Piccolo Software-in-Loop (SiL) Setup Guide

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*The Piccolo Autopilot avionics system and all of its versions (such as Piccolo, Piccolo Plus, Piccolo II, Piccolo LT, and Piccolo SL) were designed for use **only** on un-manned aircraft.* ***USE OF THESE PICCOLO AUTOPILOT PRODUCTS IN AIRCRAFT WITH HUMAN OCCUPANTS IS PROHIBITED BY THE FEDERAL AVIATION ADMINISTRATION.*** *Cloud Cap Technology, Inc. is not permitted to sell the Piccolo Autopilot to any customer that intends to use the product on aircraft with human occupants.*

Piccolo Software-in-Loop Setup Guide Change Log

February 8, 2011

- Section 3: Updated SiL startup section.

December 4, 2009

- Universal: Updated Map Actions Tool bar screen captures.

1 Introduction

This document provides first time Piccolo users a step by step guide to set up the Software-in-Loop (SiL) simulation environment. A Windows based PC is the only requirement to setup this environment.

The SiL configuration provides the same functionality as a Hardware-in-Loop (HiL) setup, but without the autopilot and ground station hardware connected. In the SiL configuration, PC applications take the place of the ground station and autopilot.

The simulation environment allows the aircraft control laws and mission functionality to be tested without risking the aircraft in a flight test. The simulation environment provides an ideal training tool that can be used in the lab. Although simulation cannot replace flight-testing, it measurably reduces the likelihood of failure by detecting bugs and deficiencies before the aircraft and related hardware are put at risk.

2 Software Installation

If you have a CD, insert it in your PC and copy all three folders from the CD to the hard drive (C) or create your own directory. The numbers behind the **`Dev Kit`** and **`FlightGear`** folders designate the latest software versions. If you are using two computers in a network, copy the same folders to both computers. If you don't have a CD, you can download these directories from our website at www.cloudcaptech.com

- **Dev Kit – 2.1.x**
- **FlightGear 0.9.10**
- **Maps**

2.1.1 Piccolo Command Center (PCC)

The Piccolo Command Center (PCC) is a software application that runs on a Windows PC and provides a command and control interface for Piccolo operators. Once installed, PCC can be run like any Windows application through the **`Start`** menu on your computer. To install the PCC, go to **`Dev Kit`** » **`Installers`**. Click **`PccInstaller.msi`** to launch the installer. Follow the on-screen instructions. Leave all the defaults as they are.

2.1.2 Piccolo Software

The Piccolo software includes all the tools, documents, and related support applications that allow you to setup and operate the SiL and/or HiL simulation environments. Once installed, these items can be accessed through the **`Start`** menu from the Cloud Cap folder. To install the Piccolo software, go to **`Dev Kit`** » **`Installers`**. Click on the **`PiccoloInstaller.msi`** to launch the installer. Follow the on-screen instructions.

2.1.3 FlightGear

FlightGear is an open source application that offers a visualization of the aircraft attitude. Visualization is not required for HiL or SiL simulation, but provides the user with a better way to visualize the aircraft state.

To install FlightGear, go to the **`FlightGear`** folder and click **`fgsetup-0.9.10.exe`** to launch the installer. Follow the on-screen instructions. Leave all the main defaults as they are. Uncheck the **`Launch FlightGear`** box at the end of the installation. For the Simulator to work in synchronize with FlightGear, parameters for FlightGear must be set up and configured correctly. The batch file **`runfgfs-c172-netctrl.bat`** in the FlightGear directory does this for you. You can use this batch file to start FlightGear from this location, but we recommended creating a shortcut and starting it from the desktop.

3 Start SiL Simulation

1. On your computer, go to the **`Start`** » **`Programs`** » **`Cloud Cap`** » **`Start airplane or helicopter software simulation.`** This automatically launches all the SiL applications required to run a simulation.

