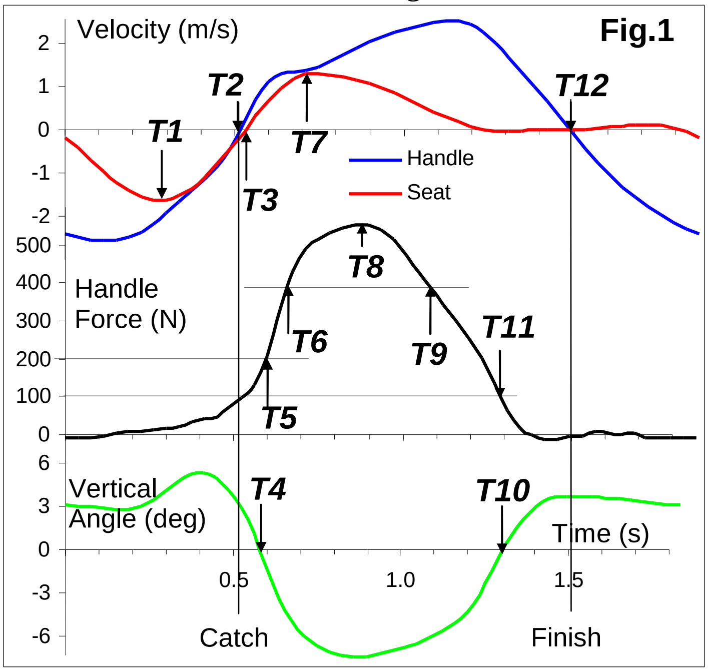
Timing of synchronisation in a crew

We have touched briefly on synchronisation in a crew (RBN 2011/02) and now will try to give quantitative evaluation of these very important biomechanical variables. Fig.1 shows the main variables of a rower at stroke rate 32 str/min: velocities of the handle and seat, handle force and vertical oar angle:



There were defined 12 key moments of the cycle:

***T1.* Min. seat velocity** (negative) during recovery, when switching from pulling to pushing the stretcher.

***T2.* Catch** – Zero handle velocity, when the oar movement changes direction;

***T3.* Zero seat velocity** at the catch, when the seat changes direction;

***T4.* Zero vertical angle** at the catch, when centre of the blade crosses water level

***T5.* Entry Force** 200N at catch (sum of left and right forces in sculling). The threshold was chosen to distinguish force in the water from oar inertia force.

***T6.* Force up to 70%,** which indicates engagement of large muscle groups.

***T7.* Max. seat velocity** during the drive, which indicates acceleration of rower's mass.

***T8.* Peak Force** – emphasis of efforts.

***T9.* Force down below 70%** shows maintenance of the force during the second half of the drive.

***T10.* Zero vertical angle** at the finish shows "washing out" of the blade.

***T11.* Exit force** 100N (sum in sculling) at the finish.

***T12.* Finish** – Zero handle velocity.

For evaluation of synchronisation, the time difference from the stroke rower at each of the 12 moments was derived for each member of the crew. Then, the following values were calculated:

1. Average difference of all rowers from the stroke. However, this value could be zero if some rowers overtake the stroke (negative difference) and others are late (positive difference). Therefore, this value could be used only for defining a direction of general trend in a crew.
2. Standard deviation SD of the differences defines magnitude of synchronisation, but not direction (it is always positive) and should be used in combination with average difference above. For simplicity, you can think that synchronisation of all rowers in a crew lies within the range ±3SD.

The data was collected in eights and divided into three groups:

J – Junior rowers in clubs, schools and universities (n=338 boat-samples at various stroke rates);

B - Seniors B, adult rowers of national level (n=161);

A – Seniors A of international level (n=170).

Table 1 below shows average direction and magnitude of synchronisation in these three groups in ms (1 millisecond = 0.001s).

Table 1	Sen.A	±SD	Sen.B	±SD	Jun.	±SD
T1	-9.8	62.5	-17.2	34.3	-11.2	41.6
T2	-13.8	15.2	-2.7	17.0	-12.9	20.2
T3	-14.3	55.3	-11.6	21.4	-13.2	27.7
T4	-0.1	34.4	-1.5	38.9	-23.2	44.0
T5	-4.9	18.1	-0.9	42.6	-0.3	31.7
T6	6.0	33.3	2.1	67.4	6.4	46.6
T7	11.3	71.6	-4.5	47.6	-4.9	58.5
T8	16.4	51.6	-9.3	85.8	-3.4	67.9
T9	4.1	39.8	-4.5	77.4	-1.2	51.7
T10	5.9	131.5	-21.3	216.4	-52.0	219.4
T11	2.7	23.6	-9.1	65.4	-11.2	36.3
T12	5.2	17.6	6.5	22.2	-4.9	25.3
Average	**0.7**	**46.2**	**-6.2**	**61.4**	**-11.0**	**55.9**

As expected, general synchronisation in Sen.A eights was better (average SD for 12 moments was 46.2ms), than in Sen.B group (61.4ms) and in juniors (55.9ms). The average direction was close to 0 in Sen.A and negative in Sen.B and Juniors, but in all moments around catch T1-T5 it was negative in all groups. This means that rowers, in general, tend to overtake the stroke. It was found that the **synchronisations at the catch and finish are significantly better at higher stroke rates**: average SD of T2 and T12 decreases from 25-30ms at 20 str/min down to 10-15ms at 40 (correlation r=-0.46 and r=-0.42).

How can synchronisation be improved? If a rower is consistently earlier or later than the stroke (average difference is significant, but SD is small), it can be improved with video or biomechanical feedback (all above criteria T1-T12 were recently included in BioRowTel reports). If mistiming is inconsistent (direction is small, but SD is high), then feeling of the rhythm should be targeted, which could be improved with various real time feedback, or pace-makers (1).

References. 1. Lazutkin V.M. 1980. Coordination of oarsman movement at catch. In *Annual Grebnoi sport* (Rowing sport), Moscow. pp. 23-26.