Subject: Potential error in FIT SDK ThreeDSensorAdjusmentPlugin, provided by www.thisisant.com

The FIT SDK provided by “This is ANT” includes some java routines, in folder, ”java.com.garmin.fit.plugin”, to extract data from Garmin FIT files. One of those routines, the ThreeDSensorAdjustmentPlugin (TDPI), has a method that performs calculations on the extracted data. The method is copied below:

private float[] adjustSensorData(int rawData[], CalibrationParameters calParams) {

float[] calibratedValues = new float[rawData.length];

float[] rotatedValues = new float[rawData.length];

// Apply the calibration parameters

for (int i=0; i<rawData.length; i++) {

float Offset = calParams.channelOffset[i];

calibratedValues[i] = (float)rawData[i];

calibratedValues[i] -= calParams.levelShift;

calibratedValues[i] -= calParams.channelOffset[i]; // this is the offset\_cal

calibratedValues[i] \*= calParams.calFactor;

calibratedValues[i] /= calParams.calDivisor;

}

// Apply the rotation matrix

// [Rotation] \* [XYZ] See FIT-1063

rotatedValues[0] = calParams.rotationMatrix[0][0]\*calibratedValues[0] + calParams.rotationMatrix[0][1]\*calibratedValues[1] + calParams.rotationMatrix[0][2]\*calibratedValues[2];

rotatedValues[1] = calParams.rotationMatrix[1][0]\*calibratedValues[0] + calParams.rotationMatrix[1][1]\*calibratedValues[1] + calParams.rotationMatrix[1][2]\*calibratedValues[2];

rotatedValues[2] = calParams.rotationMatrix[2][0]\*calibratedValues[0] + calParams.rotationMatrix[2][1]\*calibratedValues[1] + calParams.rotationMatrix[2][2]\*calibratedValues[2];

return rotatedValues;

}

}

The “adjustSensorData()” method above subtracts the offset\_cal values, extracted from the FIT file, from the different between the raw data and the level\_shift and then divides the result by the calibration\_divisor. Given the signs associated with the offset\_cal values, from the FIT file of my Magnetometer Calibration Test, this would lead to an obviously incorrect result for a number of sensors.

For example, the raw ‘Z’ axis values from the magnetometer range from 33218, with the camera upside down, to 33904 with the camera right side up. The offset\_cal for this axis, from the FIT file, is -986. The calibration\_divisor is 600 and the calibration\_factor is 1. The calculation in the TDPI leads to:

((33904 – 32768) – (-986))/600 = 3.53 Gauss

The vertical component of the earth’s magnetic field is only 0.53 G at my location, so the above result is not even close. If the offset\_cal is subtracted from the level\_shift and that result subtracted from the raw data one gets:

((33904 – (32768 – (-986)))/600 = 0.25 G

Although still not a good result, this is obviously much closer to the known value. The remaining discrepancy, I believe, is an indication that the offset\_cal values in the FIT file need to be refined based on actual data as it is obtained. For the extremes in raw data given above (i.e.orientation rotated 180 degrees) the measured field value should be one half the range divided by the calibration\_divisor, which results in the following:

(33904 – 33218)\*0.5/600 = 0.57 G

This is a reasonable result and is within 8% of the known value. The midpoint between the extremes should be equal to the level\_shift minus a refined\_offset\_cal, therefore:

refined\_offset\_cal = 32768 – (33904 + 33218)\*0.5 = -793

This has the same sign and is the same order of magnitude as the value from the FIT file but represents an improved value.

Another example of the FIT SDK potential method error can be seen with the acceleration data for the same extremes of orientation, from right side up to upside down.

The accelerometer ‘Z’ axis extremes are 34735, when upside down, and 30613, when right side up. The FIT file offset\_cal value for the ‘Z’ axis is 97, the calibration\_divisor is 2048 and the accel\_cal\_factor is 1. The FIT SDK calculation leads to the following results:

((34735 – 32768) – 97)/2048 = 0.91 g

((30613 – 32768) – 97)/2048 = -1.1 g

The known values, due to gravity, are +/- 1.0. If the offset\_cal value is subtracted from the level\_shift and that result then subtracted from the raw data one obtains:

(34735 – (32768 – 97))/2048 = 1.01 g

(30613 – (32768 – 97))/2048 = -1.00 g

These results are in good agreement with the known values.

The two examples provided above indicate that the FIT SDK methodology for applying the offset\_cal data is incorrect.

It is concluded that the offset\_cal values from the FIT file should be subtracted from the level\_shift and that result then subtracted from the raw data.