   Note: *v2.1.1 software does not support helicopter operations at this time.*

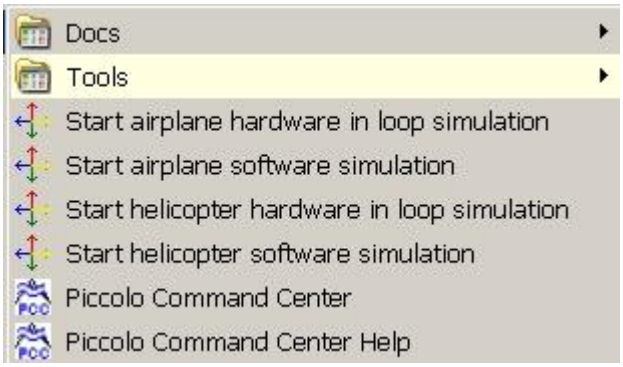

Figure 1 - Simulation Start Menu

2. The **`Communications`** window for the PCC opens. This window configures the system to allow all the SiL applications to talk to one another. Since the Ground Station and PiccoloPC applications are on the same computer, leave the default settings as they are,

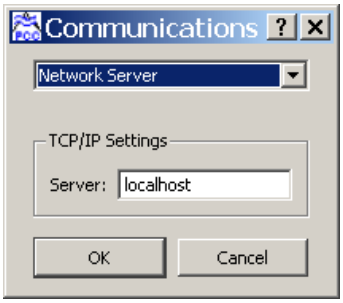

Figure 2 - Communications Window

3.1 Piccolo Command Center Display

In the default simulation shown in in **Figure 3** there is one autopilot in the network and the **`Layers`**, **`Aircraft`**, and **`Primary Flight Display`** windows are docked to the main map window. The red ring represents the ground station location at the San Francisco airport.

Zooms the map in or out. Hold the buttons down to do a continuous zoom.

Pan the map left, right, up, or down, but only if the map is not in "follow active aircraft mode". Hold the button down to pan continuously.

! For more information on how to use the PCC interface, see the *Piccolo User's Guide*.

