Realistic Expectations for RTK GPS Use

By Jerry Knisley

I am routinely involved in high-precision dredging setups. (At least, I was until I switched over to my current position at HYPACK.) One of the things that I have a hard time understanding is the level of expectation in setting up a dredge with GPS. Until recently, the highest level of accuracy that I have seen in the field was a 0.1 foot repeatable measurement checked with an RTK rover. Several environmental projects around the country require better than 0.1 ft accuracy from the excavators.

It is pretty cool when you get the system up and running and it finally meets the specification. It can take a while to get there, recalibrating the system several times to measure the offsets.

I recently spent the day on a project helping to calibrate two excavators in the cold rain in NY state. We were able to find the errors in measurement and calibrate both machines to less than 0.15 feet. It took all day and the sensors were already installed. I had to work from the trunnion out to find the problems. Fortunately, the surveyor I was working with had an RTK rover to shoot whatever measurements we needed to make the system accurate.

The reason for this article is that, recently, I had a customer mention to me that they had a RTK GPS on a hopper dredge and that the GPS was accurate to 3 millimeters. I believe the RTK manufacturers when they say they can reach this level of accuracy, but I doubt they were thinking about doing it on a large ship in the ocean. The problem comes in when you try to explain the difference between land observations and an at-sea survey environment. Most people assume that the GPS is always that accurate.

While the current RTK systems are amazing, it is unrealistic to assume that the level of accuracy of the RTK GPS is going to translate from the GPS to the drag arm connection on the front of the hopper dredge. Yes it is just math we are doing, but in a dynamic environment. The distance from the GPS to the main deck is measured, the distance forward and starboard are measured. Any error in measurement is already in error. The position also takes into account the heading of the vessel. Any issue with a misaligned gyro multiplies the position error over distance. So assuming that the GPS was able to collect sub-centimeter position in real time, the error in computing the drag arm attachment point is already close to +/-1 foot realistically.

Now, to compute the position of the drag arm, the depth of the end of each segment must be computed. The first depth is the depth of the suction in the hull. This is referred to as the trunnion point. This depth, plus the depth of the gimbal point (if the dredge is equipped with a gimbal), computes the layback of the gimbal from the position of the trunnion point. Any error in the depth computation will skew the position of the gimbal. From here we take the depth of the drag head and compute its layback from the gimbal point. Again, any depth error will skew the position of the drag head even more.

It is easy to check the accuracy of the excavator bucket position and elevation when you have a RTK rover in a static environment. It is much harder to check the accuracy of a drag head in the ocean although I have seen that accomplished.

What I wanted to express is a desire that, in this day with superb equipment, let's not forget that more than a single thing goes into the accuracy you should expect. When a specification is written, real world environmental factors should be taken into account.