Particle Analysis and Display System (PADS):

AIMMS-20 Module

Operator Manual

DOC-0185 Rev A-1

PADS 2.5.6

AIMMS-20 Module 2.7.5

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C O N T E N T S

L i s t   o f   F i g u r e s

1.0 Introduction

The Particle Analysis and Display System (PADS) is a software package that interfaces with instruments produced by Droplet Measurement Technologies (DMT) and other leading instruments used in the atmospheric sciences. This manual describes the PADS module for the AIMMS-20.

For an explanation of the basic PADS setup and instructions on how to acquire data using PADS, consult the *PADS Operator Manual*. Definitions and calculations used in the AIMMS-20 module are also described in the *PADS Operator Manual*.

Note that PADS has an ADP module that displays a subset of the data displayed in the AIMMS-20 module. The Air Data Probe (ADP) is a component of the AIMMS-20 that can be purchased as a stand-alone instrument. Customers who purchase a stand-alone ADP with PADS receive the ADP module. Both the AIMMS-20 and the ADP component are made by Aventech Research, Inc.

2.0 Configuration

Using PADS, you can configure both the software for the instrument and the instrument's data display in PADS. The following two sections explain how to do this.

Configuring the AIMMS-20

Your AIMMS-20 and data system should arrive preconfigured from DMT. In some cases, however, you may want to change the software configuration for the instrument. To do this, follow the steps below. *Note: Droplet Measurement Technologies STRONGLY recommends that customers contact our office prior to changing any of the parameters in the instrument configuration. Improper changes can result in communication failure and/or changes in PADS computation algorithms, which can compromise data validity.*

1. Click on the "AIMMS-20" tab.

2. From the **Configure** menu, select **Configure Instrument.** You will see the following window.
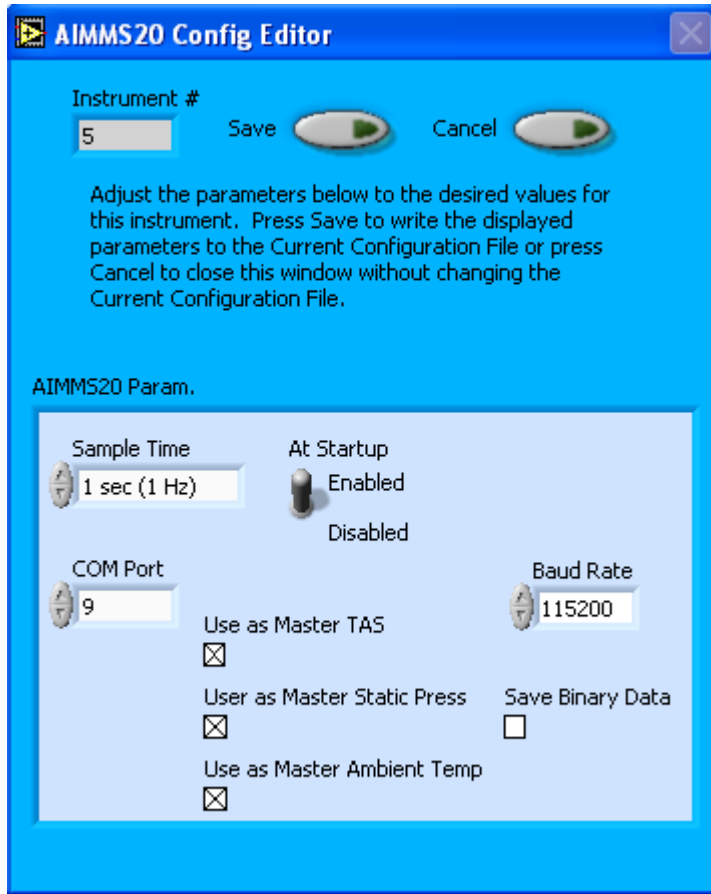
Figure 1: AIMMS-20 Configuration Editor Window

3. Now you can configure the instrument parameters to your desired specifications. You will find a list of the parameters you may want to reconfigure in the two sections below, "Occasionally Reconfigured AIMMS-20 Parameters" and "Rarely Reconfigured AIMMS-20 Parameters." If at any time you would like to revert to the previously saved values for the AIMMS-20 parameters, press **Cancel** to exit the window without saving changes.

