DYNAMOMETRIC SYSTEM FOR THE EVALUATION OF RELAY SWIMMING STARTS.

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INTRODUCTION
A system for the dynamometric evaluation of relay starts in swimming will be presented.

DESCRIPTION
The system is composed by two synchronized force plates. One (Bertec 4060-15) is placed out of the water, simulating a starting platform, with a 10º inclination. The particular location, and fixation, of this force plate was possible due to a special support constructed for this particular purpose. The second one (Roesler et al., 2003) is placed on the finishing wall of the pool, in a vertical position. The fixation of this second force plate was possible also due to a specific structure conceived for this purpose. Both force platforms are connected to a PC using the same A/D converter plate (Biopac Systems HLT100C). Landmarks in the bottom of the pool needed to be changed in order to keep the official distance from the “T” mark to the finishing wall.

RESULTS
The system displayed allow the assessment of variables such as:
(i) double contact time (contact of both swimmers with the starting/finishing wall);
(ii) impulse time;
(iii) vertical component of the platform reaction force;
(iv) horizontal anterior-posterior component of the platform reaction force;
(v) horizontal lateral-medial component of the platform reaction force;
(vi) resultant platform reaction force;
(vii) vertical impulse;
(viii) horizontal anterior-posterior impulse;
(ix) horizontal lateral-medial impulse;
(x) angular momentum at take off.
Results also allow perceiving the effect of moment transfer from the particular actions of the upper limbs in some starting techniques, or the particular effect of single or dual steps forward characteristic of more recent technical solutions for relay starts (2nd, 3rd, and 4th laps).

CONCLUSION
Results provided for such a dynamometrical setup allow swimmers to test their best solutions for relay starts, as well as to train their technique, disposing of immediate feedback about critical variables for the performance in this particular action.

UNDERWATER ELECTROMYOGRAPHY SYSTEM AND HIS DIALOG WITH OTHER INSTRUMENTATION.

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INTRODUCTION
The need of an electromyographic (EMG) system that works underwater, and more specifically, in swimming pool conditions, leads to the development of new solution of active electrodes, full compatible with current EMG technology used in Biomechanics labs.

DESCRIPTION
The active electrodes need to have some electrical requisites in conformity with Basmajian and Deluca (1985) and also, to have capability to measure 25 meters cabled EMG signals, allowing great swimmer’s mobility. The active electrode configuration uses, in the core, an AD621BN instrumentation amplifier, with a 100 gain and a CMRR of 110 dB. This IC series warranties a low gain error and low noise values. The cable’s length makes the transmission of the signal over 25 meters to became critical, once the signal must be “transported” to the main amplifier, where it will be conditioned and amplified 11 times, in an overall amplification of 1100 in all system. These two amplifiers stages allow us to achieve quality signals and a proper electrical security (Carvalho et al, 1999), keeping simple the use and maintenance, with great return and protection of investment. The cable electrical parameters reduced the transmission signal problems due to its low impedance. To isolate the active electrode from the water, a special glue was used, that involved all the electronics. The terminal water isolation in the skin was made with special adhesive and some tape. The signals will be acquired by an A/D Biopac module and processed by the ACQ 3.2.5 software. This connectivity to the Biopac allows full dialog with force plates and cameras, either in the perspective of the signal collection as of synchronization.

RESULTS
The EMG survived to the underwater tests and the water invasion of the adhesives only added some no significant noise. The signal treatment involved the following steps: (i) mean signal removal; (ii) band-pass filtering; (iii) rectification; (iv) linear envelope and (v) iEMG calculations.

CONCLUSION
The critical cable distance from the amplifier to the pre-amplifier did not affect the signal quality. The electrode isolation proved to be a good solution to work underwater.

REFERENCES
A KINEMATICAL, IMAGIOLOGICAL, AND ACOUSTICAL BIOFEEDBACK SYSTEM FOR THE TECHNICAL TRAINING IN BREASTSTROKE SWIMMING.

Lima AB1,2, Semblano P1, Fernandes D1, Gonçalves P1, Morouço P1, Sousa F1, Fernandes R1, Barbosa T1, Correia MV1, Tani G1, Vilas-Boas JP1

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INTRODUCTION
A system for real time velocimetric feedback, and for immediate disposal of kinematical data, and model, synchronized with dual-media video images, will be presented.

