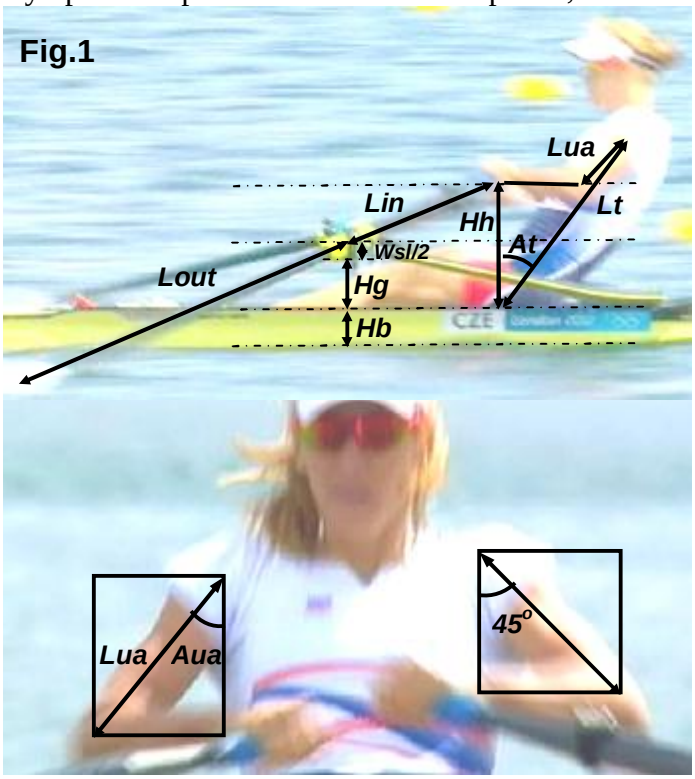
Rigging: Gate Height

We have already discussed some relationships between the gate height and the seat force (RBN 2002/05), blade pitch (2010/09), vertical angles (2009/10) and its specifics in sculling (2011/07). Now it is analysed directly and in more detail.

At the catch, a rower has much more freedom to vary the height of the handle pull, because the arm is straight. Therefore, the height of the handle and related gate height is mainly defined by position at the finish.

The simplest method to define the correct height is an empirical one: sit in the boat at the finish position, bury the blades into the water and find the most comfortable height for you. However, an analysis and normative values could be useful to predict the correct height for a rower in various boats; for understanding of effective technique and identifying the reasons of errors. Fig.1 shows the analysis of the gate height of Olympic champion in W1x Mirka Knapkova, CZE.

Fig.1



The main requirement of the correct rower's position at the finish - horizontal forearms, i.e. the elbow and the handle must be at the same level. Only this position allows effective horizontal pull. The height of the handle ***Hh*** from the seat can be calculated as:

$$Hh = Lt\cos(At) - Lua\cos(Aua)\cos(At) \quad (1)$$

Where ***Lt*** - length of the trunk from the seat to the centre of the shoulder joint, ***At*** – angle of the trunk from vertical, ***Lua*** – length of the upper arm between centres of the shoulder and elbow joints, ***Aua*** – angle of the upper arm from vertical, for which the optimal value appeared to be 45° to engage the biggest shoulder muscles: *Latissimus dorsi*, *Trapezius* and posterior part of *Deltoid* muscles. The optimal height of the gate from the seat ***Hg*** at the defined handle height ***Hh*** can be calculated as:

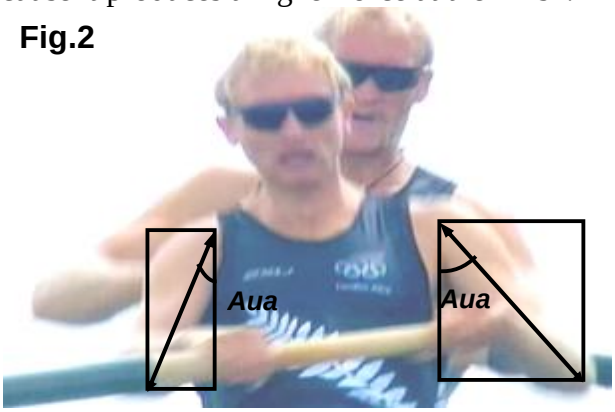
$$Hg=(Hh+Hb+\sin(-V)Lin)*Lout/(Lin+Lout)-Wsl/2-Hb=$$
$$Hh+\sin(-V)Lin)*Lout/(Lin+Lout)-Wsl/2-Hb(Lin/(Lin+Lout)) \quad (2)$$

Where ***Lout*** – length of actual outboard from the pin to the middle of the blade, ***Lin*** – actual length of the inboard from the pin to the middle of the handle, ***Wsl*** – width (thickness) of the sleeve, ***V*** – vertical angle of the oar relative to the water level, which should be below -3° for fully covered blade, ***Hb*** – height of the seat above water level. Though the model became quite complicated, it produces quite reasonable gate height ***Hg***=15.8cm at the following inputs: ***Lt***=50cm, ***At***=30deg, ***Lua***=25cm, ***Aua***=45deg, ***V***=-3deg, ***Lin***=84cm, ***Lout***=175.5cm, ***Wsl***=5.6cm, ***Hb***=10cm.

A large number of variables in the model allows endless combination of them: e.g. longer trunk leaning can be compensated by more horizontal position of upper arm, etc. Also, some variables itself are not fixed for the given rower: e.g. the length of the trunk ***Lt*** depends on the posture (how straight the torso is) and position of the shoulders (higher or lower *clavicle* and *scapula*).

The model works in sweep rowing as well (Fig.2), but upper arms usually have different angles: the inside arm has a more vertical position (elbow lower), because it produces a higher force at the finish.

Fig.2



The derived equations allow for the conclusions:

- Obviously, **a higher seat position above water (in a larger boat) requires about three times smaller decrease in the gate height**.
- **Longer leaning with the trunk at finish requires lower height of the handle and gate and vice versa**, because ***cos(At)*** decreases at larger angles. At the same other inputs above, the trunk angle 20° gives the gate height 17.5cm and trunk angle 10° – 18.5cm.
- **The lighter the gearing, the lower the gate and vice versa,** but the effect is quite small. At the same other inputs above, 10cm shorter outboard ***Lout*** would require only 0.5cm lower gate.
- **The optimal gate height is important for effective blade work and force application at the finish of the drive**. The gate being too high would increase finish slip of the blade ("washing out").