pilots view.To display the ITAF press F11 or click the face of the Kap140 or choose the menu. The AP Control Bar offers another interface

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KAP140

If not already familiar with the operation of the generic KAP140, the following link will take you to a Wiki explaining its basic modus operandi. It is vital to be familiar with the equipment, its shortcomings in particular, as otherwise you might be in for some rather nasty surprises.

http://wiki.flightgear.org/Bendix/King_KAP140_Autopilot

Prior to examining the extended functionality the interface of the ITAF provides, a brief recap of the various modes:

AP turns the auto pilot on with ROL and VS modes activated, that is wings level and current pitch maintained be it level, ascent or descent.

WARNING

Pressing AP again will turn the autopilot off, however not immedeately. It will flash for a little while prior to receeding control to the pilot.
Due to that delay in release the auto pilot should not be used at take off and turned off well before touch down.

HDG the AP will follow the direction of the heading bug of either the digital gyro or the HSI

CAUTION

The Autopilot will always turn the shortest way to the left or right. A turn must not exceed 180 degrees or the autopilot will suddenly turn in the opposite direction midturn because the other side now has less degrees to turn to.

In order to turn more than 180 degrees you need to break up the turn into phases like the first turn to 120 and just before there turn another 90.

VS the AP will ascend or descend continuously at the fpm rate specified using the UP/DN buttons. (Increments/Decrements are in 100ft lots)

One problem with VS may occur just after takeoff, when the AP senses the required VS based on pitch, air pressure and other parameters and sets your VS at 1500fpm or more. Your low powered engine can not sustain that and you will stall.

ALT activates the altitude control. Pressing ALT will stop the plane from its current climb or descend by levelling out provided no desired altitude has been preset.

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If a wanted (preset) altitude has been set and armed, ALT will automatically activate with at first the plane slightly overshooting the target and levelling out on target.

Subtleties

If the armed preset altitude differs from the current altitude you are going to climb or descend based on the +/-fpm (UP/DN) settings.

preset/armed 6000	current	3000	+600fpm	result altitude hold in 5 minutes
preset/armed 4000	current	4200	+500fpm	result climb until out of fuel
preset/armed 5000	current	3000	-300fpm	result crash in 10 minutes

Clicking ALT again will cancel altitude hold whereas pressing (UP/DN) will take you back into VS mode.

Note:

To set the desired altitude using KAP140 use the wheel to increment/decrement setting by 100ft lots, using ITAF you simply nominate the wanted altitude in the ALT: box and then press the ARM button.

NAV switches from ROL or HDG mode to follow the course set in "NAV1“ or "NAV2". The AP will then attempt to intercept the radial set in the OBS and track it following the VOR CDI. The intercept angle however should be less than 60 degrees.

If the Nav Source Switch is set to GPS/Route Manager Nav mode will fly the route as defined in the Route Manager.

APR arms the approach mode and activates the ILS/GS-Approach once the Nav receiver senses the Glide-slope in range.

REV switches to LOC Back Course mode (refer to the ILS topic) NOT IMLEMENTED YET

Note:

Other FG aircrafts come with their own KAP140 Version, original or modified, so if you fly another aircraft with a KAP140 check the documentation, if there is no doco.....

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Flight Settings Reference Tables

PA-Warrior	RPM	KTS	Flaps	FPM	RW	WS kts	From	Mix	CarbH
Taxi	1100		none	0		3,5	215		Off
Climb				300					
Climb				500					
Cruise 5k				0					
Cruise 7k				0					
Descend									
Descend									
Decend									
App Level									
App Descend									
Glide Slope									

Add your specific scenarios

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Command Lines

It is assumed you had at least a glance at the official manual and or are somewhat familiar with the concept of command lines. If not it may be useful to read up on the topic (either use the pdf found in the Flightgear Docs folder or the html version found in the Help menu.

A freshly installed FG version will come in plain vanilla i.e. You pick an aircraft, your departing airport, select a runway and off you go.
Depending on your version FG opens up with either FGRun/FFGo or QT Launcher, all providing you with the option to specify command line options.

