activated at the kick in the simulation. As the examples of the multi agent/object simulation, simple synchronized swimming by three swimmers, monofin swimming, and the shooting motion in water polo were presented respectively. In the simulation of shooting motion, the velocity of the shot ball was 13.5m/s. In future studies, various mechanical problems in swimming and aquatic activities will be analyzed by the present extensions. REFERENCES: 1. Nakashima, M., Satou, K., Miura, Y. (2007). Development of swimming human simulation model considering rigid body dynamics and unsteady fluid force for whole body. J Fluid Sci & Tech, 2(1): 56-67.

P-001

Comparison of Manikin Carry Performance by Lifeguards and Lifesavers When Using Barefoot, Flexible and Fiber Fins

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INTRODUCTION: Fins use is fundamental in aquatic rescue activities, either for sport or saving purposes. There is a large variety of fin models available in the market, and a common concern of lifesavers and lifeguards is to choose the best fin model. The main purpose of this study was to compare these two groups performing a manikin carry effort using barefoot, flexible and fiber fins. METHODS: Twenty subjects (10 licensed lifeguards and 10 lifesavers) performed 3 x 25 m maximal swim trials carrying a manikin, barefoot and with flexible and fibre fins. Each 25 m bout was divided in three parts for a detailed analysis. Instantaneous velocity to time curve (v(t)) was obtained using a cable speedmeter. Slops and Fatigue Index (FI) were assessed over the v(t) curve. RESULTS: Subjects obtained lower v values in the barefoot condition, comparatively with flexible and fiber fins (lifesavers: 0.77±0.08; 1.12±0.1; 1.31±0.11, respectively and lifeguards: 0.67±0.06; 1.03±0.10; 1.09±0.12). Lifesavers performed faster in any of the three effort segments of the 25 m effort when using fiber fins. There were no differences in the total carrying time of lifesavers and lifeguards in any of the conditions studied. The use of fiber fins by the lifesavers allowed the rise of the v and increase fatigue delay during the first half part of the test. The v decline and the FI were similar for both groups. DISCUSSION: The higher v obtained with the use of fins could be explained by the higher propulsive area of these materials. The higher observed v attained by lifesavers during the 25 m effort when using fiber fins could be due to their common use in training and competition. The absence of differences in v by lifeguards using four different fin models was already pointed out by Abraldes et al. (2007). It is possible that the eventually lower training level of lifeguards compared to lifesavers did not allow for a specialized use of any of the tested fin models. The absence of differences in fatigue indicators among the carrying effort could be a consequence of the short total effort duration. In syntheses, fiber fins seams to allow for a higher v of lifesavers when compared with flexible fins. The effect of the use of flexible or fiber fins is not evident in fatigue for both lifesavers and lifeguards. REFERENCES: 1. Abraldes, JA, Soares, S, Lima, AB, Fernandes, R, Vilas-Boas, JP. (2007). The Effect of Fin Use on the Speed of Lifesaving Rescues. Int J Aquat Res & Ed 1(4): 329-340.

P-002

Swimming Forces: A Review

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INTRODUCTION: Several studies have investigated the drag force (Zamparo et al, 1996; Sheenan & Laughrin, 1992) in various forms, while others researched the lift force as another variable of producing propulsion in swimming. Aim: To review research based on the forces in swimming in an attempt to better understand the desirability of generating maximum forward lift force and minimum forward drag force on the body seg-ments as the most efficient combination to be used for propelling the body. METHOD: A review of literature was employed for identifying the role of the 'forces' in swimming. The terms "forces" and "swimming" were used as key words. More than 72 journal articles provided by electronic libraries (e.g., Sport Discus) and textbooks were available in the literature libraries. The selection process of references was based on the following criteria: articles referring to the influence of forces in swimming, review articles and other publi-cations, focusing on literature having origin from countries where swimming is well researched (e.g. USA, Australia). DISCUSSION: The internal and external forces acting on a human body and the effects produced by these forces (Hay, 1978), that were examined are described in figure 1. CONCLUSIONS: Significant correlations exist between selected anthropometric variables and drag of the ac-tively propelling swimmer. Future examination of the active drag needs to appreciate the individual biomechanical technique and the size of the examined sample. Body position changes influence resistance. Re-search needs to report to whom those results refer to (e.g. elite, non swimmers, etc), the estimated errors in their hydrodynamic data and the procedures used to reduce them. Computational Fluid Dynamics, can work as database of drag and lift coefficients for use in unsteady flow conditions for the evaluation and the im-provement of the technique. Swimming propulsion is the result of subtle and changing combinations of lifts and drag forces.

P-003

Kinematical Characterisation of a Basic Head-Out Aquatic Exercise during an Incremental Protocol

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INTRODUCTION: The aim of this study was to analyze the relationships between musical cadence and kinematical characteristics of a basic head-out aquatic exercise, when immersed to the breast. METHODS: Six women with at least one year as head-out aquatic instructor were assessed. Subjects performed five bouts of 16 repetitions of the "rocking horse" at the "water tempo". Bouts intensity were 80% (120 b.min-1), 90% (135 b.min-1), 100% (150 b.min-1), 110% (165 b.min-1) and 120% (180 b.min-1) of the cadence reported by Barbosa et al. (2009) to achieve a 4 mmol.l-1 of blood lactate. The protocol was videotaped in sagital plane with a pair of cameras providing a dual projection from both above and underwater. The study comprised the kinematical analysis (f=50Hz) of the full cycles (Ariel Performance Analysis System, Ariel Dynamics Inc., USA). It was evaluated the: (i) cycle period; (ii) 2D linear position ranges (foot, hand and centre of mass); 2D linear velocity ranges (foot, hand and centre of mass). RESULTS: There was a decrease of the cycle period throughout the experimental protocol ($R2=0.83$; $P<0.01$). There were any significant relationship between horizontal ($0.01<R2<0.31$) class