Trio HNAV gain setting information.

GPSS tracking

The trio Pro Pilot has the capability to navigate laterally (HNAV) using two different data sources. If using a properly configured panel mounted GPS with the ARINC 429 bus wired to the autopilot ARINC label 121 can be used for lateral nav if the following conditions are met:

1. The autopilot is in the TRK (track) mode and,
2. No Track offset is being used, i.e., you want to track exactly on the magenta line using the GPS GO TO or flight plan modes.

Many users define this state as "using GPSS". In reality the data being received by the autopilot is simply a digital command telling the autopilot to bank right or left. The autopilot will simply bank the airplane right or left in order to follow the GPS bank angle command.

CRS and INT modes.

So now take the case where we want to fly an ATC vector. The GPS still has a flight plan or GO TO to keep you on the magenta line, but we do not want to stay on the magenta line. So when we shift to the CRS mode the navigation source for lateral nav also changes and now uses the serial data stream. In the CRS mode you have commanded the autopilot to fly a particular groundtrack, say 090 degrees. The aircraft, let's say, is on a course of 120 degrees. The serial data stream has a parameter showing the current GPS groundtrack. So now the autopilot will use that serial data, and the commanded groundtrack to move the airplane left to 090. The intercept mode uses the same data but in a different fashion to intercept the flight plan magenta line sourced from the GPS.

TRK mode using a track offset

In the case of using the autopilot TRK mode with a track offset the autopilot must use the serial data link since the GPSS data wants us right on top the magenta line, but we want to side step some distance. In order to accomplish this the autopilot needs to ignore the GPSS data and look at additional parameters available on the serial stream (bearing to waypoint, groundtrack, track error) to compute the geometric solution needed to maintain that offset.

Gain Settings – Why and how

When using the GPSS data we need to tailor, or "gain" the signal for proper airplane response. In the Trio Autopilot design the HNAV servo gain is the main parameter for this purpose. This is the only gain available when using the GPSS data. When properly set the airplane will track the magenta line with minimal overshoot, undershoot or oscillation. Aircraft control rigging, friction, etc., is also very important to assure proper tracking.

If we are using the serial data things change with respect to the gains available. The design is such that when using the CRS mode there are two gains in the signal path – the CRS gain and the HNAV servo gain. The HNAV servo gain is the same gain used to tune the autopilot tracking when using GPSS. In the TRK mode we still use the CRS gain for tracking and apply another gain, the TRK gain to obtain proper tracking. So in the TRK mode we essentially have three gains in the signal path: the CRS gain, the TRK gain and the HNAV servo gain.

Tuning procedure overview

Serial data nav source adjustments – no GPSS

A Pro Pilot installation may use a panel mounted GPS that has the ARINC interface, hence GPSS, or a portable GPS that has no ARINC capability. In the case of a portable the gains are adjusted differently from an installation that will use GPSS. Paragraph of 3.4 of the Avionics addendum on the STC Group website at:

https://cdn.shopify.com/s/files/1/0088/9952/6761/files/E-1006-12_Rev._A_Avionics_Addendum_Trio_Notes.pdf?2499915430226147638

describes how the gains are to be adjusted for HNAV using only the serial data (no GPSS). Note in step 2 the CRS mode gains are adjusted first (not the TRK or INT (PI) gains because as was mentioned previously the CRS gain is the base gain for the TRK mode. Once the CRS mode gain is satisfactorily adjusted the autopilot can be sequenced to the TRK mode and that gain adjusted. Note that when adjusting the CRS gain, if satisfaction cannot be obtained, then the HNAV servo gain is changed to obtain suitable tracking. In the scheme of things the signal gain path is CRS gain -→ HNAV servo gain. The HNAV servo gain is in series with the CRS gain wit hthe CRS gain being more of a "fine" gain. In that light the CRS gain seldom needs to be changed more than on or two clicks from the factory setting of 3. If you find that the CRS gain needs substantially more change then HNAV servo gain should be changed to keep the CRS gain right around the factory default.

Using a non-panel mount simplifies adjusting the TRK gain. Since the CRS gain is already adjusted the TRK gain can now be adjusted for best tracking. It is best to do this with no track offset – this is not needed if no GPSS is present as will be the case with a portable.

If you look at the attached flow chart (LNAV gain setting flow) you will see that the first block indicates that you will be following the path to the right side of the chart (No GPSS). Going through this chart shows that you adjust the CRS mode gain first. In the event you cannot dial it in then you can adjust the HNAV servo gain to get satisfactory tracking. This is also described in the Avionics Addendum paragraph 3.4 step 6 . Once the CRS and TRK adjustments are complete it is likely the INT (PI) gain will be satisfactory. If during an intercept back to the flight plan the aircraft substantially undershoots the intercept then the gain can be raised. If there is too much overshoot then the gain can be reduced. In practice we find most installation never change this gain from the factory settings.

Adjustments with GPSS active.

With GPSS active and in the TRK mode with no track offset active the only effective gain is the HNAV servo gain. Referring back to the LNAV GAIN SETTING FLOW chart below the path would be a straight drop down through the first block indicating that GPSS is controlling and the GPSS LED is on solid (HNAV servo is ON). Note also that the HNAV servo gain is the only effective gain in this scenario. Once the tracking is satisfactory in this configuration then the procedure continues to adjust the serial gains. The catch here is that to prevent GPSS from controlling the tracking a small track offset is entered so that the autopilot control is forced to the serial data link. This is shown in the AVIONICS ADDENDUM note right before paragraph 3.4.5 and block 4 of the attached LNAV GAIN SETTING FLOW chart. Once the track

offset has been entered the gain adjustments proceed just like the aforementioned serial gain adjustments. The only exception to this is if the CRS gain cannot be satisfactorily adjusted and the HNAV servo gain needs to be to dial it in. Then, of course, the GPSS mode needs to be checked to see if it is still OK. In practice we have not had to re-adjust the HNAV servo gain from the GPSS only setting.

LNAV GAIN SETTING FLOW