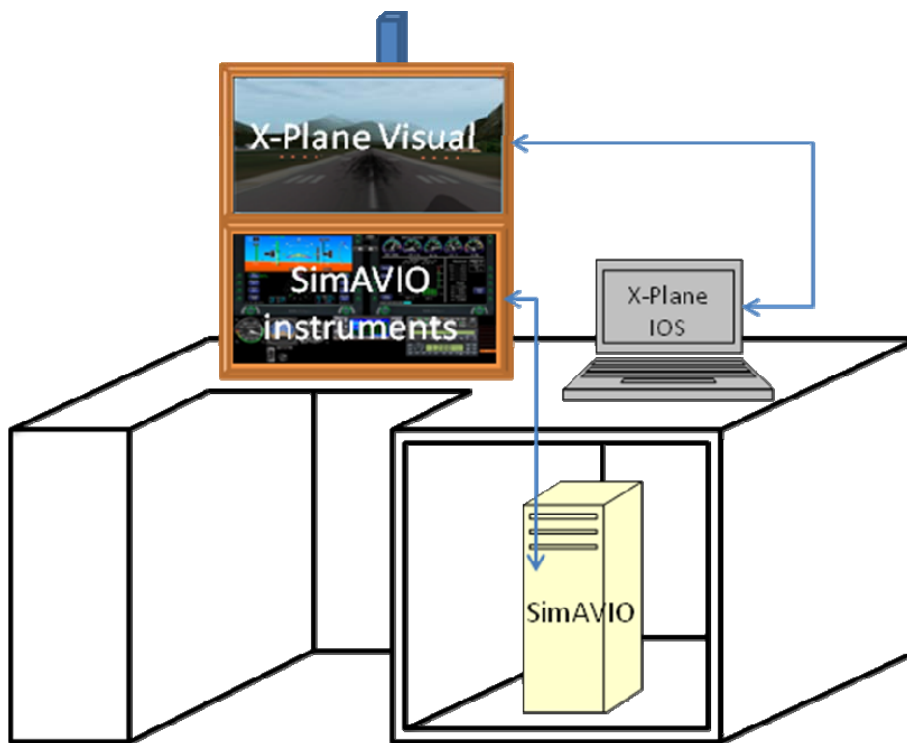


HOW TO ASSEMBLE AN INSTRUMENT TRAINER

INTRODUCTION

This article summarizes how to build an instrument trainer from readily available hardware and software that can be used for instrument training in a wide range of aircraft. It is not our intention to write an article on how to build a full motion flight simulator with a cockpit enclosure that mimics every button and lever found on the real aircraft. You may tap into a huge sub-culture of hard-core sim builders that do this as a passionate hobby. www.mycockpit.org Instead, the following procedure provides the lowest cost, highest fidelity, and the fastest time to begin your training. There is no need to program microcontrollers or embark on metal fabrication or fiberglass hull construction.

SimAVIO is not a cookie-cutter program. Our typical hobbyist is one of the “hard-core” sim builder with at least three computers running on a network with 3 or more monitors. Because this is a Getting Started guide, we have chosen a configuration that provides the most realism and the least cost/effort. Our configuration will require mid-range computer graphics and two high-end monitors.



This Do-It-Yourself Guide will call reference to procedures in our Operations Manual, and also to procedures that are in the X-Plane manual. This guide focuses on the procedures for assembling your own cockpit and selective software that is specific to this cockpit configuration. General procedures that apply to all operations of SimAVIO and X-Plane will be discussed in the Operations Manual.

Figure 1 provides a sketch of the simulator in this kit. This configuration is ideal when an instructor and a student are operating the simulator together with separate mouse control. A two computer simulator allows the X-Plane sounds and SimAVIO sounds to be played simultaneously. The SimAVIO touch-screen

monitor sits flush on the top of the table, and the yoke is mounted below the table. The X-Plane drives two monitors: the outside view stacked above the SimAVIO panel, and the Instructors Operating Station (I.O.S.) on the tabletop next to the pilot’s chair. As a future upgrade, we recommend enhancing the outside view by spanning it across three monitor (left, center, right). This can be done using a single HDMI or VGA source and a single license of X-Plane with the Matrox Triple Head to Go.

http://www.matrox.com/graphics/surroundgaming/en/games/supported/flight_simX/

See the Operations Manual <http://www.flythissim.com/SimAvio%20Operators%20Manualrev4.pdf> for system requirements, installing and activating SimAVIO, networking to X-Plane, opening panels, manipulating the gauges and instruments, setting failures, and troubleshooting.

