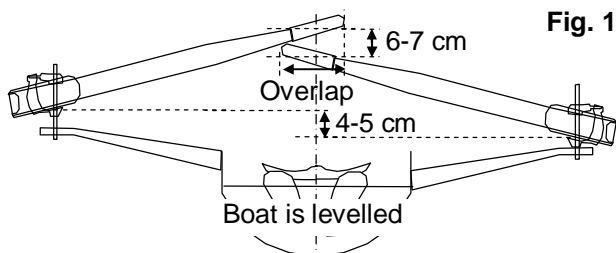


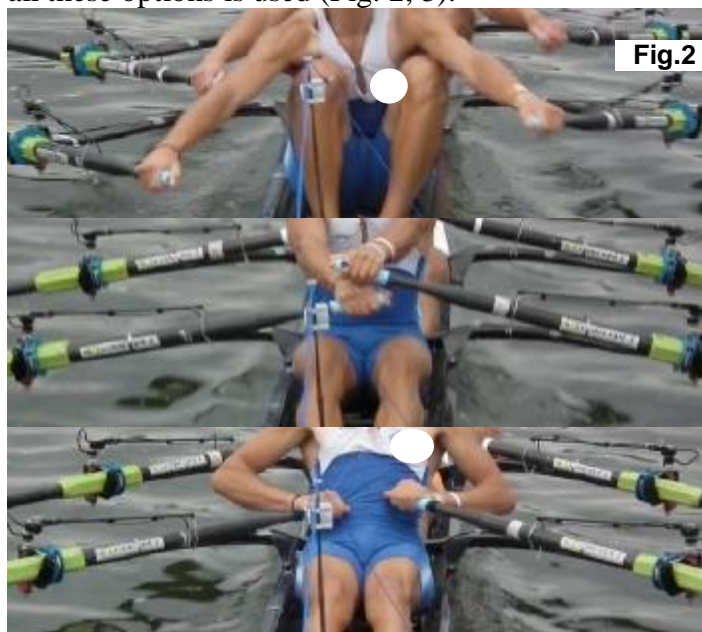
### Asymmetry in sculling

Asymmetry in sculling is defined by the overlap of the scull handles, which is commonly set to 18-22 cm (Fig.1). Overlap itself is defined by the inboard length and necessity to scull long angles 100-120deg. At in-board 88cm, span 160cm and overlap 20 cm (+4cm of swivel width), the distance between handles is about 100cm at catch angle 70deg and 30cm at finish angle 44deg. If the overlap would be set to zero, then above distances would be 20cm wider, which is too wide for a normal sculler.



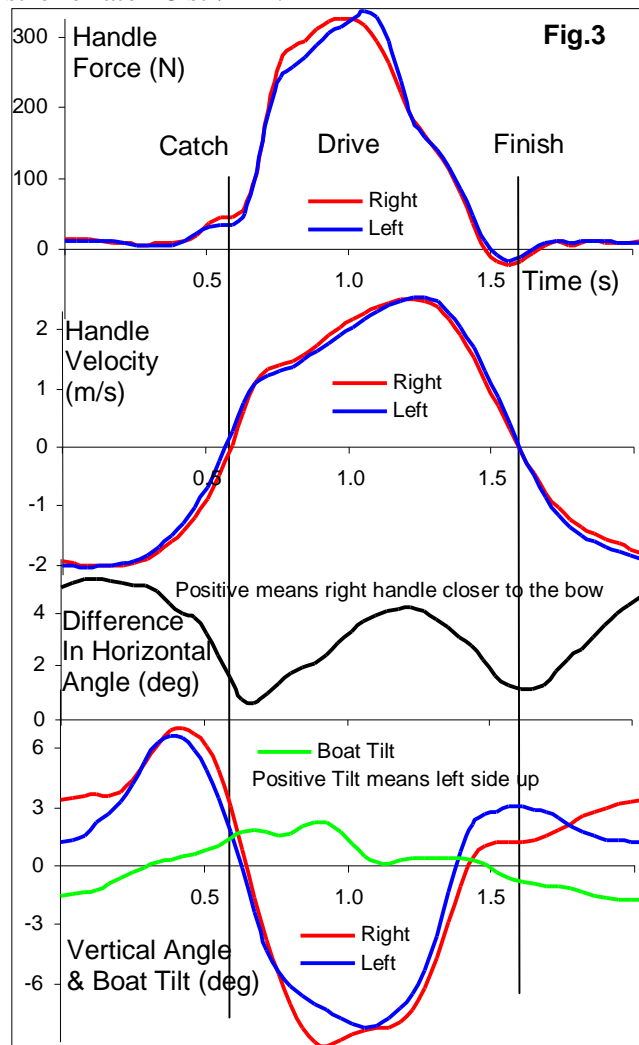
If a sculler pulls the handles symmetrically in the horizontal plane, then vertical distance between them at the middle of the drive must be 6-7 cm. To achieve this, difference in height of the gates must be set at 4-5 cm, if a boat is kept level and blades move at the same depth in the water. At the finish, however, a sculler must pull the handles the same 6-7 cm apart, which is very difficult in terms of balance and could negatively affect an athlete's posture.

The usual difference in height of the gates is set to 1-2 cm, which allows pulling the handles at the finish to more or less the same height. Therefore, at the middle of the drive, a sculler has to separate the handles in the horizontal plane (pull one handle in front of another) and/or tilt the boat and/or move the blades at different depth in the water. Usually, a combination of all these options is used (Fig. 2, 3).



As the most common sculling style is "left handle above right", the right handle is usually pulled in front

of the left. Fig. 3 shows typical data of a single sculler at stroke rate 28 str/min.



Left catch angle is about 1 deg longer and this difference in the angles increases up to 4 deg at the middle of the drive, then decreases again down to 1 deg at finish. To do this, the sculler must apply forces asymmetrically: right handle force increases faster at catch, which creates higher velocity and allows the right handle to take position in front. At about 30 deg oar angle, the left force increases and became higher than the right one, which allows the left handle to catch up the right one at the finish of the drive. This asymmetry in forces creates a small (0.5-1 deg) wiggle of the hull during the drive, which increases the drag resistance losses. In fact, this particular sculler put right blade deeper at catch, which makes forces asymmetry worse. During the first half of the drive, the boat also tilts about 2 deg right side down. At the finish, the tilt decreases down to zero, which helps to keep the balance

How can an athlete minimize losses caused by asymmetry in sculling? **Pull the handles with even forces to reduce the boat wiggle. Don't worry too much about the boat tilt at catch and middle of the drive. Try setting the overlap to 18 cm and the difference in height of gates to 1.5-2 cm.**