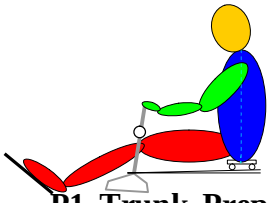
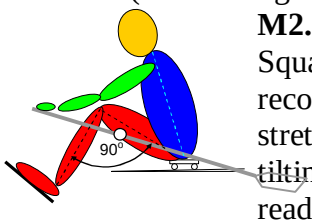
Stroke Cycle

The purpose of this article is twofold: 1) to describe our model of rowing technique; 2) to clarify definitions of rowing biomechanics terminology. The stroke cycle could be presented as 8 "Moments" M1-M8-momentary snapshots, and 8 "Phases" P1-P8 - transitions between the moments (Fig.1).



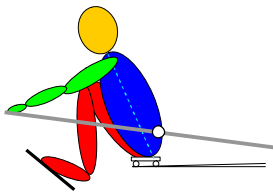
M1 Cycle Start. During recovery, the oar is perpendicular to the boat (zero oar angle). The handle is on top of the knees; the trunk is nearly vertical.

P1 Trunk Preparation. The trunk together with pelvis continues rotation ("pivoting") around hips, and the hamstrings and gluts are stretched. Knees gradually rise and the seat accelerates towards the stern. The rower smoothly pulls the stretcher according to the stroke rate (faster at higher rate).



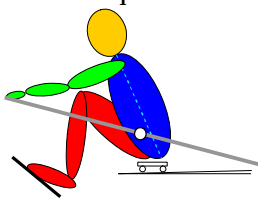
M2. Recovery Transition. Square (90°) knee angle during recovery. Handle on top of the stretcher. The trunk completed tilting forward to 25-30° and ready for the drive. Shoulders are low and stretched forward.

P2. Final Recovery. Heels are rising from the footboard and toes start pushing the stretcher, which leads to the boat deceleration and legs/seat velocity decreasing. Then, the blade is squared; and the handle is thrown away towards the stern and upwards. At the last moment (0.02-0.04s), legs are "catching" through the stretcher to create counter-movement of the blade into the water.



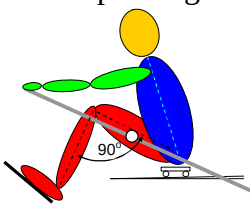
M3. Catch. The furthest position of the handle to the stern. Arms and wrists are straight; shoulders are low and extended. Low back is in straight and braced position; the chest is compressed to thighs. Shins are vertical, heels are risen from the stretcher.

P3. Blade entry. The blade sharply enters into the water with a small splash towards the stern, which is achieved by "kicking" the stretcher through the toes and knees are extended by means of fast, but "light" work of quads muscles.



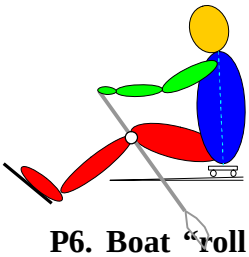
M4. Full blade immersion. The seat and handle has passed 6-10cm from the catch. The trunk keeps the catch position. The rower is "hanging" on the handle through the stretched arms and shoulders.

P4 Initial boat acceleration. The direction of blade movement becomes horizontal. The handle force quickly increases and the boat acceleration becomes positive. The rower's weight is lifting from the seat and suspending between handle and stretcher.



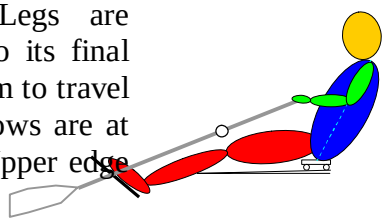
M5. Drive Transition. Square (90°) knee angle during the drive; handle on top of the stretcher. Legs/seat velocity achieves its maximum; trunk still holds the catch position.

P5. Rower's acceleration. Heels are placed onto the footboard and pushing it. The muscle activation is sharply switched from quads to gluts and hamstrings, from knee to hips extension, which "opens" the trunk, pushes the knee down and "automatically" extends it. The force and power achieve their maximums by means of usage of the biggest muscles of the body. Acceleration of rower's CM increases, but the boat acceleration decreases.



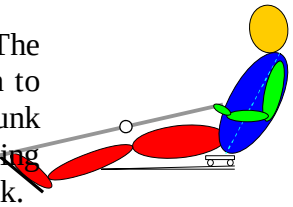
M6. Middle of the drive. The oar is close to the perpendicular to the boat and handle on top of knees. Legs are nearly straight; trunk is vertical, shoulders and arms are beginning to pull.

P6. Boat "roll out". The handle continues acceleration by means of a fast extension of the trunk as well as pulling with the shoulders and arms. Forces are decreasing, and the stretcher force decreases faster than the handle force, which causes significant boat acceleration.