4. When you are done configuring the AIMMS-20 parameters, press **Save** at the top of the Config editor window. (If you would instead like to revert to the previously saved values, click **Cancel**.) Then press the green **Reset Program** button for the new configuration to take effect. Note that pressing the **Reset Program** button will clear any data currently being displayed.

Occasionally Reconfigured AIMMS-20 Parameters

At Startup Enabled / Disabled: If you want the AIMMS-20 to acquire data when PADS begins sampling, make sure this parameter is in the "Enabled" mode. In some cases, such as if the AIMMS-20 is inoperative, you may want to use this control to disable the probe. Disabling the AIMMS-20 allows data to transmit from other instruments without interference.

COM Port: This is the serial communications port that the AIMMS-20 uses to connect with the computer. This number should match the computer hardware configuration for the particular computer you are using. If you are not using multiple computers, this number should not be changed.

You will notice that there are other parameters listed on the **AIMMS-20 Config Editor** window. You should not need to change these, and changing them may compromise your data. If you are curious about these parameters or think you do need to modify them, see the section titled "Rarely Reconfigured AIMMS-20 Parameters" below or consult with a DMT technical representative.

Rarely Reconfigured AIMMS-20 Parameters

The AIMMS-20 configuration editor displays several parameters that you will rarely need to modify. The following is a list of these parameters and an explanation of what they do.

Instrument #: This lists the number corresponding to the instrument you are viewing, in this case the AIMMS-20. If your AIMMS-20 has been assigned instrument number one, you will see "1" in this field. You should not need to modify the instrument number, and in fact you are unable to do so from within PADS.

Sample Time: This parameter indicates the time interval at which the AIMMS-20 relays sample data. The AIMMS-20's sample time should always be set to one Hertz. Note that the instrument does collect data at a shorter interval than one Hertz; wind speed and direction readings, for instance, are gathered at a rate of five Hertz and then averaged over the past four seconds. For channels that store instantaneous rather than averaged data, such as wind components, PADS displays the most recent data the AIMMS-20 has relayed.

Baud Rate: The Baud rate for the probe is defined at manufacture, and you should not need to change it. PADS lists this parameter because some probes can run at different baud rates. So if you reconfigure your hardware, the baud rate may change. In general, a higher baud rate means that the probe can transmit data more quickly to the computer. However, higher baud rates may not work with some computers and can result in unreliable data transmission.

Use as Master TAS: When checked, this box tells PADS to use the AIMMS-20's True Air Speed measurement as the TAS Source on the Setup window.

Several different instruments are capable of providing True Air Speed to PADS. If more than one such instrument is installed in your system, only one of them can be used as the global source for True Air Speed for calculations. When your system comes from DMT, one instrument will be selected as the Master TAS.

Use as Master Press: When checked, this box tells PADS to use the AIMMS-20's static pressure measurement as the default master source for static pressure. This source appears on the PADS Setup window upon startup. While multiple instruments can potentially provide this measurement, only one instrument should be selected as the source.

Use as Master Temp: When checked, this box tells PADS to use the AIMMS-20's ambient temperature measurement as the default master temperature source on the Setup window. While multiple instruments can potentially provide this measurement, only one instrument should be selected as the source.

Save Binary Data: When this box is checked, PADS creates an extra output file that stores the AIMMS-20's data stream in binary format as it comes across the serial port. There is no tool for viewing this data in an accessible format. It is intended solely as a diagnostic to be sent to Aventech, the AIMMS-20's manufacturer, as necessary. The default setting for this parameter is off.

After making changes in the instrument configuration window, you will need to press the **Save** button and then click the green **Reset Program** to activate these changes. Clicking **Reset Program** will clear any data PADS is currently displaying.