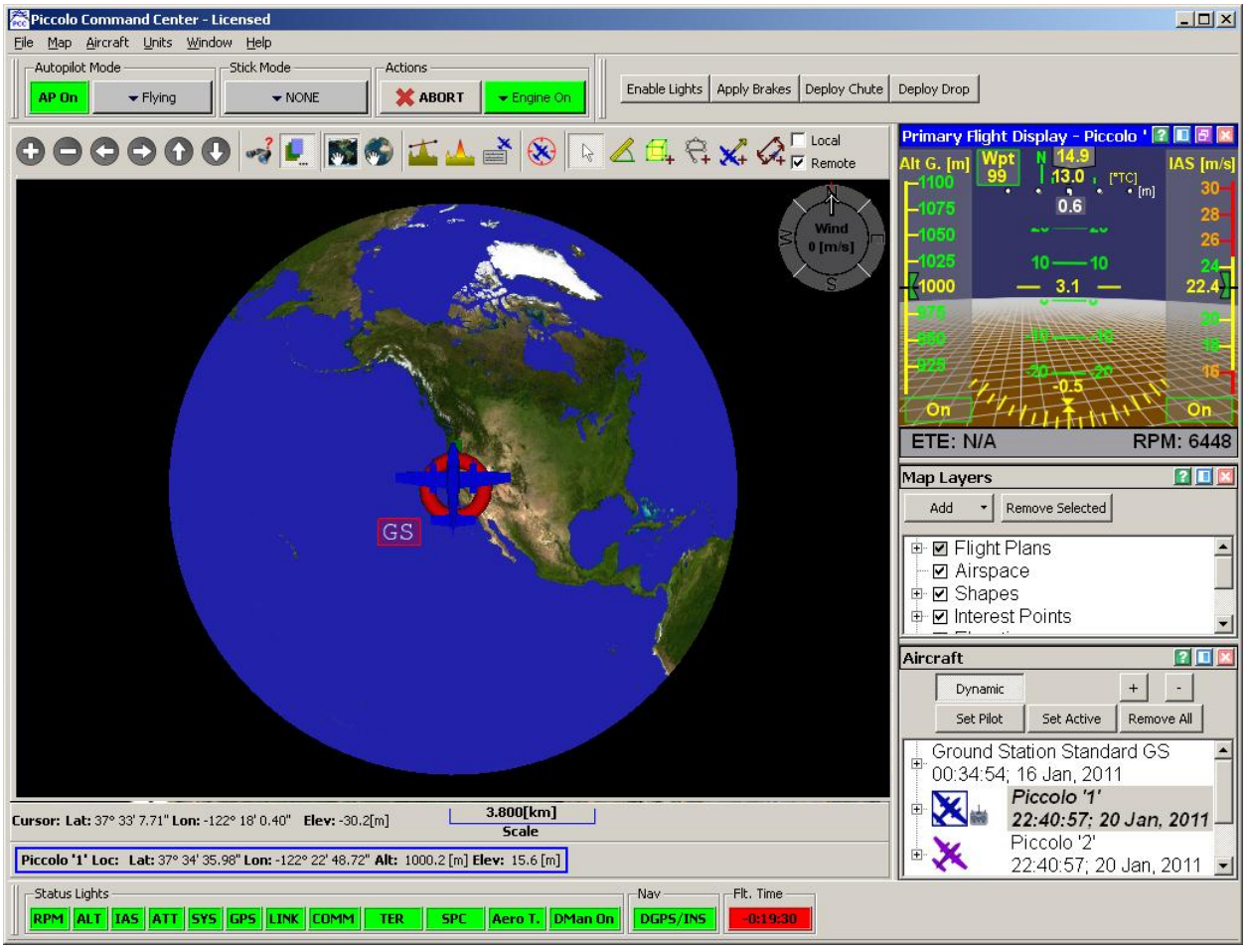

Figure 3 - Piccolo Command Center Display

3.1.1 Map Window

The map window of the PCC is the largest display, and the most important. It cannot be turned off, moved or docked. All other windows are docked with respect to it. If you have an internet connection, **Figure 6** gives an overview of what the PCC looks like with the default urban area map of the San Francisco airport downloaded from TerraServer.

If you do not have an internet connection CCT includes a basic map directory with the installation CD.

! See the Map Layers section in the Piccolo User's guide for in-depth instructions on how to create and import custom maps and other GIS imagery.

