Applied Mathematics Seminar

University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

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Joint work with Drew Harrison, Evan Crotty, Jonathan Holmes, Richard Conway, Thomas Barr and Matthiue Milloz

Fast Algorithms for Sprint Start Technologies

Background: A series of experimental studies carried out by the Human Performance Laboratory at the University of Limerick have established that the first response all athletes make when executing a sprint start is to push the ground with their hands. Current protocol for detecting false starts in international athletics is to monitor movement of the feet at the starting blocks.

Objective: Develop and integrate statistical algorithms for a disruptive technology.

Methods: (Experimental) Over a series of experiments, elite sprinters (n>20) repeatedly executed sprint starts and their reaction times were simultaneously determined by (i) an approved IAAF start system; (ii) accelerometers placed on the starting blocks; and (iii) a prototype hand force-plate detection system. An IAAF certified official starter administered the starts. (Statistical) An algorithm based on CUSUM scores was developed to process the accelerometer readings from the blocks in place of the less sensitive threshold method used by the IAAF system. A signed score algorithm was developed to determine reaction times based on hand force plate detector. Method comparison of these determinations of reaction time were made incorporating linked replicates.

Results: In all trials, force on the hand plate system was detected in advance of movement at the blocks. The statistical reliability of these detection systems is discussed.

Conclusion: The new hand plate sensor system represents a major shift in design of sprint start detection technology because it fundamentally changes the way in which a false start is detected. This new system examines changes in the ground reaction force under the hands using a custom built hand plate sensor and signal processing algorithm. Our research has revealed that in all cases, the change in force at the hand ground interface precedes the response in the blocks by between 40 to 100 ms. Consequently, starting-block based systems are not capable of detecting an athlete's first response to the start signal and this is a fundamental drawback in the technology currently in use.

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