Configuring the AIMMS-20 Display

To configure the AIMMS-20 display, click on the AIMMS-20 tab if you have not already done so. Then select **Configure** from the menu bar and click on **Configure Display.** This will bring up the following window.

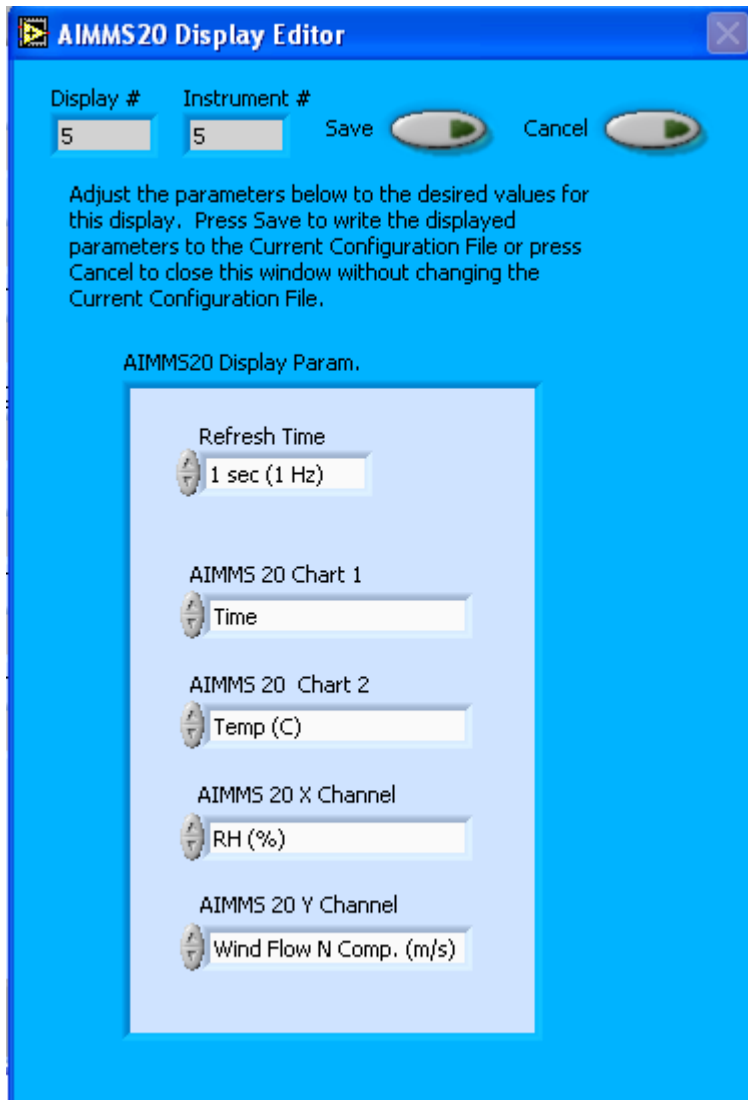*Figure 2: AIMMS-20 Display Editor Window*

You do not need to modify the **Display #** or **Instrument #**. Changing the **Refresh Time** allows you to set the time intervals for data display during acquisition mode; you can choose any time that is equal to or greater than the sample time. (Choosing a time less than the sample time is not useful, since the same data will be displayed multiple times.)

The AIMMS-20 Display Paramater box at the bottom of the window allows you to configure the channels on the AIMMS-20's selectable graphs. The first of these charts is located in the **Selectable Charts** tab. This graph plots the channel specified as "AIMMS-20 X Channel" with respect to the channel specified as "AIMMS-20 Y Channel." The two other selectable charts are located on the **Time Plots** tab, and they chart the "AIMMS-20 Chart 1" and "AIMMS-20 Chart 2" channels with respect to time. For information on specific channels and their definitions, consult *Appendix A: AIMMS-20 Channels* and the *PADS Operator Manual's Appendix A: Definitions.*

To change the channels in the Display Parameter box, you can click on the arrow buttons to scroll between available options. You can also click on the white fields to bring up a list of all the available channels, from which you can choose the one you want.