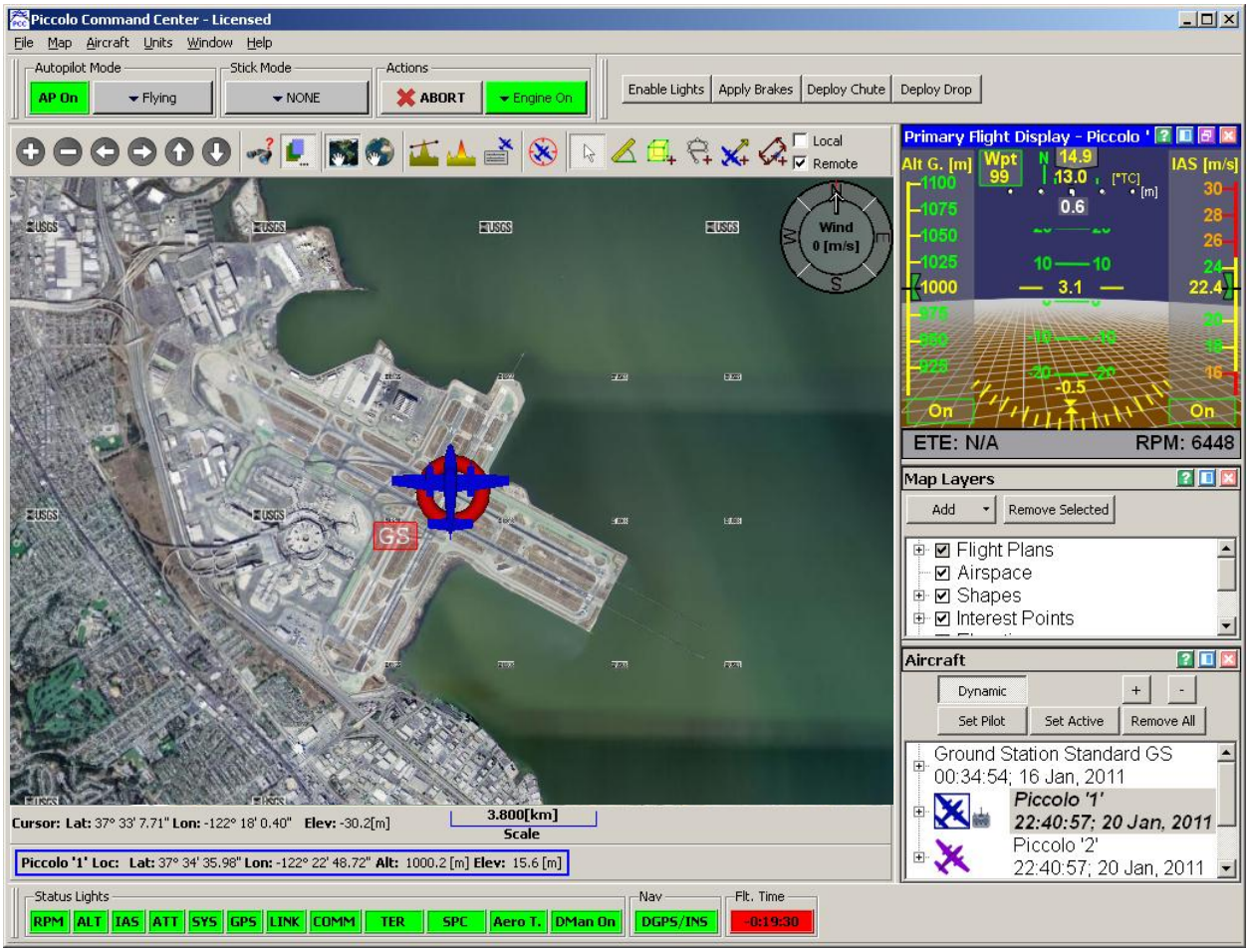

Figure 4 - Map Window

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3.2 Verify Communications

From the Simulator window, open the **`External`** menu and verify that **`AP Simulation`** is checked. This allows the Simulator to talk to the PiccoloPC application. If **`AP Simulation`** is not checked, it means Simulator cannot find the PiccoloPC application.

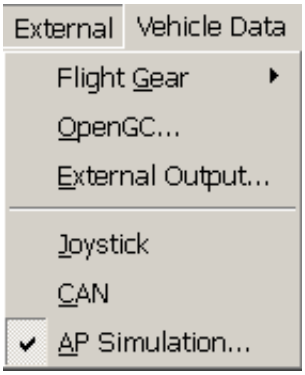

Figure 5 - External Menu

! Troubleshooting Tip: If the Simulator cannot find the PiccoloPC application, check the settings on your computer Firewall. Some Firewalls may not allow local TCP connections and could interfere with setting up a suitable SiL environment. If you have a Firewall on your computer, check the Firewall settings and restart the SiL.

4 Create a Simple Flight Plan

1. To create a simple flight plan, select the **`Quick Flight Plan`** icon on the map actions toolbar.

Figure 6 - Map Actions Toolbar

2. Move your mouse over to the map and click anywhere in the map area that you want to create a plan. The **`Quick Plan`** window opens (**Figure 7**) and displays the latitude and longitude of the position that was clicked in the map. In this window you can enable an orbit flight plan and select the altitude and radius for the aircraft to fly in.
3. For this simulation, enter a 500 meter altitude and a 1000 meter radius and click **`OK`**.

   ! See the *Flight Plan* section in the *Piccolo User's Guide* for more information on how to create detailed flight plans.

   When the aircraft is launched it will climb to the altitude set in this flight plan and fly in a 1000 meter radius of where you initially clicked on the map.

