Abstract

Lap sector segmentation using discrete fourier transformation and geospatial alignment for inter- and intra-athlete workout file comparison

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Abstract

In this paper we introduce a workflow for automatic lap detection in Global Positioning System (GPS) workout files followed by subdivision in distance-based sectors.

First, Discrete Fourier Transform (DFT) power spectrum analysis is used to detect the number of completed laps in the athletes' workout files. Subsequently, when the number of completed laps is available, a geospatial neighborhood based search procedure detects the lap split points in the workout file. Combination of the number of laps and the consecutive lap boundaries enables sector based geospatial alignment.

This is achieved by a mechanism, aligning the base course with laps of several workouts, based on a combination of cumulative lap distance and geospatial distance between sector start- and end-point. Geospatial alignment allows straightforward sector based performance comparison of the recorded workouts of circular mass-start sports events.

As mentioned, workout laps are mapped on a base course, which is usually a hand-drawn GPS trace, or a GPS file offered by the race organizers. The base course is further subdivided in a number of fixed-length sectors, allowing a more detailed comparison between a set of laps. Course sector start- and endpoints are matched with the closest points in the participants' laps extracted from their uploaded workout files.

As these matching points are timestamped, the elapsed time between both points serves as a completion time of the sector in question. The proposed workflow enables inter- and intra-athlete lap comparison and is providing additional insights such as: an overview of the sectors where the biggest differences were made; the n hardest sectors to complete based on lap time or the engagement score of a sector based on the average and the standard deviation of duration.

Keywords

GPS analysis, Fourier Transform, sector time comparison, geospatial alignment