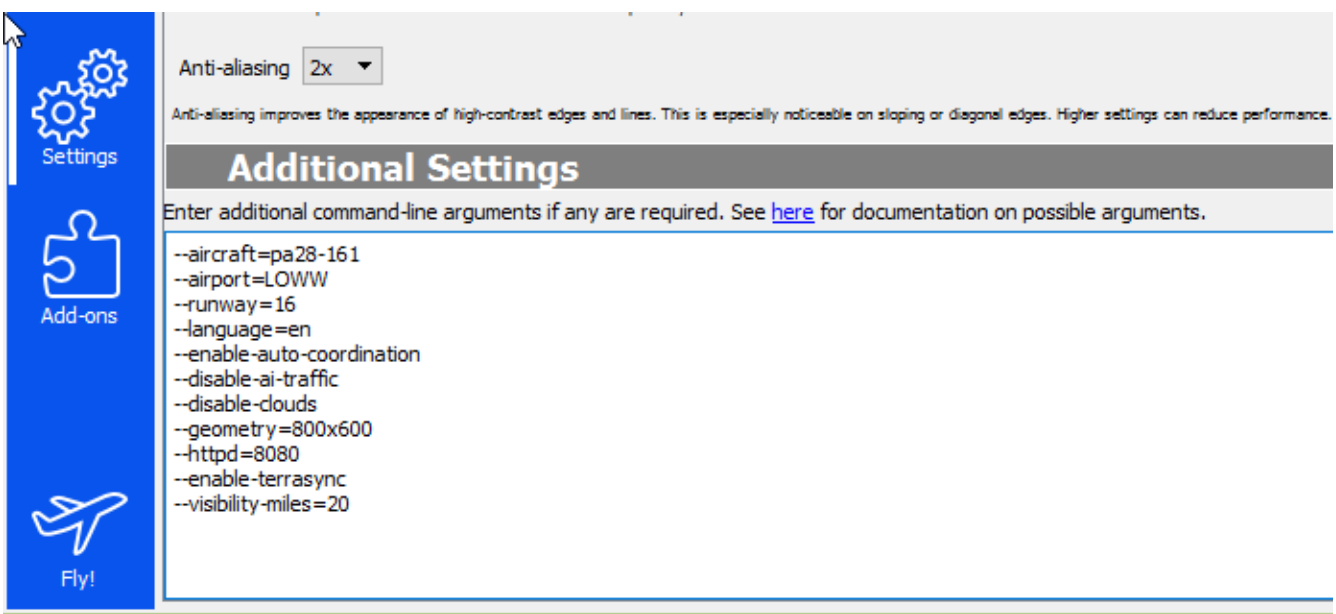
Sooner or later you may wish or need to change your settings, maybe just change the weather, use the moving map or turn other features or general options on or off.

Therefore we need to know what's available. A good start are the Command Line WIKIS

http://wiki.flightgear.org/Command_line Windows/Linux
http://wiki.flightgear.org/Command_line_options

Most of them are self explanatory and in order to use them you need to be in a Launcher like QT Launcher or other depending on your Operating System and Flightgear Version.
Alternatively you can also specify them directly using a command prompt or embed them in some sort of text-file ending with the extension .bat (a Windows Batch File)

This is an example of one of the QT Launchers:



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--aircraft=WarriorII-160
    you want to fly the PA28-Warrior