SIMULATOR COMPONENTS REQUIRED

The following table breaks out the cost for each item needed to build this simulator. These prices are before taxes and environmental disposal fees if any.

1 COMPUTER FOR SIMAVIO

Desktop gaming PC with a dedicated graphics card: \$800

- Graphics card: nVidia GeForce GTS 250 1GB DDR3 2DVI PCI-Express Video Card
- Memory: (4) GIG DDR3 1066 Memory
- CPU: Intel Core i5 Processor i5-750 2.66GHz 8MB LGA1156

A PC with this exact configuration is available for purchase through Precision Flight Controls website. http://www.flypfc.com/index.php?i_id=3

1 LAPTOP (OR DESKTOP COMPUTER FOR X-PLANE)

In this computer configuration, X-Plane will use two monitors: the laptop screen will display the Instructors Operating Station (IOS), while the added monitor will display the X-Plane outside view. It is important to match the resolutions for both monitors. X-Plane has a difficult time dealing with two monitors that have dissimilar resolutions when displayed in full screen view. See the section on of the Operations Manual entitled "Setting up a three monitor, two computer simulator" for procedures on configuring your displays.

\$ 800	Desktop computer
\$ 800	Laptop computer
\$ 250	24" monitor
\$ 350	23" touch-screen monitor
\$ 30	X-Plane
\$ 140	SimAVIO + panels
\$ 120	Saitek yoke and throttle
\$ 50	Monitor mounts
\$ 150	Desk materials
\$ 2,690	Total

TOUCH-SCREEN MONITOR FOR SIMAVIO COCKPIT DISPLAY

We use the Acer T230H in this demo with resolution 1920 x 1080. High resolution monitors are necessary to properly display the fine details and text on the SimAVIO instrument panel.

A 23" or 24" monitor will provide a 1:1 scaling on the PFD, MFD and standby gauges. The panels that we selected are the "compact" panels. To identify these panels, the file will contain the word "compact" in the name. For example:

Cirrus_SR20_compact_Avidyne.fts These panels are designed to maximize the real estate on the monitor, and leave no area for the X-Plane outside visual.

SOFTWARE

- X-Plane version 9.45 or greater. \$29.95
- SimAVIO: \$39.95
- SimAVIO add-on panel: \$98.95

Fly This Sim has hundreds of different panel configurations to choose from. The add-on panels are generally sold by aircraft manufacturer and glass versus analog. FTS software may be purchased at www.flythissim.com.

Under the main categories of glass and analog:

GLASS

- Avidyne Entegra (series 7) + STEC-55X + Garmin GNS430W (2)

- Piper Warrior, Arrow, Archer, Saratoga, Seminole, Seneca
- Cirrus SR20, SR22, SR22T
- Garmin G1000
 - Cessna 172R, 172SP, 182T, T182, 206H, T206H
 - Beech Baron, Bonanza
 - Cessna Corvalis 350, 400 and 400TT
 - Diamond DA40, DA42

ANALOG

- Steam gauges + STEC-55X + GNS430W (2)
 - Cessna 172P, 172R, 172S, 182 Turbo, 182-T, 421C, 414A
 - Beech Bonanza, Bonanza TC, Baron, Baron TC, Duchess, Travelair
 - Arrow, Archer, Seminole, Seneca
 - King Air A100, B200, BE1900, C90B, Pilatus PC12, Piper Cheyenne, Cessna 501

CONTROLS

- Saitek Pro Flight Yoke System (with throttle quadrant): \$120
- Rudder Pedals (optional for Instrument Flight training)
- PFC430 Control Head (optional) \$500

The yoke from Saitek was designed to be mounted ABOVE the table. In order to keep the instrument display and the outside visual at the correct height relative to the pilot's viewpoint, the yoke was disassembled from the shaft and rotated 180 degrees. By doing this, mounting holes could be drilled and tapped in the bottom of the yoke assembly and mounted to the underside of the table.



The Saitek yoke can be replaced by a joystick by loosening the three 1/4x20 machine screws. The joystick platform is mounted using the same fasteners and mounting holes in the table. The joystick can also be placed on the tabletop to the left or right of the pilot (depending on the aircraft you are simulating).

The throttle quadrant can be inserted and mounted into the rectangular cut-out on the left or right side of the pilot (depending on the aircraft you are simulating)

We felt it was unnecessary to install rudder pedals since this simulator would be used primarily for practicing instrument approaches. Rudder pedals are necessary in a simulator for taxiing, takeoff, slips, and crosswind landings.