When you are done, click on **Save** to update the configurations or **Cancel** to revert to the previous configurations. After you reset PADS, you will be able to see any changes by clicking on the **AIMMS-20 Selectable Charts** tab. Note that clicking **Reset Program** will clear out any data currently being displayed.

Configuring channels in the Configuration Display Editor will change the display upon start-up. Once PADS has started, you can select any channels to be displayed. See the "Selectable Charts" heading under the "Chart Displays" section for more information.

3.0 The AIMMS-20 Window

The different parts of the AIMMS-20 Window are discussed below. For explanations of the **Enable** button, **COM Port** indicator, and **Fault/No Fault** button, see the "Instrument Tabs" section of the *PADS Operator Manual*.

Data Tabs

The AIMMS-20 channel data section has four tabs, two data tabs and two chart tabs. The data tabs are the AIMMS-20 Full Data and AIMMS-20 Heading. For information on the instrument's other chart tabs, see the section entitled **Chart Displays**.

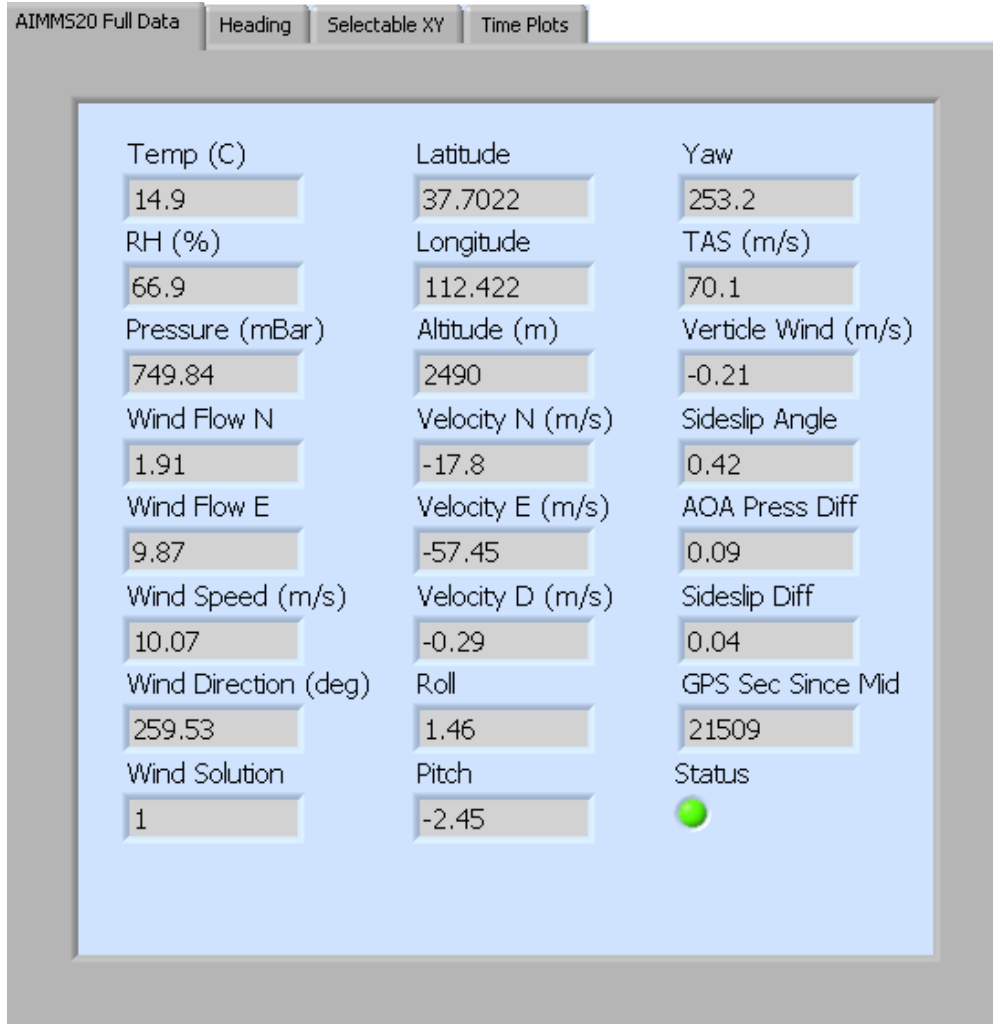The AIMMS-20 Full Data window is shown in Figure 3.