--airport=LOWW
    Vienna is your desired departure

--runway=16
    this is your favourite runway

--language=en
    your OS is Spanish but you really would like FG in English

--enable-auto-coordination
    synchronises ailerons & rudder

--disable-ai-traffic
    relevant only for multi player

--disable-clouds
    in case you are a good weather pilot

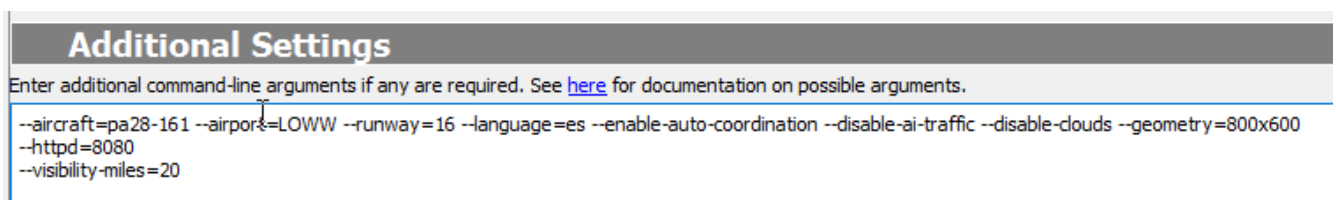
--geometry=800x600
    your systems recommended or best screen resolution

--httpd=8080
    internet port for online moving map, some documentation shown in a browser,...

--visibility-miles=20
    how far you want to be able to see

That s an awful lot of typing and you need to do it again and again and to make matters worse if you accidentally close the dialog rather then fly, all the settings go to nirwana....

You can type one line at a time as shown above, but you can also put it all in a single line if you wish:




```
--altitude=3500 --heading=330 --vc=85 --nav1=160:108.5.3 --dme=nav1
```

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Batch Files

Your FGNavigator1 contains a folder named QuickStarts which contains a number of quick start options WINDOWS10 batch files. Copy that folder on to your desktop and you are on the runway or starting in the air with just two or three clicks completely bypassing the FG Launcher.

More detail can be found under the menu option Practise Approaches.

About these batch files - USE AT YOUR OWN RISK

Batch files are basically just containers of a list of command lines. Once the file is executed it simply feeds the commands to Flightgear like the Launcher does.
Batch files can also prompt for input amongst other things. Yet they are just plain text files you create or modify with a text or word processor and Save with a .bat extension

First of all the included batch files are designed to run on Windows10. Older Windows Versions use a slightly different syntax and as such the above mentioned files may not run.

If that's the case use your search engine to look up creating or modifying batch files.

The author of this document is not familiar with Apple or Ubuntu, KDE or other operating systems but rest assured there is plenty of info out there how to automate the start-up of FG with something similar to DOS/Windows batch-files.

Here an example of a batch file:

```
set /p ac=Aircraft:
set /p ap=Airport:

"C:\FlightGear 2017.2.1\bin\fgfs.exe" --fg-root="C:\FlightGear 2017.2.1\data" ^
--aircraft=%ac% ^
--airport=%ap% ^
--dme=nav1 ^
--timeofday=morning ^
--enable-auto-coordination ^
--disable-terrasync ^
--enable-freeze ^
--enable-fullscreen
```

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line 1 and 2 will act as storage for user input for craft and airport by the means of prompts displayed by line 4 and 5.

IMPORTANT! ***Line 3 tells the batch file where on the PC it can find the Flightgear Installation. If you have a different version you need to change the 2018.3.2 bit to whatever your version is and possibly change the path as well.***

--disable-terrasync

If enabled FG in the background downloads scenery as you fly or synchronises data in the background gobbling up system resource like memory....

--enable-fullscreen FG will open in full screen mode at default resolution unless otherwise specified.

Note – if you use windows you might prefer to set the geometry property to ie 800x600, no full-screen and maximise the window after start-up, this way you do not lose the taskbar.

Generally its a good idea to back up whatever customisation's you put into place.