MONITOR MOUNTS



Arrowmounts Desktop Mount for 13 to 24 inch Flat Panel TVs AM-D2410: \$25 x 2

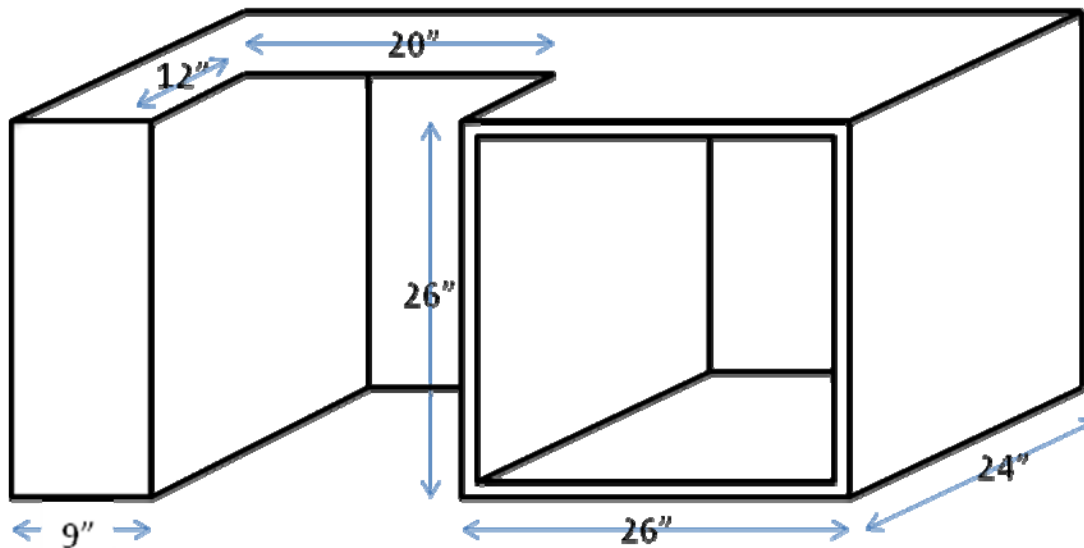
Unfortunately, this desktop monitor mount was discovered AFTER we fabricated our own as shown in our pictures. We recommend the Arrowmount instead for your simulator. It may be possible to combine two of the articulating arms/mounts to a single channel stock post.

It may be necessary to attach supporting blocks to the backside of the monitor to prevent movement when the instrument monitor is touched. (See close up image). Machine screws were used for fine alignment and to ensure a tight fit.

BUTTON ASSIGNMENT

Buttons can be assigned any simulator command. In our yoke, we chose the most commonly used by pilots: flaps, parking brakes toggle, trim, view, and autopilot disconnect. To assign buttons on your yoke or throttle, see the X-Plane wiki <http://wiki.x-plane.com/Chapter 3: Initial Flight Setup#Button Assignment>

DESK:



The dimensions of the desk were chosen to provide the most realistic viewing that a pilot would experience in a general aviation aircraft. Ergonomically, the yoke and throttle are at the approximate height and the split between the top and bottom monitors approximates the location of the glare shield. Finally, the visual screen is low on the horizon.

Melamine was the construction material of choice due to its pre-finished surface and ease of assembly. Screws normally do not split the wood, and wood glue is not necessary allowing for easy disassembly and redesign.

ADJUSTABLE HEIGHT CHAIR WITH LOCKING WHEELS

It is important to use a chair that has an adjustable seat height and locking wheels. The locking wheels will prevent the chair from sliding forward or back while applying force to the yoke or rudder/brake pedals. Adjustable seat height will allow differing body types the proper fit and viewing position.

CONCLUSIONS

SimAVIO is graphics rendering software used by flight simulation enthusiasts, training schools, and manufacturers of FAA approved training devices. This Do-It-Yourself guide described the hardware, skills, cost and time needed to build a flight simulator in your home or flight school. The scale of this simulator project is manageable in time and cost, while providing a high degree of realism. It was also selected to leverage the advantages realized by separating the cockpit instruments from the external view. The components necessary included Melamine fiberboard, one touch-screen monitor, one regular monitor, one desktop computer, one laptop computer, two articulating monitor mounts, a yoke, a throttle, X-Plane, and of course SimAVIO. Optimal dimensions were selected to provide the most realistic positioning of the body relative to the controls and view for most general aviation aircraft.