Variable Lever Arms: OEM6 and OEM7 Setup

Introduction

This document will cover what variable lever arms are, how to set them up, and the commands and logs needed to verify and use variable lever arms.

The commands and setup can be used in OEM6 or OEM7 and apply to general gimbal (variable lever arm) setups, not specific to any one device. The PAV80/PAV100 APN (APN-069) is specific to that Leica device and has several differences with regards to setup when compared to other gimbal mounts.

What is Variable Lever Arm

Variable lever arms (VLA), also referred to as gimbal mounts, is a setup that allows an IMU to rotate independently from the vehicle itself. For example, during alignment the IMU Y axis may match the vehicle Y axis but as the IMU rotates the IMU Y axis may now be 90° from the vehicle Y axis and this difference needs to be accounted for.

These applications are commonly used in helicopters and photogrammetry systems.

Set Up

In a non-VLA setup for OEM6 you have:

- SPAN Body Frame: as defined on the IMU
- SPAN Computation Frame: derived by rotating the SPAN Body Frame so the Z axis is pointing up, for gravity direction.
- Vehicle Body Frame: vehicle frame Z axis pointing up, Y axis forward and X axis to the right

For VLA you add in:

- Mount Body Frame: the gimbal mount frame axis direction
- Mount Computation Frame: derived by rotating the mount body frame to make the Z axis pointing up, to match the SPAN computation frame.

In OEM7 it's similar except fewer frames, in non-SPAN VLA you have:

- IMU Body Frame: as defined on the IMU
- Vehicle Frame: default is Z axis pointing up, Y axis forward and X axis to the right and is the default frame for the attitude output logs.

For VLA you add in:

- Gimbal Body Frame: Axis of the gimbal plane.
- Mount Body Frame: Axis of the gimbal mount itself.

In both OEM6 and OEM7 VLA the gimbal needs to be in its locked position to setup. The locked position is a known the 'home' position where the gimbal can return each time it is locked.

OEM6

To set the VLA frames:

Specify the rotation between the SPAN computation frame and the gimbal computation frame, use the **GIMBALSPANROTATION** command, which is from the gimbal computation frame **to** the SPAN computation frame.

```
GIMBALSPANROTATION XAngle YAngle ZAngle [XUncert] [YUncert] [ZUncert]
```

Next set the mount body frame using **SETGIMBALORIENTATION** command, to define which axis is pointing up.

```
SETGIMBALORIENTATION mapping
```
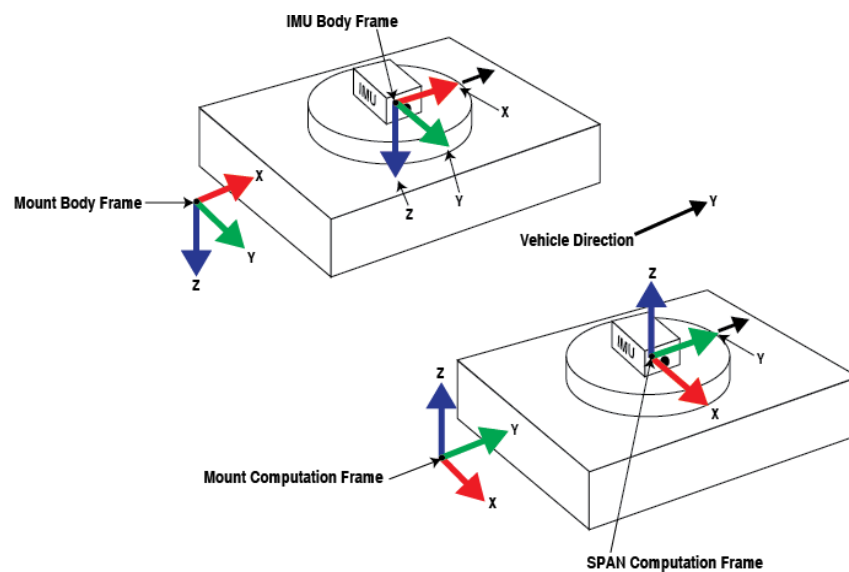
To set the VLA frames:

Specify the translation offsets between the gimbal lever arms (center of rotation) and the IMU frame (center of navigation) from the IMU.

```
SETINSTRANSLATION GIMBAL X Y Z [XUncert] [YUncert] [ZUncert]
```

Now specify the rotation offset between the gimbal lever arms and the IMU, thus tying in the gimbal mount body to the IMU body.

```
SETINSROTATION RBM XAngle YAngle ZAngle [XUncert] [YUncert] [ZUncert]
```
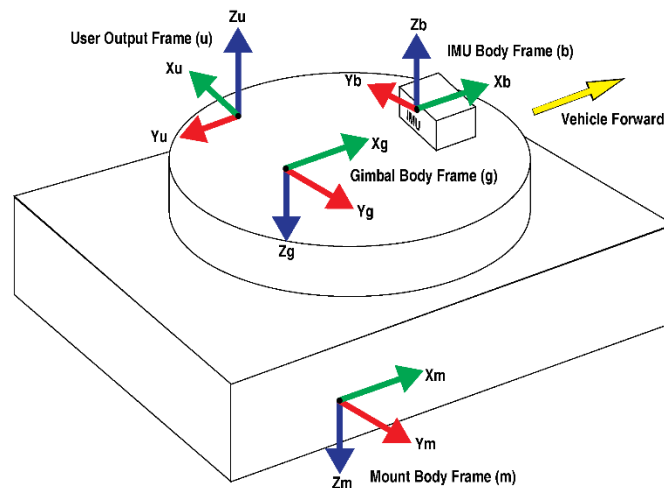

As of now, we have the frames all lined up, the lever arms in and the SPAN solution should be outputting INS_ALIGNMENT_COMPLETE.

In both OEM6 and OEM7 when the gimbal is in its 'home' position the gimbal and mount body frames are in the same orientation. Once the gimbal is unlocked and rotates these 2 frames now differ. This difference needs to be fed back into the SPAN OEM6/OEM7 receiver by the user as an **INPUTGIMBALANGLE** message with the format:

```
INPUTGIMBALANGLE XAngle YAngle ZAngle [XUncert] [YUncert] [ZUncert]
```

Or you could send it in as a binary formatted message see:
https://docs.novatel.com/OEM7/Content/SPAN_Commands/INPUTGIMBALANGLE.htm?

In OEM6 and OEM7 the INPUTGIMBALANGLE message rate is 1Hz

N**OTE all rotations are right handed in the order Z, X, Y**

Conclusion

The point of Variable Lever Arms is to allow an attitude of the IMU when it is locked and when it is in motion.

As the SPAN filter receives the **INPUTGIMBALANGLE** message it can calculate the difference between the IMU's current position and its locked position, and outputs the gimbal locked position as a **GIMBALLEDPVA** message, which can be logged on new. This becomes the PVA of the vehicle.

By logging **INSPVA** you have the IMU PVA as it rotates independently upon the gimbal.