



GM Calibration Routine

By Bob Glover

Recently, HYPACK was in Panama City Panama working on part of the Panama Canal widening project. We were setting up two extended-reach Caterpillar excavators, which were to be used for both dredging and rock placement. These two machines were purchased new and needed to be completely setup using the HYPACK® Excavator System. We found that this would serve as an excellent opportunity to test a new calibration routine that is currently in development.

As anyone who has attempted to calibrate an excavator knows, (and I assume that you must, considering you are reading this article) accurate calibrations can become very difficult when using the normal procedure of taking measurements using measuring tapes and the like.

Currently, we are developing a routine that will no longer require the long pull of the tape while capturing the X distance from boom pin to bucket. It will also replace the need to measure the H1 distance between deck and boom pin. This is good news for anyone who has had the fun of attempting to get very precise calibration measurements while in adverse conditions.

The goal of any excavator system is to have the most precise machine possible, when using RTK GPS which, in theory, can produce centimeter accuracy in both horizontal and vertical position. It seems a shame to add to an error budget by trying to make such sensitive measurements using a tape measure. Simple mistakes in measurements can lead to disastrous calibrations, and completely unacceptable positioning tolerances. This calibration routine is only used for systems that are running RTK GPS. Although it will work when in differential, it would seem that the built-in error budget without precise positions would render any reliable reference check unsatisfactory.

The remainder of this article, assumes that you understand and have used the HYPACK® Excavator system with DREDGEPAK®. Once we have completed further testing in the field, we plan to add this new calibration routine into the excavator driver itself.

CALIBRATION PREPARATION

Before you begin the calibration routine, prepare as follows:

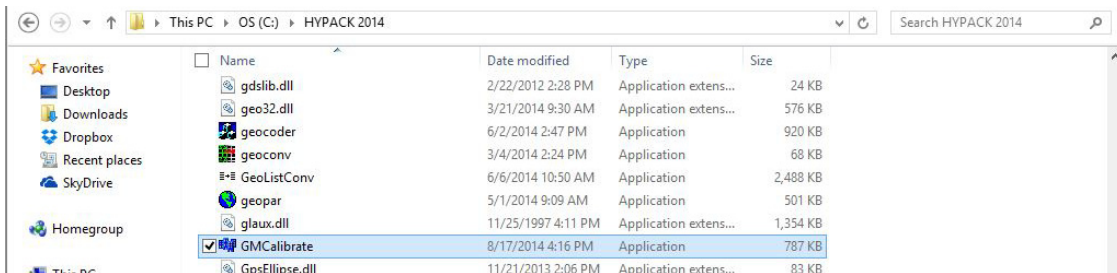
- Correctly configure the excavator.dll.
- Launch DREDGEPAK®.
- Record a known point using RTK GPS to eliminate any chance of incorrect position data.
- Set the excavator so that the bucket teeth align directly on top of this point.
- The excavator must be in the correct calibration position. In all excavator calibrations, the bucket is placed with the bucket perpendicular to the deck.

Note: *Measurements of the boom, stick and bucket lengths need to be extremely accurate, along with all GPS offsets.* This is often overlooked and, much the same as calibration measurements, if you are off on any of these, the final position of the bucket teeth are sure to be compromised.

THE CALIBRATION PROCESS

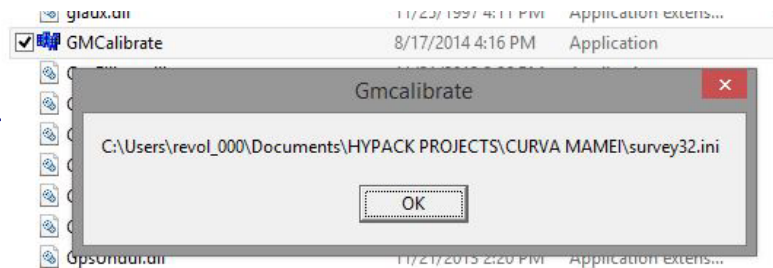
1. **Launch GM Calibrate.** The calibration routine, is currently called GM Calibrate.exe and is located in the HYPACK® root folder.