Figure 3: AIMMS-20 Full Data Window

AIMMS-20 Full Data Tab

The AIMMS-20 Data tab displays commonly used channels. For information on specific channels, their definitions, and their acceptable ranges, consult *Appendix A: AIMMS-20 Channels* and the PADS Operator Manual's *Appendix A: Definitions*.

The **Status** indicator turns bright green when the status indicator is on, as shown in Figure 3. Status is on when all of the following conditions are met:

> 1.) PADS has received data from the AIMMS-20.
> 2.) No communications error has been reported.
> 3.) The AIMMS-20 has reported a valid wind solution.

A valid wind solution (Wind Solution=1) in turn depends on several conditions:[1]

1.) The attitude solution is running. The attitude solution provides roll, pitch, heading and inertial velocity components of the aircraft. To generate this data, the AIMMS-20 requires valid navigation solutions from both GPS processors and a minimum of four matched satellite pairs.
2.) The pitot-static pressure reported from the air-data probe is above a threshold of 200 Pa / 2 mBar (for fixed-wing aircraft), and 50 Pa / .5 mBar (for helicopter setups).
3.) The purge-valve sequence is not in effect. (This condition is applicable to canister models that have this option installed.)

When the **Status** indicator is off, data being displayed in the 3-D Tracking Plot may not be current. For more details, see the section entitled 3-D Tracking Plot.

Heading Tab

The heading tab displays two dials. The first shows the direction in which the aircraft is heading. The angle displayed is the angle from true north. The second tab shows the wind direction, which is the direction the wind is flowing from (not to).

Chart Displays

The last two tabs on the AIMMS-20 tab, **Selectable XY** and **Time Plots**, are user configurable charts. **Selectable XY** plots any available channel with respect to any other available channel. Use the fields marked **AIMMS-20 Y Channel** and **AIMMS-20 X Channel** to specify channels for the graph. You can either click on the text control to the right, which brings up a selectable list of channels, or you can use the button on the left to scroll between channels.

The **Time Plots** tab allows you to chart two selectable channels with respect to time. Use the fields above the graphs to specify the desired channels (see Figure 4). Again, you can either click on the text control to the right, which brings up a selectable list of channels, or you can use the button on the left to scroll between channels.

If you would like to change the default channels displayed in **Selectable XY** and **Time Plots** upon start-up, go to the **Configure** menu, select **Configure Display**, and choose the desired channels. Then press the **Reset Changes** button to apply this configuration.