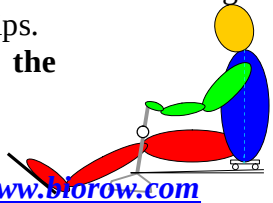
M7. Late drive. Legs are straight, trunk is close to its final position, handle has 5-7cm to travel (the less the better). Elbows are at the level of the handle. Upper edge of the blade surfaces

P7. Blade extraction. The stretcher force is sharply cut, but the arms continue fast drive of the handle forward-down. This causes the trunk to begin return movement to the stern. The rower's weight is fully transferred onto the seat. The blades are quickly and cleanly extracted from the water.



M8. Finish of the drive. The handle is in the furthest position to the bow. Legs are straight, the trunk angle is 20-25°. In sweep rowing the outer hand "brushes" the trunk.

P8. Early recovery. The handle starts moving towards the stern and the blade is feathered. The hands, arms and shoulders are smoothly extending and "follow" the handle. Then, the pelvis and trunk together are "pivoting" around flexing hips.



M1 Cycle End / Start of the next one.

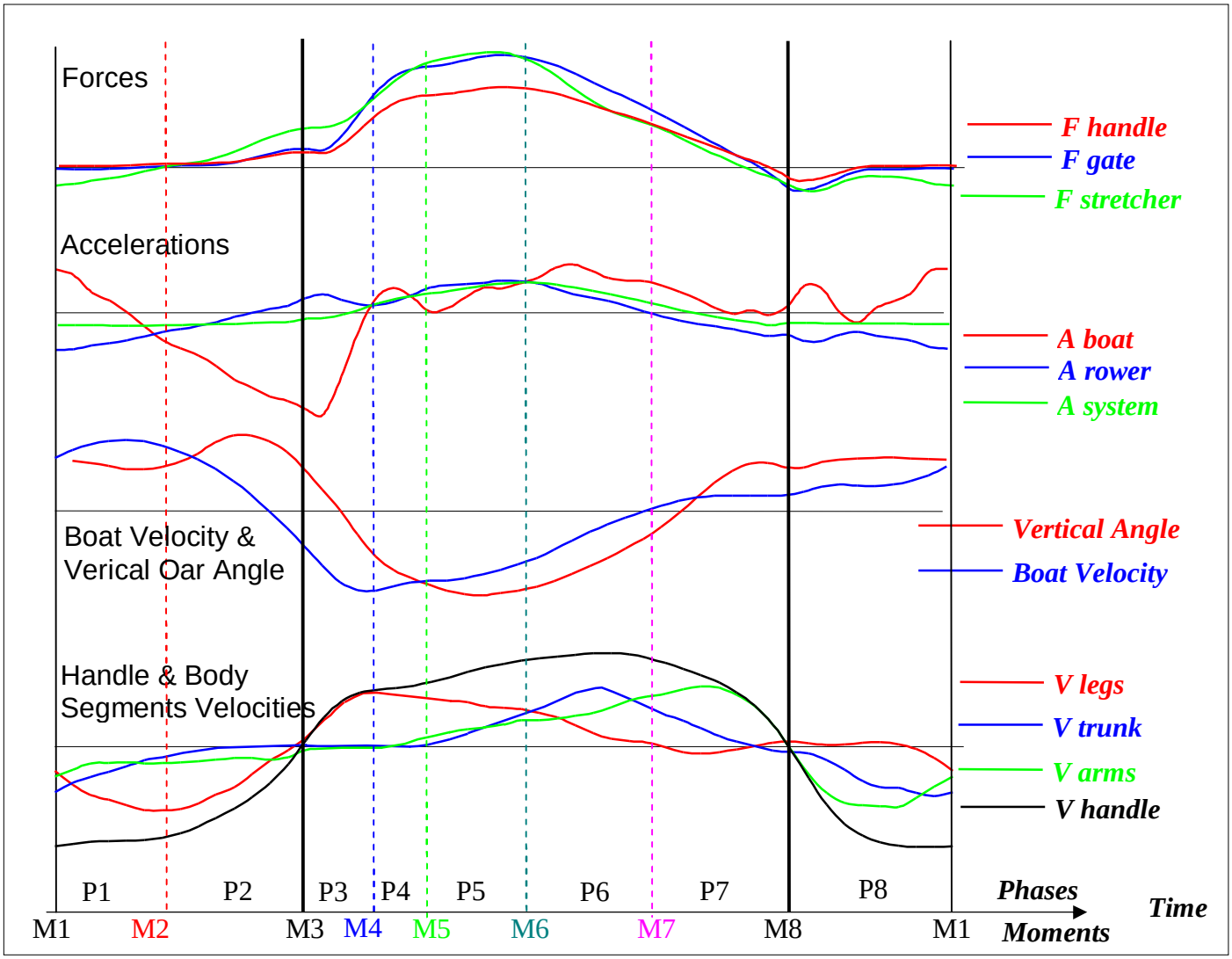


Fig.1. The main biomechanical variables during the stroke cycle

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2. 2010. Kleshnev V. Boat acceleration, temporal structure of the stroke cycle, and effectiveness in rowing. Journal of Sports Engineering and Technology, 233, 63-73.
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