The kinetics of a wheelchair sprinter racing the 100m final at the 2016 Paralympic Games

Tiago M. Barbosa[a,b,c], Eduarda Coelho[c,d]

[a]Nanyang Technologic University, Singapore; [b]Polytechnic Institute of Braganca, Portugal; [c]Research Centre in Sports, Health and Human Development, Portugal; [d]University of Tras-os-Montes and Alto Douro, Portugal

Introduction

Background: For support staff and researchers the assessment of the performance in competitions is paramount.

One of the biggest challenges assessing a Paralympian in competitive settings is to monitor his kinetics.

An option is to run analytical models, estimating the sprinter's kinetics.

Aim: To carry-out a case study of a wheelchair sprinter's kinetics racing the 100m final at the 2016 Paralympic Games.

Methods

Subject:

- Male
- T52
- European medallist
- National record holder (100 & 400m events)
- Finalist at WC and PG

Procedures: Split times for every 8.5m were measured by a video analysis system (Kinovea, v.0.8.15) using the marks on the track for the hurdle events.

The race was modelled by a mono-exponential equation:

$$v_H(t) = v_H \cdot (1 - e^{-t/\tau})$$

The modelled speed-time function was then integrated to set 20m splits over the 100m distance (Fig 1).

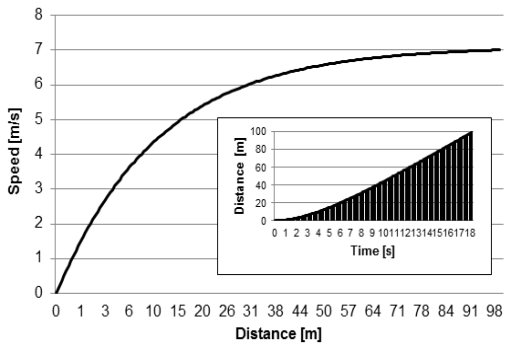

Fig. 1 – The speed-time curve modelled and its integration to set the 20m splits.

Model: The model reported by Fuss [1] was employed to estimate the kinetics.

The model encompasses the estimation of the energy output (E_{output}) and energy input (E_{input}).

The latter term is the sum of the energy of the rolling friction (E_R), energy of the drag (E_D) and E_{output}.

$$E_{output} = \frac{m \cdot v_H^2 + \sum_{i=1}^{3} I_i \cdot \omega_i^2}{2} \qquad E_{input} = E_R + E_D + E_{output}$$

The E_R and E_D were computed by a coast-down technique as reported elsewhere [2].

Results

It was noted a reasonably slow increase of the E_{input} and E_{output} in the first meters (Fig 2).

We failed to verify clearly a steady-state or an impairment of the two terms in the last few meters.

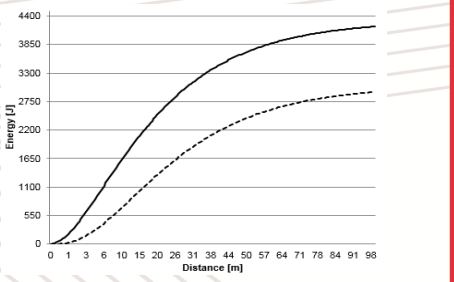

Fig. 2 –The finalist's kinetics at the Paralympic Games 2016. E_{input} (solid line), E_{output} (dash line).

The E_{input} and E_{output} in the first split represented 27.66% and 17.18% of what was delivered in the end of the race (Table 1).

Table 1 - The finalist's kinetics by splits.

Split	E_{input} [J]	E_{output} [J]
0-20m	1149	496
20-40m	3020	1790
40-60m	3685	2412
60-80m	4003	2731
80-100m	4153	2887

Conclusions

Data suggests that the 100m is a very short event and the sprinter was unable to achieve the maximal power.

References

[1] Fuss. Sports Engineering, 2009;12(1): 41-53
[2] Barbosa TM et al. Procedia Engineering, 2016;147: 2-6