How sports biomechanics can foster in-field performance assessment: technical issues and applications in swimming

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Sports biomechanics can fruitfully support a successful coaching outcome by a timely feedback to the athlete to objectively target performance aspects and protect from injuries. The systematic monitoring and motor ability assessment, through the analysis of mechanical variables determining the sport-specific performance, can reinforce the link between research and coaching practice, especially in élite sports.

With reference to the ICF framework promoted by the World Health Organization, motor ability is typically assessed using both capacity and performance tests as carried out in laboratory settings and in-field, respectively. Laboratory tests normally use movement analysis equipment such as stereophotogrammetry and dynamometry. Conversely, what typically happens in in-field applications is the adoption of qualitative assessment in sport environments through direct observation, field test batteries, product measurements.

In the last 20 years, the advent of MEMS technology dramatically changed the state of the art and inertial sensor-based applications are rapidly spreading into both research and professional environments. However, robustness and reliability of sensor measurements are still a matter of debate due to a number of methodological issues that still represent an issue for the straightforward application of this technology in real sport settings.

In this talk, the state of the art about the use of magneto-inertial sensors into in-field sport settings for motor ability assessment will be provided. A specific emphasis will be placed on the need to take into account sensors limitations (static bias, drift, sensors-to-body movements), and on the opportunity to follow good practice rules for a better exploitation of their potential.

From a methodological standpoint, main activities are addressed to the estimation of spatio-temporal parameters, the definition of body segment orientation, and the estimation of kinetic and energy-like quantities. This quantitative approach will integrate with, or eventually substitute for, the evaluation tests currently adopted in in-field settings, joining objectivity with field applicability.

References to the most recent approaches in terms of sensor systems (e.g smart textiles) or advanced processing (e.g machine learning) will be also provided. A specific reference to swimming biomechanics applications will be presented as a paradigmatic case presenting several technical challenges and potential applications.