

Graduation Assignment

Graduating in sports engineering

High-precision positioning for Elite Sport Applications

Elite cyclist Tom Dumoulin (Giant-Alpecin) won this year's first leader jersey of the Giro d'Italia with a difference of 0.01 seconds. In the 100 m men sprint final at the 2004 Summer Olympics in Athens the first four athletes were within 0.04 s of each other. At the Summer Olympics of this year in Rio it took a photo to separate the men's single sculls as the clock used for timing could not distinguish a difference between them.

These examples show that subtle differences as small as one hundredth of a second can already significantly determine race or match outcome. For training elite athletes often make use of motion capture systems to objectively and quantitatively receive feedback and determine technique adjustments. The subtle differences described above set a high requirement for the system's accuracy. If the measurement system is not able to determine the subtle differences the athlete must rely on his or her

subjective intuition (or the intuition of the coach).

High-precision GPS technologies (such as Real-Time Kinematic) offer a promising solution that can achieve the desired accuracy in cycling. The TU Delft Sports Engineering Institute is, in collaboration with Team Giant Alpecin, investigating the feasibility of such a high-precision GPS system to track elite cyclists during a descent and time trial. The aim of the TU Delft Sports Engineering Institute is to develop a turn-key high-precision GPS system that can be used for accurately determining cyclist's positions and has the potential to be used for different types of sports as well (for example running, football, sailing).

However, the sports environment and motion of the athlete still offer some practical challenges that have to be addressed. Possible research questions are:

- Is the sampling frequency of high-precision GPS technologies high enough to capture the fast and dynamic motions of the athlete?
- How sensitive is the high-precision GPS technology to signal-occlusions?
- What accuracy can be expected from these measurements?
- What influence does the environment and system's placement on the athlete's body have on this?
- Can the system be made light enough such that it can be worn by the athlete without any interference on his or her performance?
- What other kinematic variables can be captured with the high precision GPS technology?

Information Daan Bregman (d.j.j.bregman@tudelft.nl), Marco Reijne, Christian Tiberius and Peter de Bakker