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[1] Information obtained from Aventech Research Inc., which manufactures the AIMMS-20.
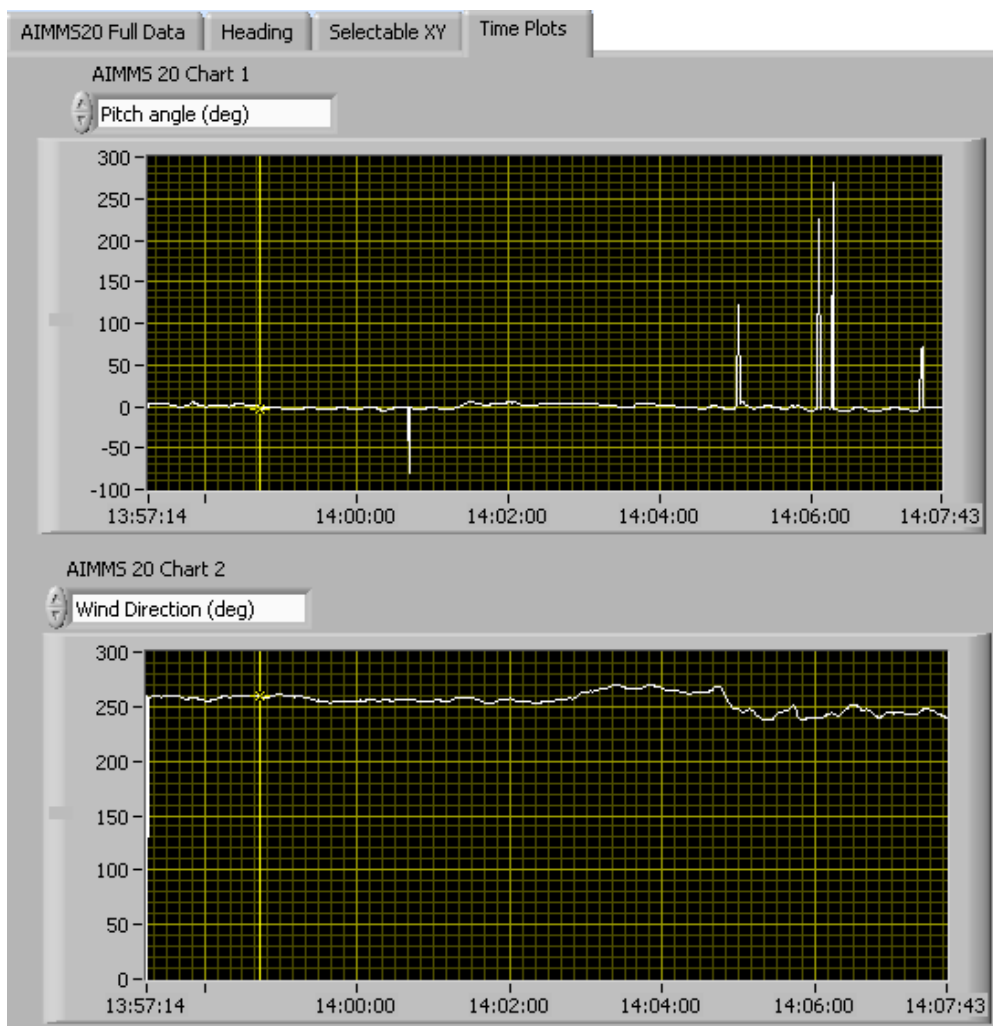
Figure 4: AIMMS-20 Time Plots Tab

When you access time-series charts in playback mode, the currently selected moment in time is indicated by a yellow cursor, as shown above. The y-axis value for this time is indicated by cross (+) on this cursor. Note that when you display a large range of time-series data, the chart display does not have sufficient resolution to display each individual time point. To increase resolution, zoom in on the data by changing the time interval to a smaller range.

On all the charts with x and y axes, you can change the scale by typing a different number into the starting and ending values on each axis. For instance, if you want to change the time period in one of the graphs above to end at 14:00:00, you simply select the field that currently says 14:07:43, type in 14:00:00, and hit the <Enter> key. In acquisition mode, you must disable autoscaling (see below) before you modify fields in this way.

Many charts also show you options for scaling and copying the data when you right-click on them, which brings up a drop-down menu. These options are as follows:

Autoscale   This autoscales the relevant axis. In autoscaling mode, the minimum and maximum values of the axis are set automatically so that all data points can be seen in the display. Note that on charts that have autoscale buttons, like the large histogram chart on some instrument tabs, the buttons override the Autoscale options in the drop-down menu. To see autoscaling options in the drop-down menu, position the cursor over the relevant axis before right-clicking. Note that you may not always be able to autoscale the x-axis.

Copy Data   This copies the chart to the clipboard using a screen capture. This chart can then be pasted into other documents like Word or PowerPoint presentations.

Export Simplified Image   This copies a simplified image of the data to the clipboard or an output file. You can choose the format you desire—bitmap (.bmp), encapsulated postscript (.eps), or enhanced metafile (.emf). Note that when you select the .eps option, you must copy the data to a file. Unless you specify otherwise, output files will be saved in the time-and-date-specific output file directory for the current session.

Clear Graph   This erases the currently displayed data points from the graph.

More information about each of the tabs on the chart displays section is given below.

