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BOOK OF ABSTRACTS **Open Access**

Data driven bike fitting

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During bike fitting sessions, the optimal cyclist' position is determined. Finding this optimal cycling position is often a time-consuming and labor-intensive process, i.e., a standard bike fitting procedure takes at least two hours when done by an expert bike fitter. The best position is a combination of comfort, performance and injury prevention (1,2,3,4). To get to this optimal position, a series of adjustments are made to the bike configuration. To date, however, bike fitting suffers from expert subjectivity as there is no consensus among bike fitters on which parameters to focus on. In order to examine this hypothesis about expert subjectivity, a reproducible test methodology is currently under development to perform and evaluate a bike fit by a group of independent experts in Flanders. Results of these tests will be discussed during the presentation.

To solve the expert subjectivity problem, and to improve the overall fitting process, we started a research project to develop a methodology to perform automatic bike fitting based on novel data-driven decision-making processes. The data is provided by the Bioracer Motion mo-cap system, which consists of two arrays of high-speed infrared cameras which capture positional data of the active infrared markers which are placed on the cyclists' body. Up till now, mainly rule-based feature engineering techniques were studied and evaluated on the Bioracer Motion datasets. Biomechanical experts their experience was used as an input to the system and also to verify new findings.

Preliminary experiments focusing on saddle height optimization already show the feasibility of the proposed methodology. Saddle height is a determining factor in knee injuries (5,6,7) and the outputted power (8). However, it is important to mention that saddle height optimization is only a small step in the bigger bike fitting process, as there are many other parameters that should be optimized (9).

In the saddle height experiments our methodology was to compare three different bike configurations (i.e., saddle too high, too low and the 'optimal' position) for different pairs of markers. An example of these spatio-temporal comparisons is shown in Figure 2. This graph shows the relation between the crank angle speed and the right knee Z speed over time. A good feature to track would be the occurrence of the minimum with regard to the crank angle. If the saddle is in a position that is too high, for example, the minimum occurs at a particularly lesser crank angle. Several of these kind of features are evaluated on the Bioracer Motion dataset to determine the rate of true positives and false positives for each of the features. The lesser false positives, the higher the weight of this feature. In the end, a series of eight features (focusing on the left/right foot and knee movement in X/Y direction) are fed into a weighted feature sum, based on which the saddle height correction is suggested. This methodology results in a 100% correct saddle height up to an accuracy of 5mm for a test set of 40 fits.

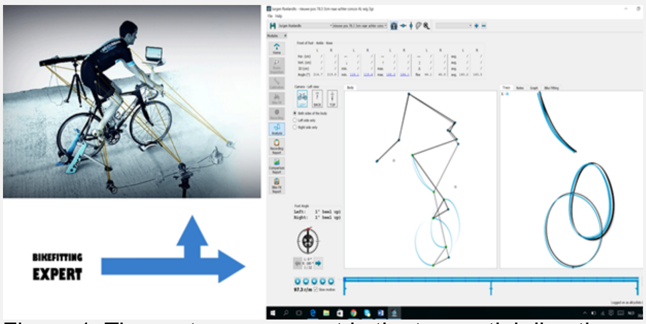

Figure 1: The vector component in the tangential direction can be represented by the sum of two waveform components.

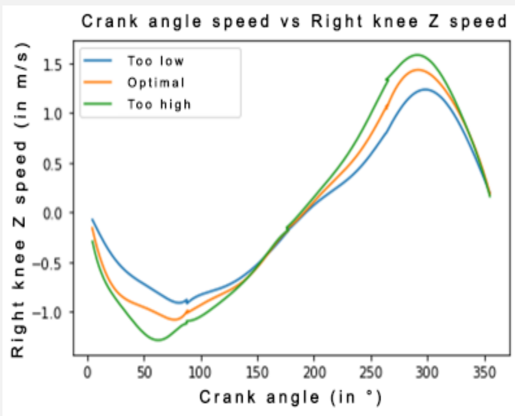

Figure 2: a plot af the Right knee Z speed in regard to the crank angle for three different saddle height configurations

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