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PIPER CHEROKEE WARRIOR II PERFORMANCE DATA

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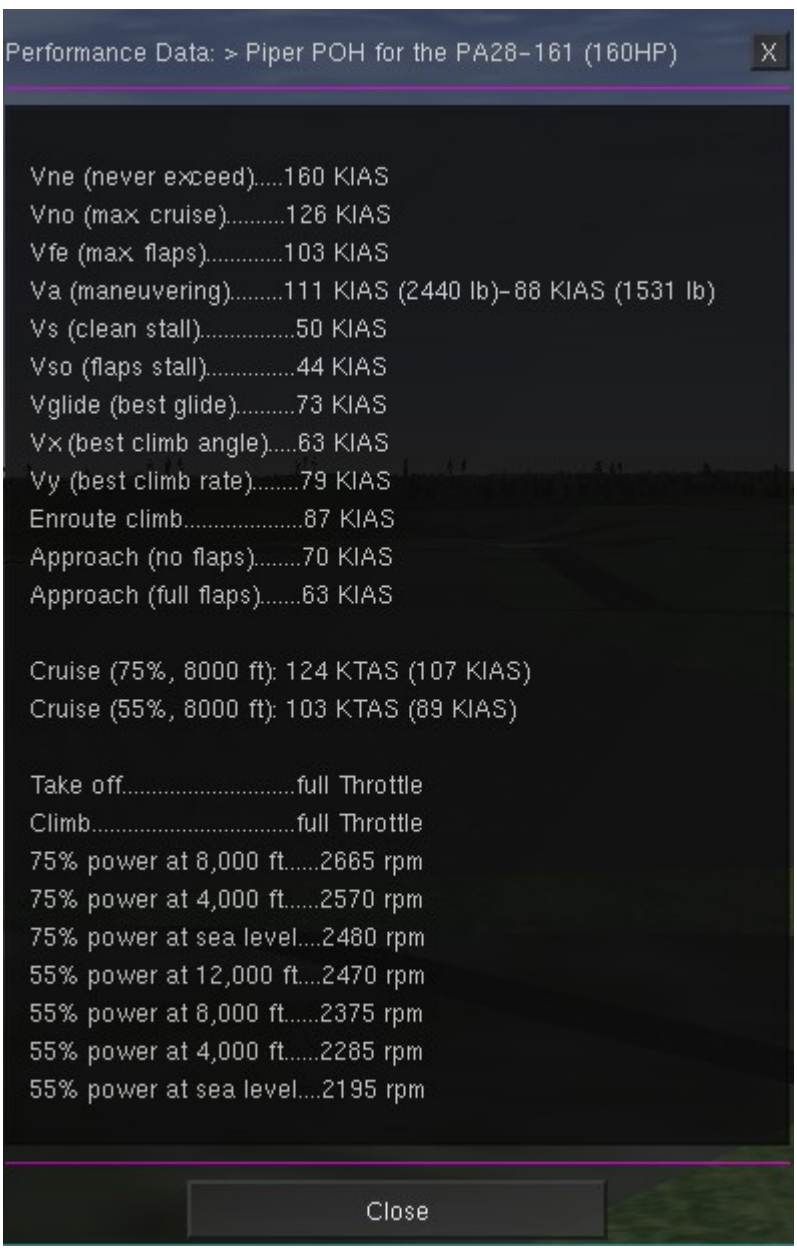
The Piper Cherokee Warrior II is a four-seat, fixed-gear aircraft with performance is very similar to that of the Cessna 172n and 172p, which share the same 160 hp Lycoming O-320 engine. Next to the Cessna 172, the Warrior is probably the most common trainer at flight schools as well as a popular entry-level aircraft for new owners and for rental pilots at FBO's.

Like the 172, the Warrior is a very easy plane to fly: its stall is gentle, and its responsiveness to control inputs is slow (making it harder to overcontrol, an especially useful trait for new IFR pilots).

There are a few important differences from the 172p aside from the low wings:

- it does not glide quite as well, so the flare is shorter (don't let the speed decay too much) and there's a slightly higher stall speed
- it is a little gentler in the stall and a little more stable in turbulence



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Fuel

Total fuel:	50 gal US
Usable fuel:	48 gal US
Grade:	100LL/100 (Avgas)
GPH (75%, 8000 ft):	10.0 gph ROP, 8.8 gph LOP/WOT
GPH (55%, 8000 ft):	7.0 gph ROP, 5.5 gph LOP/WOT