3-D Tracking Plot

The 3-D tracking plot provides a three-dimensional view of the aircraft's latitude, longitude, and altitude. Figure 5 shows the 3-D tracking plot.
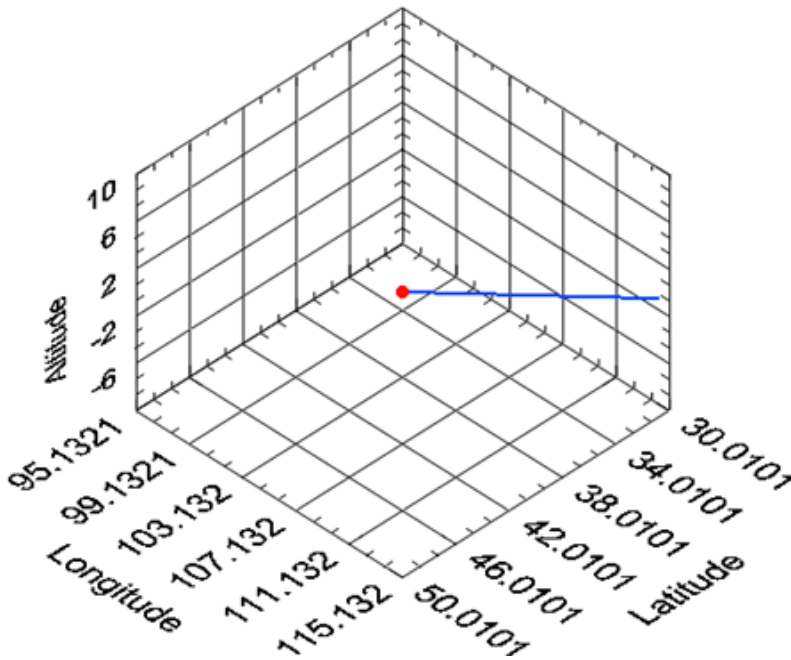
Figure 5: AIMMS-20 3-D Tracking Plot

The red dot indicates the aircraft's location. You can rotate the tracking plot in three-dimensional space by clicking on the plot, holding down the mouse, and moving the mouse around. Using the scroll button on your mouse will let you zoom in and out on the plot. If you hold down the shift key and the left mouse button, you can change the plot's position in the window.

The **3D Plot Color** control allows you to choose the color for the historical data displayed in the 3D plot. In Figure 5, for instance, the 3D Plot Color is blue. If you click on the colored square beneath the "3D Plot Color" label, you will see a variety of color choices. Clicking on a color will select it as the 3D Plot Color. You can also click on the palette icon to see additional colors or specify colors using R-G-B values.

The **ViewMode** indicator allows you to modify the tracking plot's display. The default mode is cwViewUserDefined, which displays the view in three dimensions. **ViewMode**'s other options project the 3D data onto two axes—X and Y, X and Z, or Y and Z. Selecting one of these options has the effect of temporarily "collapsing" the omitted axis as if you were looking at cubical space head-on. For instance, displaying the same data as shown in Figure 5 in cwViewXZPlane mode collapses the y-axis, longitude, as shown in Figure 6.
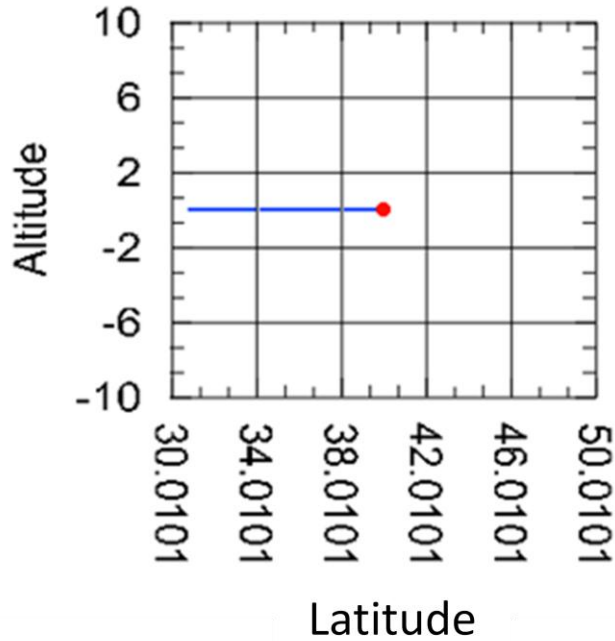
Figure 6: 3-D Tracking Plot in cwViewXZPlane Mode