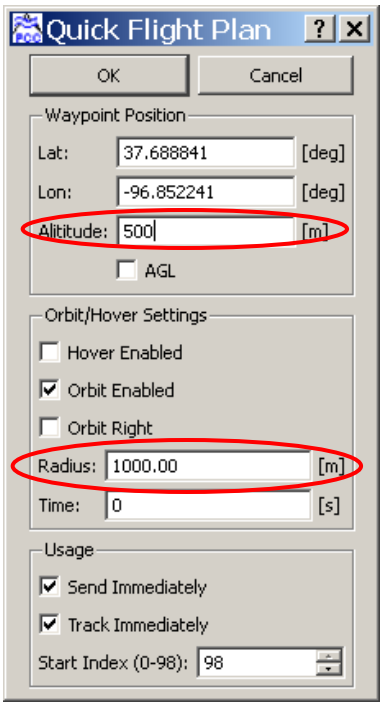

Figure 7 - Quick Flight Plan

4.1 FlightGear

1. If you wish to use FlightGear for visualization, open the **`External`** menu and select the latest version of FlightGear that is on your PC.

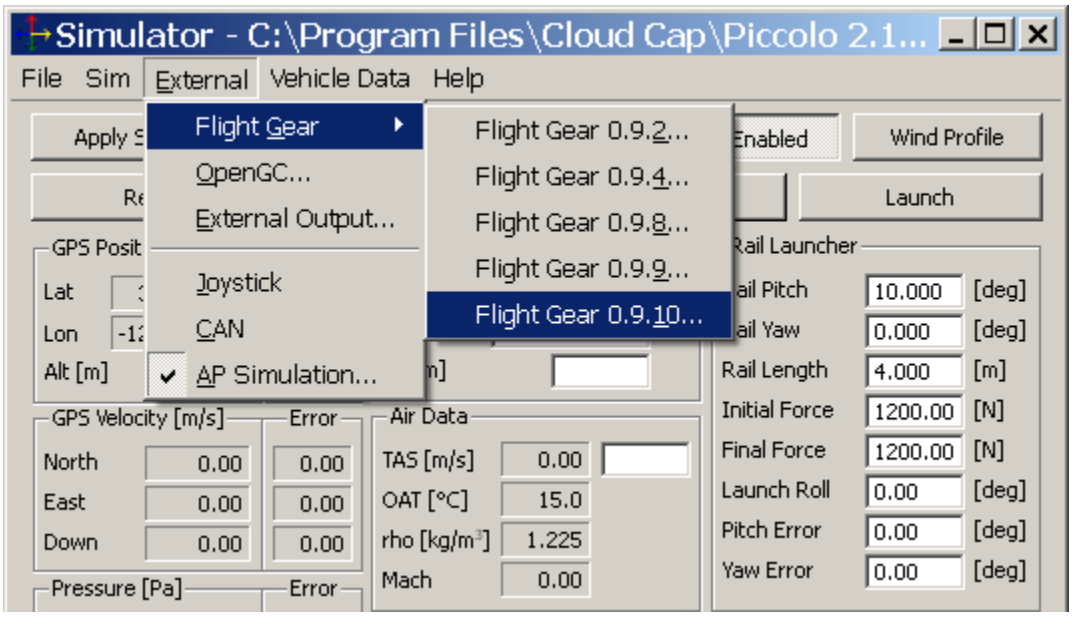

Figure 8 - FlightGear

2. If FlightGear, Simulator, and PCC are installed on the same computer, leave the default in the **`Host`** field as "localhost" (**Figure 9**). If FlightGear is installed on a separate computer, enter the computer's IP address or the name of the FlightGear computer in the **`Host`** field. Click **`OK`.** Click **`OK`**.