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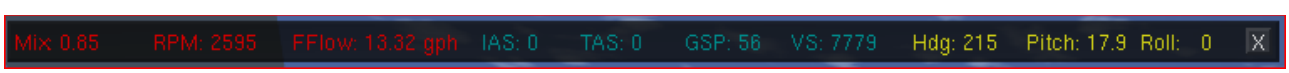
The Menu

While most of the menu items are self explanatory, here is a quick run down:

- Aircraft Config - opens the configuration dialogue
- Checklist - displays the Checklist dialogue
- DashBar - displays engine, speeds and attitude data



- Emergency Procs - part of the checklist dialogue
- Flight Statistics - keeps track of flight sessions and incidents
- Fuel Status - popup once fuel gets a bit low, details time remaining etc.
- Heading Selector - lets you change heading in external views if not in GPS mode
- Presets Bar - adjustment of parameters and shows flighttime
- Adjust Pilot Seat - Shift position up down forward or back look up or down

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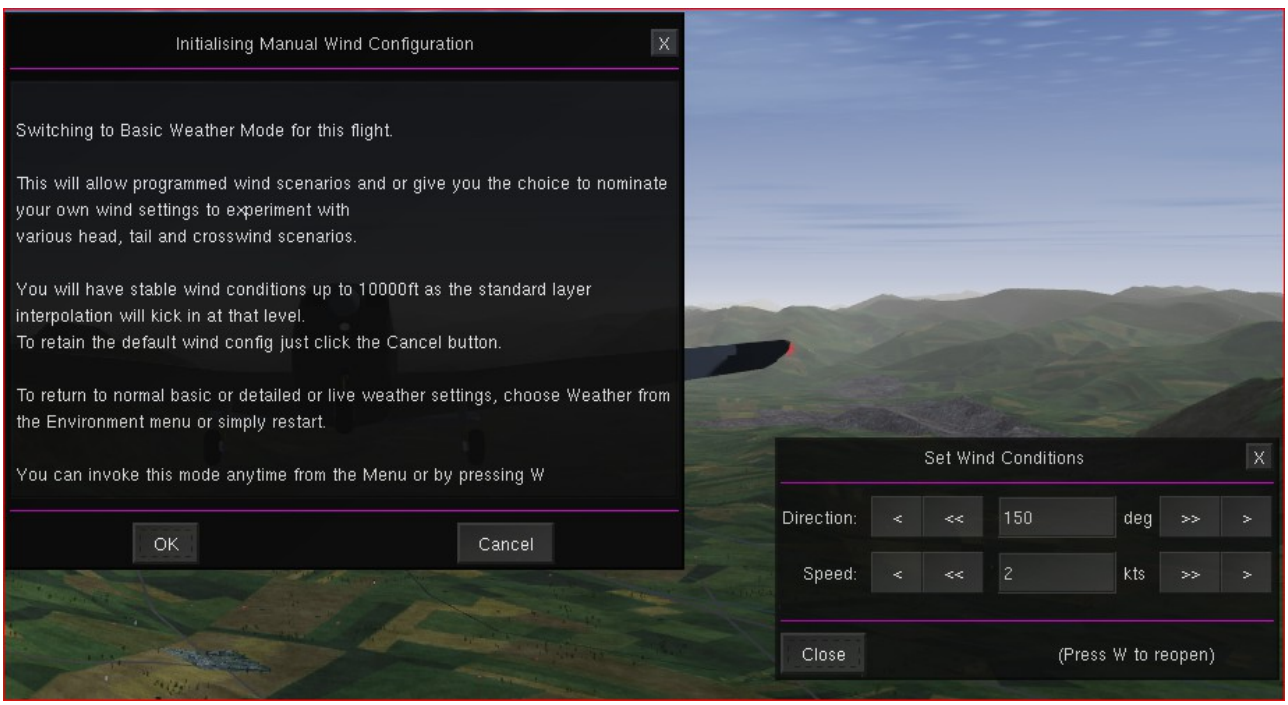
- Set CallSign - only relevant if on multiplay or conversing with ATC
- Specification - data extract of the POH
- Toggle View Bar - allows you switching between select views

Wind Settings:



This feature allows you to override Flightgears inbuilt weather engines and or live weather if connected to the net.

