Background

In 2013 we started developing a rowing power meter as we felt that the major limitation of all past and present telemetry systems was the time it took to install them. This meant that unless you had a full-time boatman they almost always stayed on one boat and were of limited use. We felt that if we developed a design that could be installed in under a minute it would be used by multiple crews and squads on a daily basis and be far more effective.

Our initial approach was to try and create a design that worked with standard oarlocks but this had two challenges, angle measurement and the space available for force measurement. We developed a design that measured angles using a rotary encoder driven by a miniature flexible drive shaft that clamped to the oarlock top nut. This worked well and the zero angle for each oarlock would have been established each time the oarlock was fitted by placing a narrow tape mark on the side face of the boat and directing a built in laser onto it.

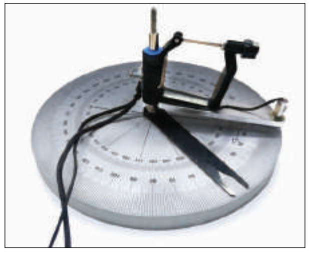
Force measurement was more problematic though as the clearance within an oarlock, even with the nut on the top bar adjusted fully out, is less than 4mm. We tried to develop a strain gauge based force sensor to fit this space, but it meant that only a very thin wear plate could be used and that changed the feel of the oar when squaring and feathering. The alternative to strain gauges was to use a Piezo sensor but Piezos suffer from a number of issues that mean that it would be hard to achieve long term accuracies of even +/- 10%, and +/-2% is what is needed (interestingly US patent 10016158B2 was granted on this force sensing approach in 2018 but our design doesn't conflict with their method of force measurement, nor with their other main claim of mounting the device by 'surrounding a portion of the oarlock').

We then worked on the idea of making our own, standard cost, custom oarlock so that people could install these on all the boats they wanted to use sensing modules on and then just quickly fit them when they needed to. This approach also allowed the oarlock to incorporate an RFID chip to store the standard rigging information for that boat (span, blade length and inboard) as these figures affect power calculations. We were also able to create a design that allowed pitches to be adjusted in the usual way and for height adjustments to be quickly made using standard clips.

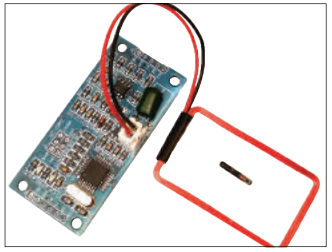
We went ahead with this design approach and after a great deal of CAD development and FEA analysis made the first prototype system. We then needed a test and calibration rig so we designed and built one using a 1.1kW/1.5 HP motor that simulated rowing with a 160Kg oarlock force at rate 36, for days on end, which no rower could do. After numerous iterations the force sensor design was finalised and then tested in boats as well as being life tested on the rig.

We are now finalising the Oarlock and Sensing Module mouldings for the sweep versions and the PCBs and firmware are being developed for a 2020 launch. The sculling versions will then follow on.

Initial Design Approach.

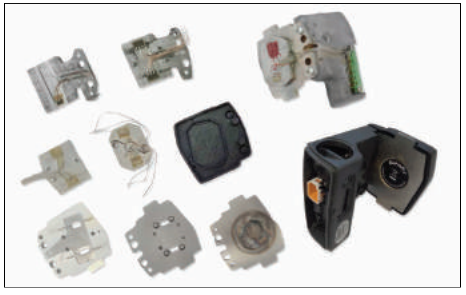


Initial test rig for Gyro angle measurement and infrared datum sensing.



RFID trials.

Cycling power meters, from all the major manufactureres, were taken apart.



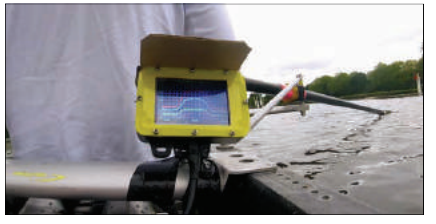
Prototype force sensing modules.

Static calibration rig, using weights measured to 1g accuracy.

Test and calibration rig.

Wired test rig.

In boat testing.



In boat testing.