Static Pressure Testing of the Pressure Sensors on eo SwimBETTER
PILOT.

Dr Neil Baker, Assoc Prof Peter Sinclair, Dr Kenneth Graham

Introduction/Background

The validity/reliability/accuracy of sensors used in sport are important to allow for confidence in the quantitative changes in values measured and recorded. The use of first principle physical techniques for evaluating the values recorded by sensors allows for both tracing measures back to known standards and easy replication by others.

This document outlines an initial series of pressure measures on 4 handsets (8 sensors) conducted at an aquatic centre with a 5-metre deep pool.

Methods

A simple physical approach was used whereby the known relationship between depth in water and hydrostatic pressure was used as the basis of assessing the **eo** SwimBETTER pressure sensor.

Sensors were turned on and placed on their side, in a weighted bucket, to minimise the difference in the depth of the pair of sensors on a handset when they were lowered into the pool. The bucket had holes drilled in its side and bottom to allow free entry and egress of water. The bucket was attached to a cord that had marks placed on it such that each mark, when aligned with the water's surface would result in an initial depth of one metre and a change of depth of one metre. The marks had been measured using a steel metre rule with the first mark aligned to the sensor location on the handsets.

Measures were made at one metre depths from the surface (zero metres) to a depth of four metres. The bucket was lowered over a period of 30 seconds and recordings made for a period of 30 seconds at each depth. Measures were also made at each metre depth on the way back up to allow for the determination of any hysteresis.

Each run was done with a pair of handsets (totalling four sensors) and two runs of a pair of handsets totalling 4 handsets and 8 sensors were undertaken.

After the handsets returned to the surface data collection was stopped and the data downloaded via a Bluetooth connection to a laptop computer.

Seven hundred data points from the pressure sensors, corresponding to 14sec while the sensors were stationary, were averaged for each depth. Depth in m was calculated for each averaged pressure measure using the formula $depth = \frac{pressure\ (hPa)}{10g}$, where pressure was the difference between recorded pressure and the pressure above water, and g is acceleration due to gravity.

Sample Results

Figure 1: Pressure data from 1 handset (2 sensors) corrected to a depth measure (metre) and plotted against sample number. Data is presented from both the lowering and raising of the pressure sensors.

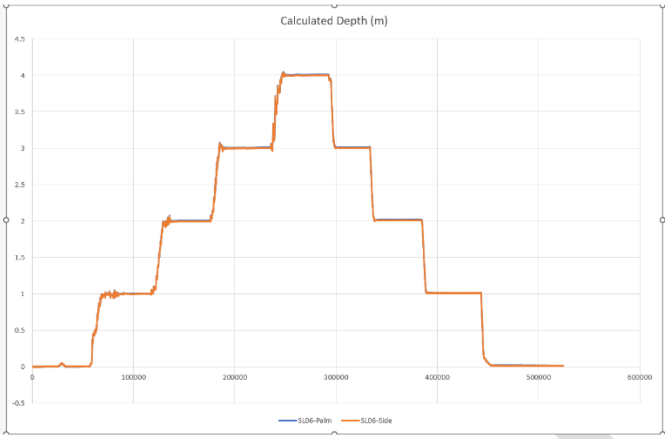


Figure 2: Pressure data (converted into metre depth) from the sensor from one handset plotted against the depth of the sensor in the water.

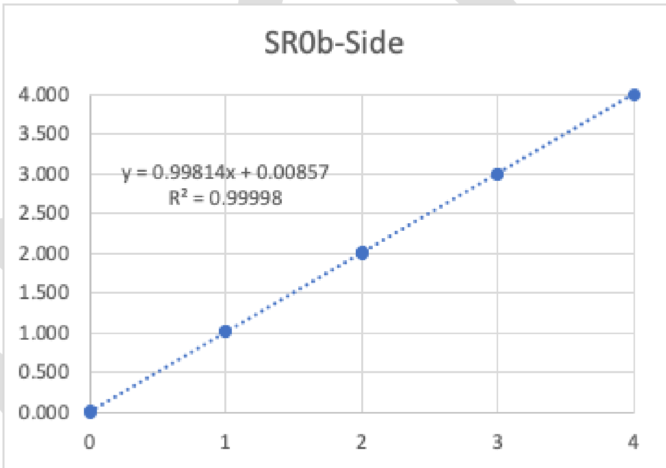
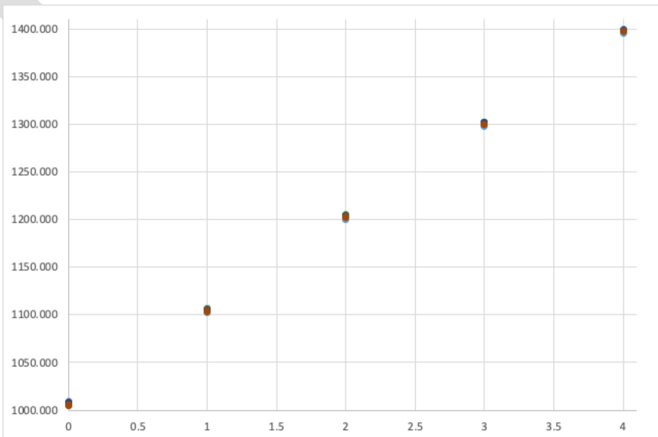


Figure 3: Pressure data from 8 sensors (four handsets) plotted against depth (metres). The equation for the combined sensor data is "pressure = 97.862*depth + 1006.570, R^2 = 0.9999"



Discussion

Based on the initial trials of assessment of the pressure sensors by the static testing they appear to be:

1. reliable between and across sensors, showing minimal differences between sensors and no hysteresis.
2. sensitive to pressure changes and responding rapidly to increases and decreases in pressure.
3. accurate across the range tested when the pressures measured are aligned to the expected values at each of the depth.