Day-to-day fitness assessment in cycling, based on a power/heart rate model

Arno Knobbe[1], Arie-Willem de Leeuw[2], Mathieu Heijboer[3], Tim Verdonck[4], and Steven Latré[2]

Having a frequent, reliable estimate of an athlete's current fitness is an important element in monitoring their health and performance in training and competition. There is a wealth of physical tests available to produce such estimates, but unfortunately they are often cumbersome or even disruptive to the intended training schedule. For that reason, such tests are used sparingly, and a good assessment of one's fitness is only available at fairly low frequency, say once per month. The work I present here is aimed at obtaining a similar fitness assessment on a daily basis, relying entirely on data that is being collected while the athlete is going about their daily routine (on the bike). Central to our approach is a prediction model that aims to model the heart rate response of a cyclist while riding, as a function of primarily the power exerted over the past minutes, but also taking into account environmental factors such as altitude. Based on how the heart responds (in a non-trivial manner) to the required work, we are able to assess a rider's level of recuperation as well as produce proxies for aerobic and anaerobic thresholds, on a day-to-day basis. Thus, our approach allows an athlete and their coach to monitor fluctuations in fitness and how these depend on the training and race load. The power/heart rate model is developed in collaboration with Team Jumbo Visma.
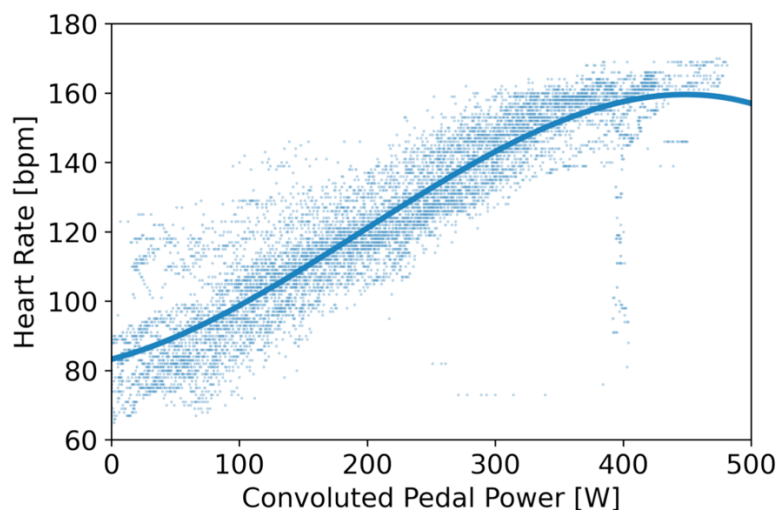

Figure 1: From external to internal load: the S-shaped model that describes how pedal power, convoluted over time with an appropriate rider-specific kernel, determines the heart rate.

[1] LIACS, Leiden University, Leiden, the Netherlands.
[2] Department of Computer Science, University of Antwerp - imec, Antwerp, Belgium.
[3] Team Jumbo-Visma, 's-Hertogenbosch, the Netherlands.
[4] Department of Mathematics, University of Antwerp, Antwerp, Belgium.