Multiple Monitors in FlightGear: Quick and Dirty

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Introduction

If you're like me, you may not have the equipment and space to set up multiple monitors for FlightGear permanently. But you might have an odd assortment of computers and monitors that you can set up now and then for a short time. This is a quick and dirty guide for setting up multiple monitors for FlightGear in just a few minutes.

Position the monitors

Aligning the images will be much easier if you follow these guidelines:

- Keep the screens vertical (not tilted).

- Raise or lower each monitor so that their centers are aligned horizontally (Fig. 1).

- Place the monitors at eye level.

- Position all the screens the same distance from your eyes.

- Aim all the monitors directly at your eyes. In other words, your line of sight should be perpendicular to the face of the monitor image.
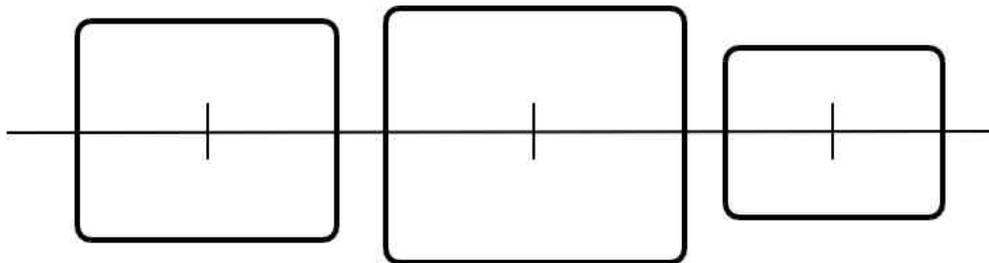
Fig 1. Align horizontally on center

Start the master with `--native-fdm`

The "master" computer is whichever one you designate to compute the flight dynamics model (FDM) for the network. For this tutorial, we'll designate the computer attached to the monitor in front and center as the master. The `--native-fdm` option tells the master to send its FDM results to another computer. The form is

```
--native-fdm=socket,out,60,IP of slave,5500,udp
```

Add one of these options for each slave computer. The 60 refers to the number of times per second that the master will send updated FDM information to the slave. The 5500 is the UDP port number to use.

This option can be set in the GUI launcher by clicking Advanced->Input/Output.

Start a slave with `--fdm` and `--native-fdm`

Start each slave with these options:

```
--fdm=external
--native-fdm=socket,in,60,,5500,udp
```

Note the double comma – no IP address needs to be specified. The 60 refers to the rate at which the slave should expect to receive FDM updates from the master and should match the corresponding field of the master's `--native-fdm` option. The 5500 is the UDP port number to use.

These options can be set in the GUI launcher at Advanced->Flight Model and Advanced->Input/Output.

Scale slave

If all your screens are the same physical size, skip to the next section. If your slave and master monitors are different sizes, you need to scale the images displayed on the screens to approximately the same physical size. If your master monitor is already set to a reasonable field of view, don't change it. Use the x/X key on the slave to zoom its display in or out so that its image is the same physical scale as the master. For example, use a ruler to physically measure the distance between two arbitrary instruments on the instrument panel, then zoom the slave so that the distance between the same two instruments is the same (Fig. 2).

Fig 2. Scale to the same size

Make note of the resulting field of view so that you can put it on the command line next time and not have to repeat this step. The new field of view briefly shows on the display when you zoom in or out. The command line to use the future is:

```
--fov=degrees
```

GUI users can also enter the field of view in Advanced->Rendering->FOV.

Pan slave

If you've followed the suggestions so far, then this final adjustment will be magically simple. Right-click the mouse to get into pan view mode (where the cursor becomes a double-headed arrow). Avoid panning up or down. Just pan right or left to where the image should be.

You might want to position your aircraft on a paved runway in preparation for this adjustment. Taxi a little distance so that the distinct runway markings appear to be continuous from one display to the other, as if the monitors were windows. Weave around a bit and check that the runway markings flow from one screen to another as you would expect.