The above dialogue will pop up in some Nav Scenarios and can also be called up via pressing Shift W. Once you click OK you can specify your desired wind direction and speed for up to 10000ft.
Can be useful for takeoff practise with head, tail or crosswinds etc.

The items contained in the **HowTO** and **Miscellaneous** menu are pretty self explanatory and the **Nav Scenario** menu puts you on a runway, somewhere in the air engine running and sometimes radios preset with frequency, etc. Each scenario provides basic instructions or explanations, but you still have to do you flight plan to work out fuel requirements, altitudes, speeds, setting instruments etc. Example on the next page.

The combination of Dash/ApControl/Preset and ViewBar can be called up by pressing CTRL-C or clicking the hotspot on the AOA.

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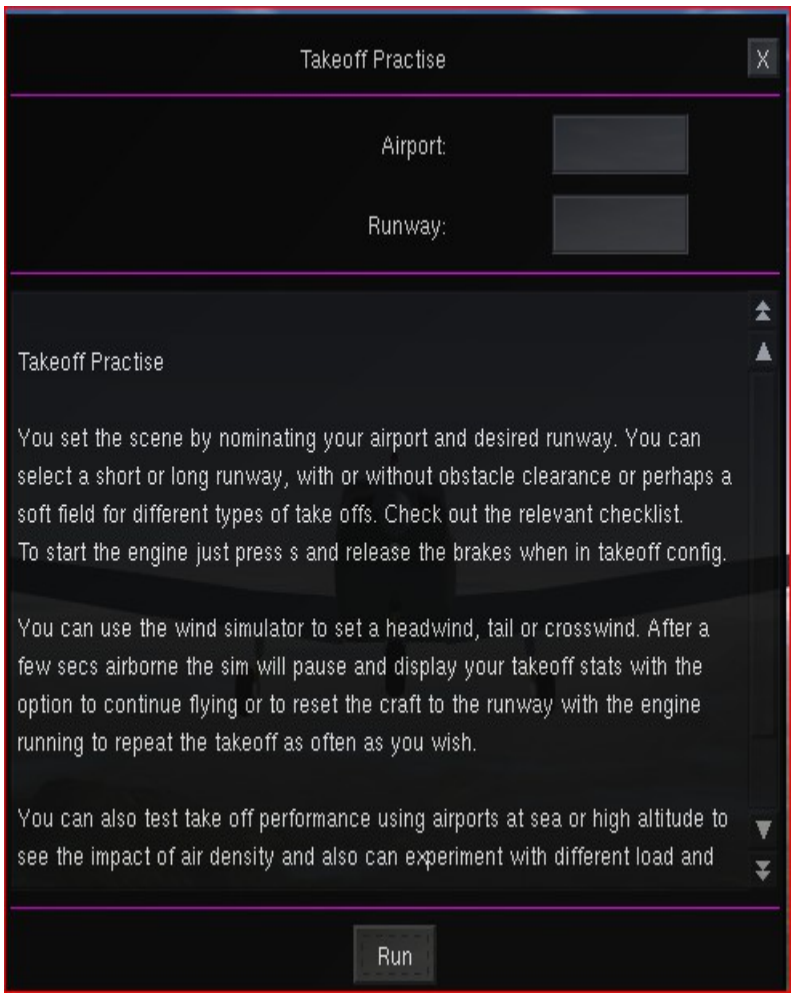
A Nav Scenario Takeoff Practise Example

Select Airport and Runway, then click OK



Set your wind parameters or just close the dialogue, then press s to start the engine.

Get into your required takeoff config aka flaps, no flaps, rev up with brakes on,....
and commence the takeoff roll and take off

Once the wheels are off the ground you will see the following dialogue …

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Reset will take you back with the engine running and you can try again, whereas Continue will switch to normal flightmode and you can go sightseeing....

At present some of the data is not accurate as still work in progress.

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FG Wikis

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