DESCRIPTION
The system is composed by three different unities: (i) a dual-media image setup (Vilas-Boas et al., 1997), upgraded for images in follow up; (ii) a cable speedometer (Lima et al., 2006), and (iii) a FM transmitter/receiver system, adapted for swimming use, and able to deliver real time velocimetric information to the swimmer and coach. The dual-media follow up images setup uses a special chariot to move, along the lateral wall of the pool, a set of two video cameras: one underwater camera (Submergible AC230V), and one over-water (JVC GR-SX1, SVHS). The images of both cameras are mixed (Panasonic Digital AV Mixer WJ-AVES5), edited (Sony Color Triniton TV SX1, SVHS). The images of both cameras are mixed (Panasonic Digital AV Mixer WJ-AVES5), edited (Sony Color Triniton TV SX1, SVHS). Differences in refraction are corrected using the zoom optics of the over-water camera, and a calibration device. The dual-media images are mixed with the display of a PC with kinematical information provided by the speedometer. This is a device for measuring the rotational velocity of a cylinder over which a fine nylon cable is passing through. This cable is fixed to the swimmer at hip’s level. The movement of the cylinder is monitored by a rotating incremental coder connected to a microcontroller (PIC18LF1320, Microchip). A electrical brake motor allow the reduction of the inertia of the all system, keeping the cable straight, and also allows the cable recoil action. The speedometer was also equipped with a audio output, that allow a sound of variable frequency to be sent to the swimmer and coach through AM/FM receivers (Roadstar TRA-2221D) placed below the swimmers cap.

RESULTS
Results are v(t) real time curves, synchronized with images, and with corresponding auricular sounds. The software also allows the immediate modelling of a typical stroke cycle, both bimodal or trimodal, displaying mean velocities in noticeable points, mean phase durations and accelerations.

REFERENCES
INTRODUCTION
A breaststroker does not find spontaneously his optimal style. In the past, each swimmer was evaluated in our Centre from video observation using a checklist of faults and a physical profile. To evaluate at international level, a specific digitizing system for movement analysis was developed. However, this was time demanding and the success depended on the expertise of the researchers themselves. The objective of this project is to develop a fast, so-called kinesiological evaluation system, usable by a trained expert in any pool.

METHODS
The movement and physical analysis data of 62 breaststroke swimmers at international level were available. Four style groups (N±15) were composed, based on the maximum waved and cambered body positions in the cycle, being the most typical to derive different propulsion concepts. In addition to an undulating and flat style, two other consisted of much waving and little cambering and vice versa. Each group and two gender groups were sufficiently large to locate movement variables (angles, amplitudes,...) statistically relevant for velocity variation of the body centre of mass and even for swimming velocity (2, 3).

RESULTS
First, the style group is estimated by overlaying the two average stickfigures of the two most typical body positions of the whole population on the two corresponding video pictures. Beforehand, an estimation of the most appropriate style is made from the physical profile (1). Next, faults are quantified by overlaying nine average stick figures of the selected style group, delimiting phases in the cycle. These contain also specifications of performance relevant angles, amplitudes,... (see figure). Immediately after the evaluation, a report is ready to be given to the coach.

DISCUSSION
For the training of future experts, e.g., in short courses, an interactive multi-media package is available. It contains extensively animations of the swimmers and of the water displaced; written documents only are not satisfactory. The content consists of the stroke mechanics (propulsion concepts, balance,...) and of case studies, including follow-ups.

REFERENCES

PROPELLING EFFICIENCY IN SPRINT FRONT CRAWL SWIMMING.

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INTRODUCTION
In swimming, generation of propulsion will always lead to a loss of mechanical energy, which is used to give fluid a kinetic energy change. Consequently, not all of the total mechanical power (Pe) generated by the swimmer is available to overcome drag. The propulsive efficiency (ep) is defined as ratio of the power to overcome drag (Pe) relative to the total mechanical power. Previously, ep was measured using oxygen uptake measurement techniques that could only be used at slow speeds. In a group of top-level swimmers an average ep value of 63.5% (range 50 - 77%) was found at a swimming speed of 1.29 m•s-1. In the present demonstration a new approach to measure ep at higher speeds is presented and evaluated.

DESCRIPTION
The system to Measure Active Drag (MAD-system) provides fixed push of pads below the water enabling propulsion generation without loss of energy to the water. Therefore, all-out sprints performed on the MAD-system enabled faster swimming than all-out sprints swimming ‘free’. Considering that power to overcome drag relates to swimming speed cubed, and assuming equal power output in two 25 m sprints (free and MAD), the ratio of speed cubed sprinting all-out ‘free’ relative to the speed cubed sprinting all-out on the MAD-system reflects ep.

RESULTS
For the thirteen elite swimmers ep values of on average 75% (range 68 – 84%) for an average speed of 1.64 m•s-1 were found. This compares reasonably well with the previously reported values.

CONCLUSION
The determination of ep based on two sprints free and two sprints on the MAD-system, is fast and can be incorporated in a test to evaluate changes in performance factors with training.