After you establish the correct view angle, you can avoid having to do this step in the future by specifying the angle on the command line. Unlike the FOV, the pan angle doesn't appear on the screen when you change it. You can discover your current pan angle by browsing the internal property tree at /sim/view/config/heading-offset-deg. The command line format to use in the future is:

```
--prop:/sim/view[0]/config/heading-offset-deg=degrees
```

Use negative offsets to look to the right, positive offsets to look left. GUI users are out of luck (the Advanced->Rendering->View Offset setting and the `--view-offset` command line option evidentially do something else).

Improvements and variations

Best FOV

The field of view (FOV) in a single-monitor setup is flexible. Your brain understands what your eyes see across a wide range of FOV settings. When you add a second or third monitor, you are more likely to notice distortions from an incorrectly chosen FOV compounded across multiple screens. There's a quick and dirty method to determine the correct FOV if your monitors are immediately adjacent each other with little or no visual gap between screens. Measure or estimate the angle from your eyes to the leftmost and rightmost edges of the overall image (Fig. 3). Divide by the number of monitors. Zoom

the center monitor to this FOV and scale the side monitors to match. Your brain will be able to interpret the distortion resulting from using slightly wider fields of view, but significantly wider views may make it hard to align all the screens without distortion as you roll and pitch in your aircraft.
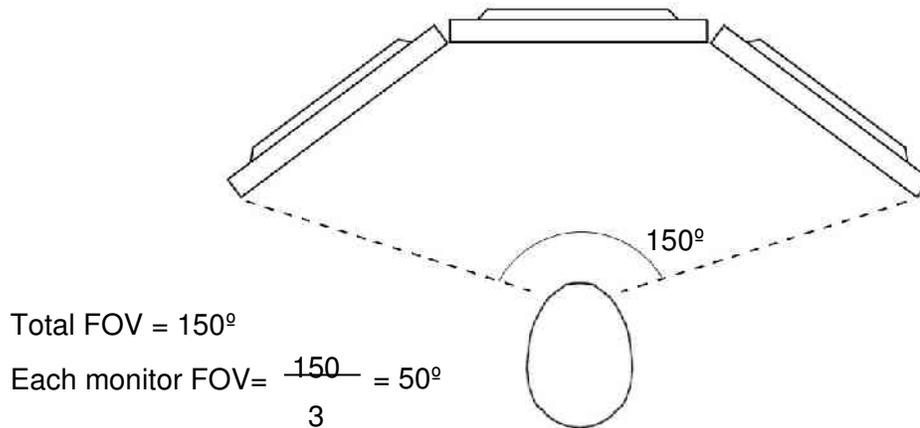
150º

Total FOV = 150º

Each monitor FOV= $\frac{150}{3}$ = 50º

Fig 3. Field of view

Step outside the cockpit

FlightGear's aircraft models simulate the restricted view a pilot has from the pilot's seat. If you want a less restricted view out the side monitors, you can change the view origin to a point just outside the aircraft body without distorting the overall image alignment perceptibly. You can do this graphically when the program is running by clicking View->Adjust View Distance. Note the setting before you change it, particularly the right-left position (Fig. 4). You can dial in a new view origin by clicking and holding the left mouse button on the dial. There's a trick to making fine adjustments with this control. Click on the dial with a mouse left click. Hold the mouse button down and drag the cursor out to the edge of the screen. Your mouse will then work like an invisible, extended handle to the dial.
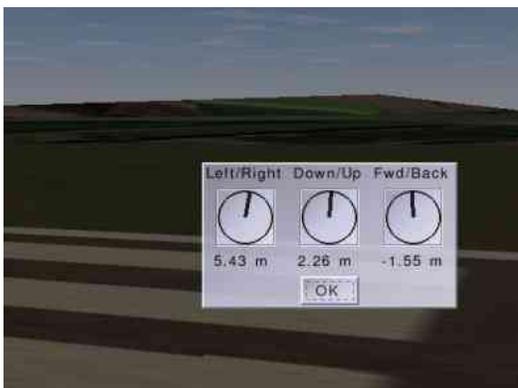
Fig 4. Adjusting the view origin

After you select a new view origin, make a note of the three values in the view location GUI so that you can specify these values on the command line in the future and not have to repeat this exercise. The format is:

```
--prop:/sim/view[0]/config/x-offset-m#meters
--prop:/sim/view[0]/config/y-offset-m#meters
--prop:/sim/view[0]/config/z-offset-m#meters
```

Use positive X values to move your viewpoint to the right, positive Y offsets to move higher, and positive Z offsets to move aft.

