BIOROW BIOMECHANICS OF ROWING

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News

The World Rowing Championship 2013 have just finished in Chungju, South Korea. 10 medals were won by the teams, which BioRow had been working with during this season: 6 gold (LM2- SUI, LM1x DEN, LM2x NOR, M4- NED, M2x NOR, LM4- DEN) and 4 silver (LM1x FRA, M2- FRA, LM2x SUI, ASW1x NOR). Congratulations to the rowers and coaches! Well done!

Rower's mass suspension

Recently, we have conducted another experiment on vertical forces. In addition to the seat force (RBN 2013/04), vertical and horizontal forces at the stretcher were measured at three points, where the stretcher is mounted to the boat (Fig.1) and summed up.

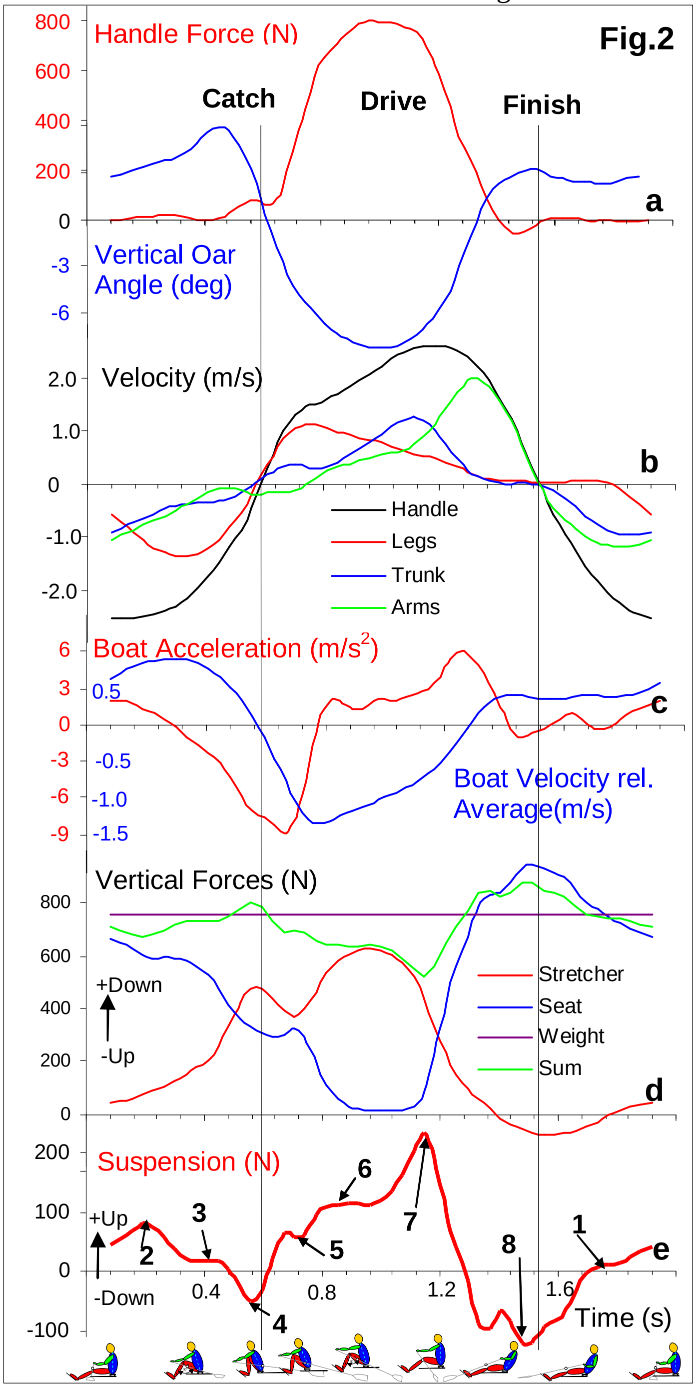
Fig.2 shows the data of a single sculler (1.87m, 77kg) at a stroke rate 32 min^{-1}. The vertical forces at the seat ***Fseat*** and stretcher ***Fstr*** were summed up and the sum was compared with the rower's weight ***Fw*** (Fig.2, d). Then the sum of the forces was subtracted from the weight, so the suspension ***Fsus*** of the rower from the boat was found (Fig.2, e):

$$Fsus = Fw - (Fseat + Fstr) \qquad (1)$$

The suspension is close to zero at the beginning of the recovery (1), when the rower's weight is placed on the seat and the vertical stretcher force is zero. Mid-recovery (2), the weight is transferring onto the stretcher and the suspension has a short peak up to 90N, which could be explained by negative vertical acceleration of the rower's CM descending on the slides. Before catch (3), the suspension is close to zero again, but this balance of forces is very dynamic: vertical stretcher force quickly increases, because the weight is being transferring from the seat.

At the catch (4), 63% of the rower's weight is located on the stretcher and only 39% left on the seat, so the suspension is negative -50N, which could be explained by upward acceleration of the arms and handles. Just after the catch (5), the suspension became positive, but the weight at this phase is transferring back onto the seat and the suspension has a little hump, which could be related to a rower's acceleration upwards on the slides and increase of the vertical handle force, which pushes him down.

During the "initial boat acceleration" phase (P4, RBN 2013/07), the weight is nearly completely lifted from the seat (only 20N left ~2%), but ~83% of it is transferred onto the stretcher (6), so only 15% of the rower's weight is suspended and makes the system rower-boat lighter. Another 50N ~4% of the vertical component of the handle force could be added (calculated at 4° pitch, RBN 2013/02), which pulls the rower down, so the real value of the suspension could be ~19-20% of the rower's weight.



At the middle of the drive (7), almost the whole weight is still lifted from the seat, the stretcher force quickly decreases, so the suspension has a sharp peak up to 230N ~30% of the rower's weight or 25% of the system weight (+18kg boat). At the finish (8), the ***Fstr*** is slightly negative, but ***Fseat*** is high (125% of ***Fw***), so the ***Fsus*** is negative -100N, which is related to vertical trunk acceleration.

The suspension could make the system rower-boat 20-25% lighter, which decreases water displacement and drag resistance. This research was done for the first time in the history (to our knowledge) and further experiments and analysis required

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