   Note: *To determine the IP address of your computer. Open a Microsoft DOS command prompt shell window by clicking the* ***`Start`*** *menu at the lower-left of your computer's desktop and select* ***`Run`****. If you are using Windows XP or Vista, type "cmd" (without quotation marks) into the* ***`Run`*** *box and click* ***`OK`****. Otherwise, type "command" (without quotation marks) into the* ***`Run`*** *box and click* ***`OK`****. In the command prompt window, type in "ipconfig" and press* ***`Enter`*** *on your keyboard.*

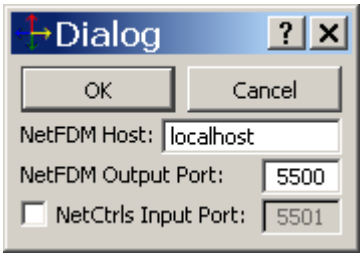

Figure 9 - FlightGear Comms Dialog

3. Start FlightGear using the supplied batch file **`runfgfs-c172-netctrl.bat.`**

5 Launching the Aircraft

4. From the PCC window, verify the following:

   ☑ The aircraft is in Prelaunch mode.

   ☑ The AP is on.

   ☑ The engine is on.

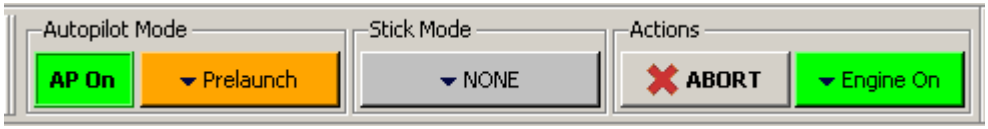

Figure 10 - Aircraft Actions Toolbar

5. Click **`Launch`** from the **`Simulator`** screen. Control of the aircraft is performed by Piccolo, and your interaction with the system is through the Piccolo Command Center.

Note: *In the default configuration, the Simulator application launches with a dynamics model of the Arcturus T15 UAV with a Honda gas engine rated 1.5 hp. See the Piccolo Simulator document for more information on modifying this dynamics model.*

6. Once the aircraft is flying, you may wish to perform basic flight tasks with the aircraft. See the *Piccolo User's Guide* for more information on how to:

   - Create a multipoint flight plan
   - Create a landing plan
   - Create an airspace boundary
   - Track a waypoint
   - View a bread crumb trail
   - Change aircraft altitude

If you are having problems setting up the SiL environment, contact us by e-mail at support.cct@goodrich.com or phone at +1.541.387.2120.

6 SiL Checklist

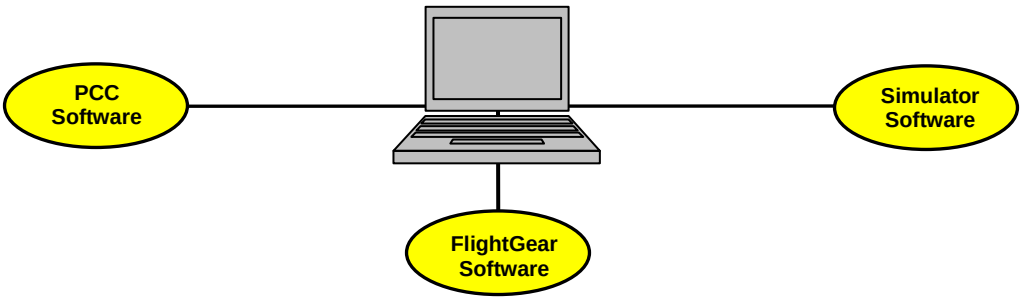

Figure 11 - SiL Environment

- ☑ Load the software to the PC.
- ☑ Start the Software-in-Loop Simulation.
- ☑ Verify communication between Piccolo and the ground station.
- ☑ Verify that AP Simulation is checked in the Simulator window.
- ☑ From the Piccolo Command Center window, create a simple flight plan.
- ☑ From the Simulator window, select the latest version of FlightGear.
- ☑ Enter the address of the FlightGear PC (if needed).
- ☑ Start FlightGear using the batch file *runfgfsnet-c172.bat.*
- ☑ Launch the aircraft from the Simulator window.