Stereoscopic flying

Using the view location adjustment described in the previous section, you can view the world in three dimensions. Place two monitors side by side as close together as possible. Shift the view origin of one to the left, and the other to the right, for the effect as shown in Figs. 5a and 5b.
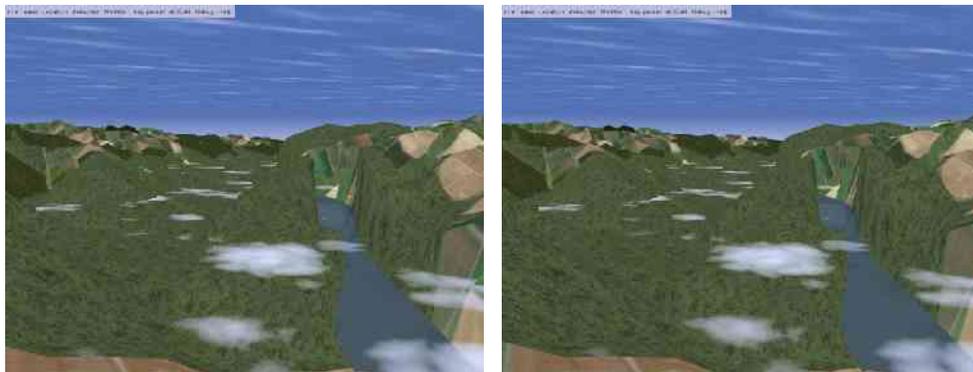

Fig 5a. Remote Peruvian Andes in stereo, for cross-eyed viewing

Fig 5b. Remote Peruvian Andes in stereo, for non-cross-eyed viewing

Troubleshooting

Flight Model

If the master display shows an instrument panel but no scenery, verify that option `--fdm=external` is not on the command line or in any configuration file. In the GUI launcher, verify that Advanced->Flight Model is not set to external.

If a slave starts up in a different part of the world or otherwise seems to run independent of the master, verify that the slave uses the option `--fdm=external`.

Angles

If you just can't get the images to match up initially or to remain aligned as you pitch and roll your aircraft, then check that you began your alignment procedure with the front center display set to view directly forward with no pitch. You can move the front display directly right or left with no problem, but any movement up or down will make it harder to align the displays on the sides.

Also check that you began your alignment procedure with the center display set to the correct field of view. It's easy to set the center display to a field of view too wide, which then strains the forgiving geometry of our quick-and-dirty approach.

Rendering

If the terrain looks different on the master and slave, or if runways or other objects appear different, check that the master and slave use the same scenery and objects data. This is generally anything at or below `$FG_ROOT/data/` and at `$FG_SCENERY`. These directory hierarchies can be replicated locally, or shared at a common network location.

If the master and slave show different cloud layers, or different visibility, or position of the sun, or appear different in other ways, check that the master and slave use the same or compatible options. If the command lines appear to be the same, check for options in all the possible configuration files such as `preferences.xml`, and `~/.fgfsrc` (`system.fgfsrc` in Windows).

Network

If a slave shows an instrument panel but no scenery, it may indicate that the FDM results are not getting transmitted from the master to the slave, so the slave doesn't know where it is, and therefore doesn't know how to render the scenery. Verify that the master uses one option `--native-fdm` for each slave, with the correct IP address of the slave.

Check that the slave has a matching `--native-fdm` option for input with no IP address given. See if the two computers can ping each other. Verify that there's no firewall blocking traffic between the two computers.

Fig. 6. Flying under the Golden Gate Bridge
Two laptops, two desktops, Linux and Windows

Summary, contact, and document information

FlightGear's support for multiple monitors is flexible, general, and easy to configure by the seat of your pants. Experiment and enjoy.

Check for later versions of this document at http://www.inkdrop.net/dave/multimon.pdf.

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