FIGURE 1. The GM Calibrate Program



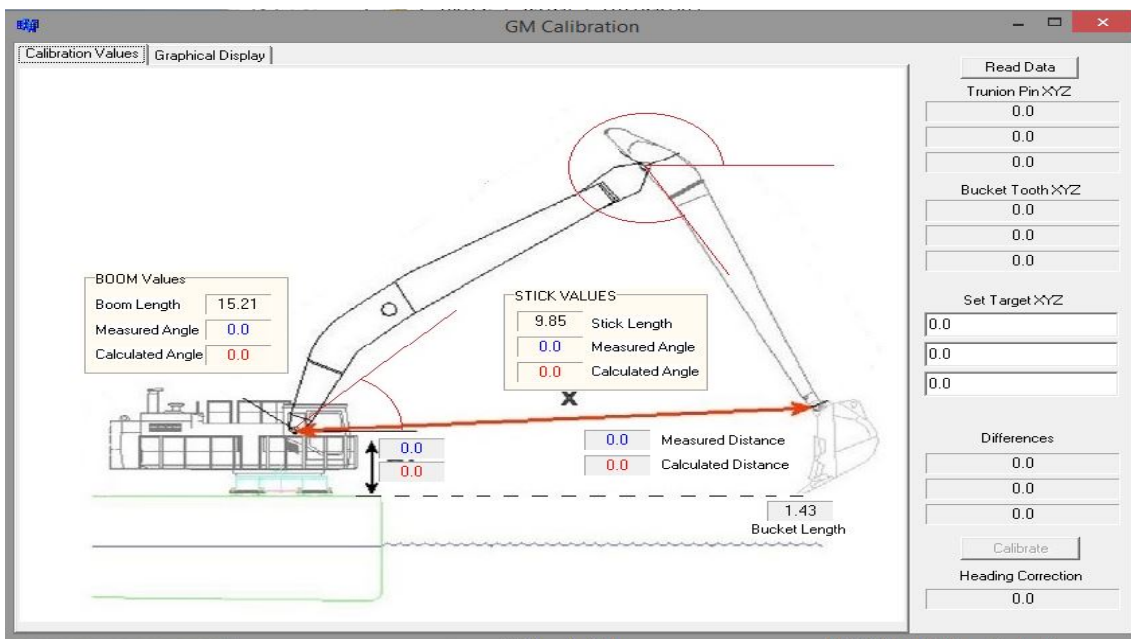
2. **Confirm the hardware configuration that the GM Calibrate routine will be using.** This is read from the current project that is open in DREDGEPAK®. Remember that DREDGEPAK® must be running for the calibration routine to open correctly.

FIGURE 2. GM Calibrate asks for confirmation that it should use the hardware configuration stored in the survey 32.ini of the current project.



Once confirmed, the main calibration screen opens. It shows the current boom, stick and bucket measurements as read from the excavator driver setup.

FIGURE 3. GM Calibration Window—All Angles and Positions Begin at Zero.