When you rotate the display, however, the view returns to three dimensions. In playback mode, you will need to change the sample time before PADS updates the display with a new ViewMode.

Occasionally a problem with the AIMMS-20 data feed results in erroneous and extremely high or low readings for altitude, latitude or longitude. This problem usually only lasts for one sampling instance, but it can corrupt the 3-D tracking plot by altering the plot's scale and the aircraft's position. In order to circumvent this problem, PADS tests the current data. If it detects an erroneous reading, it turns the **Status** indicator off and displays the previous sampling instance's data. PADS only reuses data this way once, however; if the program detects two or more erroneous readings in a row, it inserts NaN (not a number) for the Latitude and Longitude. The 3-D plot omits NaN data from its display, so in this case the track will appear to have gaps. The erroneous data will not cause the plot axes to rescale inappropriately, however.

Appendix A: AIMMS-20 Channels

A complete list of AIMMS-20 data channels appears below. The AIMMS-20 output file will contain data values for each channel for each sampling instance. You can also plot each of these channels against time using the AIMMS-20 Selectable Charts tab.

For definitions of the channels, see *Appendix A* in the *PADS Operator Manual*.

The AIMMS-20 relays two data packets of information for each sampling instance. The channels in bold below are sent in the first data packet, which mostly contains information on wind conditions. Channels in italics are ones that the AIMMS-20 sends in the second packet.

Time	*Longitude (deg)*
Hours	*Altitude (m)*
Minutes	*Velocity N (m/s)*
Seconds	*Velocity E (m/s)*
Temp (C)	*Velocity D (m/s)*
RH (%)	*Roll Angle (deg)*
Barometric Pres. (mBar)	*Pitch angle (deg)*
Wind Flow N Comp. (m/s)	*Yaw angle (deg)*
Wind Flow E Comp. (m/s)	*True Airspeed (m/s)*
Wind Speed (m/s)	*Vertical Wind*
Wind Direction (deg)	*Sideslip angle (deg)*
Wind Solution	*AOA pres. Differential*
Hours 2	*Sideslip differential*
Minutes 2	*Status*
Seconds 2	*GPS Time*
Latitude (deg)	

AIMMS-20 channels fall into several broad categories:

Time Channels: Time, Hours, Minutes, Seconds, Milliseconds, and GPS Time store time data. Time is generated by the PADS computer clock and is the time when the program receives both AIMMS-20 data packets. Hours, Minutes, Seconds, and Milliseconds are times that the AIMMS-20 clock generates when the probe collects the first data packet. Hours 2, Minutes 2, Seconds 2, and Milliseconds 2 are times that the AIMMS-20 clock generates when the probe collects the second data packet. GPS Time is included in every instrument's list of channels whenever a GPS (such as the AIMMS-20) is included as one of the PADS instruments.

Wind and Ambient Conditions Channels: These include Temp (C), RH (%), Barometric Pres. (mBar), Wind Flow N Comp. (m/s), Wind Flow E Comp. (m/s), Wind Speed (m/s), Wind Direction (deg), and Wind Solution.

Aircraft Data Channels: These include Latitude (deg), Longitude (deg), Altitude (m), Velocity N (m/s), Velocity E (m/s), Velocity D (m/s), Roll Angle (deg), Pitch angle (deg), Yaw angle (deg), True Airspeed (m/s), Vertical Wind, Sideslip angle (deg), AOA pres. Differential, and Sideslip Differential.

Channels for Other Statistical Data: Status stores statistical data the AIMMS-20 has gathered on the communication between PADS and the probe.