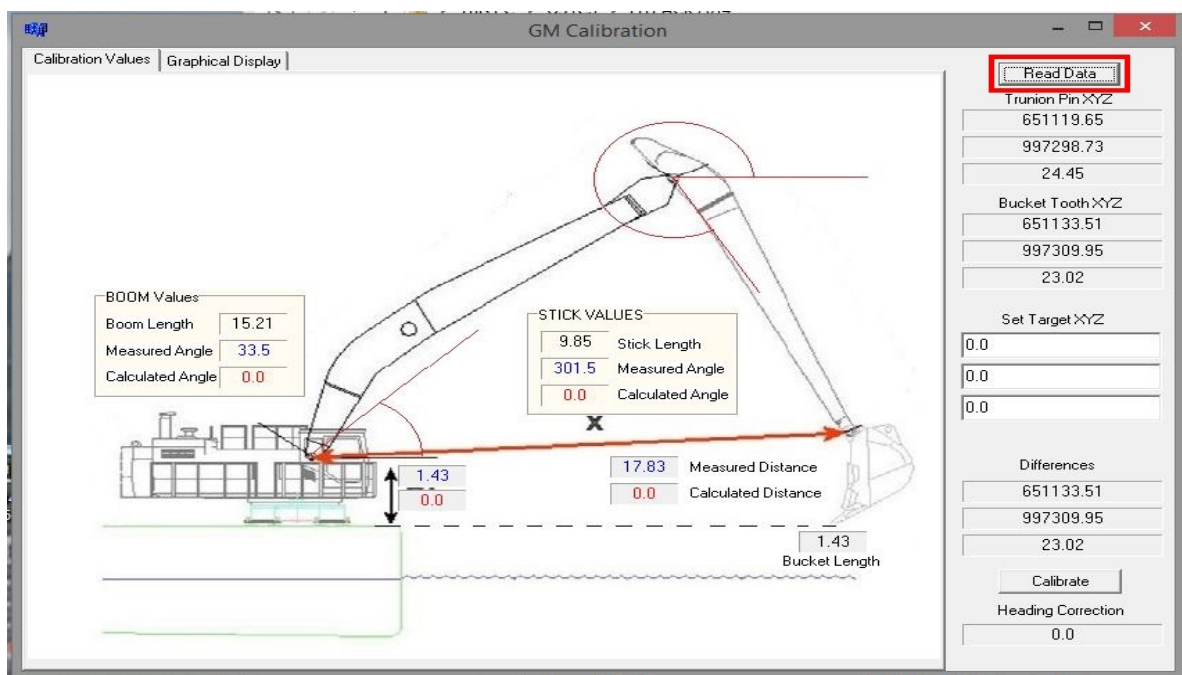


3. In the calibration window, click the **Read Data** button at the top of the screen. This tells the routine to read the sensors and calculate a position for the trunnion pin, as well as for the bucket teeth as it currently sits.

Important: Any change in position from the time the Read Data button is clicked can cause errors in the final calibrated bucket position. This is why having a GPS in fixed RTK mode is necessary for precise final bucket positioning.

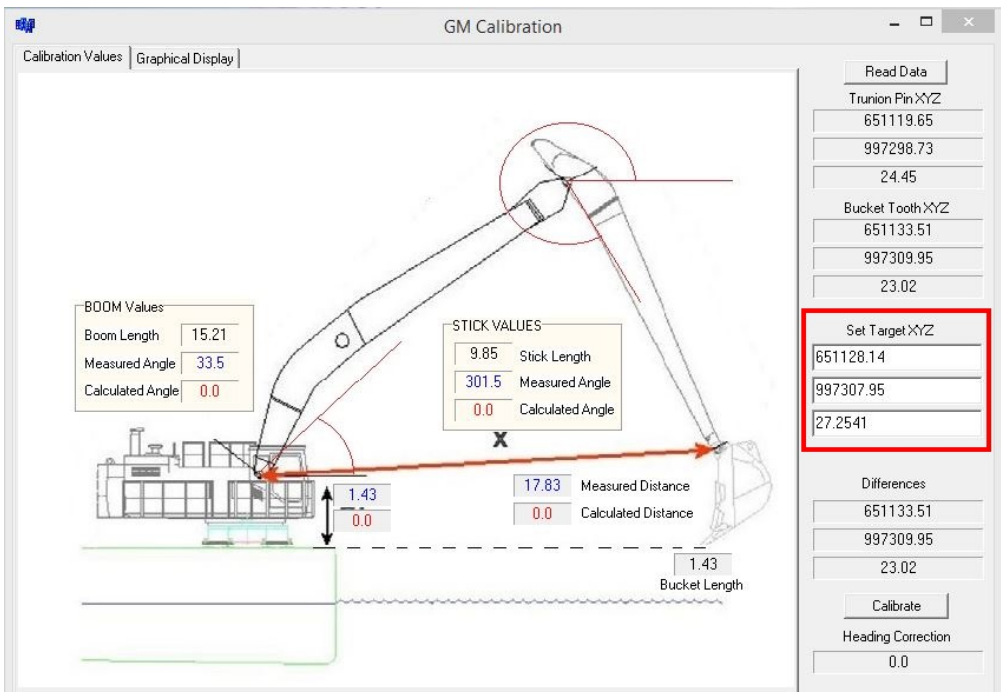
Notice that the trunnion pin and bucket tooth horizontal and vertical positions are now calculated along with the current measured boom and stick angles. The trunnion and bucket positions are populated.

FIGURE 4. GM Calibration Reads the Sensors and Calculates the Trunnion and Bucket Pin Positions



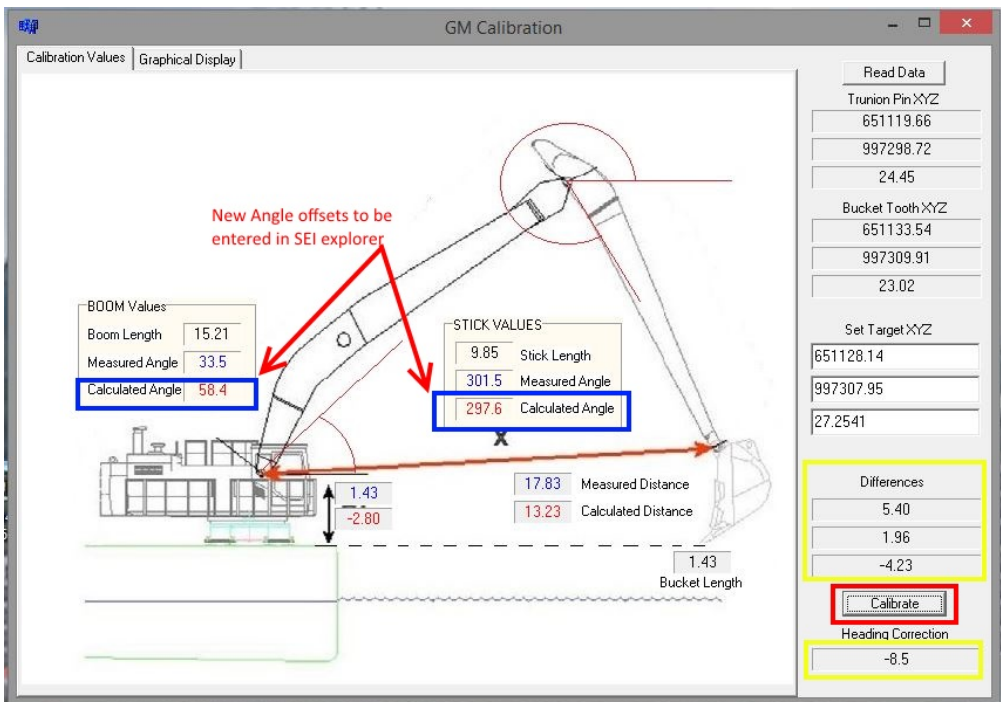
4. Enter the known X, Y, Z coordinates from the point over which the bucket has been setup under **Set Target XYZ** and click the **Calibrate** button.

FIGURE 5. Enter the Target Position



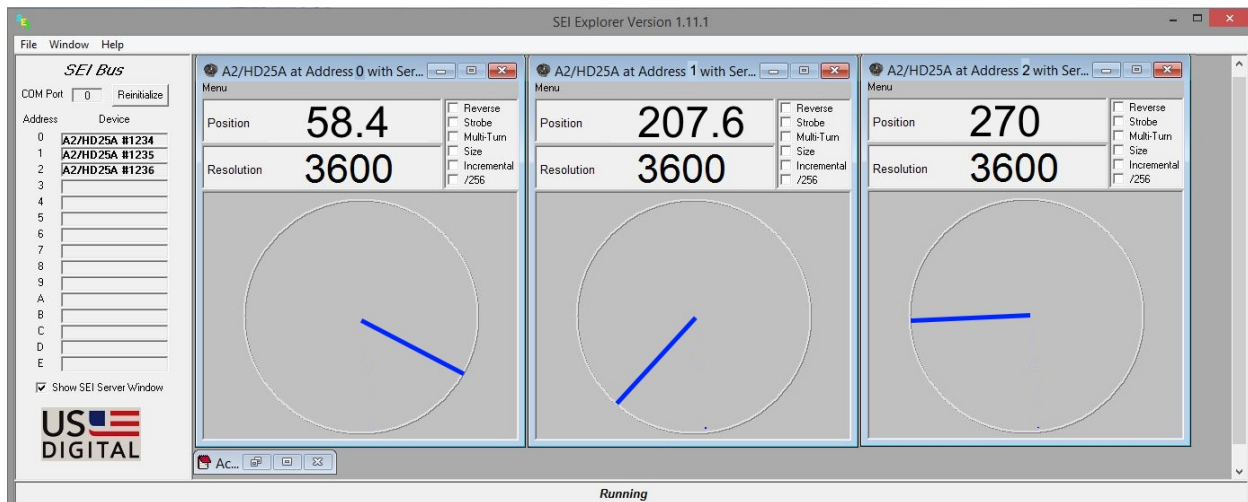
The new calibration routine will now calculate the true angles that should be used to produce the correct math needed for the most precise final bucket position. The differences between the measured and calculated angles will also be displayed along with a heading correction (Figure 6).

FIGURE 6. Calculated Angles, Angle Differences and Heading in the GM Calibration Dialog



5. **Note the calculated angles and the heading adjustment on paper.**
6. **Close DREDGPACK® and open SEI explorer.**
7. **In the SEI interface, change the current position settings of the boom and stick sensor to match the newly calculated angles derived from the calibration routine.**
The boom and stick sensors should always reside in address one and two respectively within SEI explorer.

FIGURE 7. *Entering the Measurements in SEI Explorer*



We are looking to integrate the calibration, so that once the final calculated angles are determined, they will automatically populate in the SEI software, thus saving the extra step of entering them in SEI.

8. **Restart DREDGEPAK® and the excavator will be fully calibrated.**
9. **Check the bucket on predetermined bench marks to assure correct calibration.**

FIGURE 8.
Excavator Display in DREDGEPAK®

We are looking forward to having this new calibration routine included in HYPACK® 2015. Should you be interested in beta testing this new routine, please feel free to contact Bob@HYPACK.com and I would be happy to assist in the process.

