

Motion Analysis of the 2009 Men's 100 m World Record

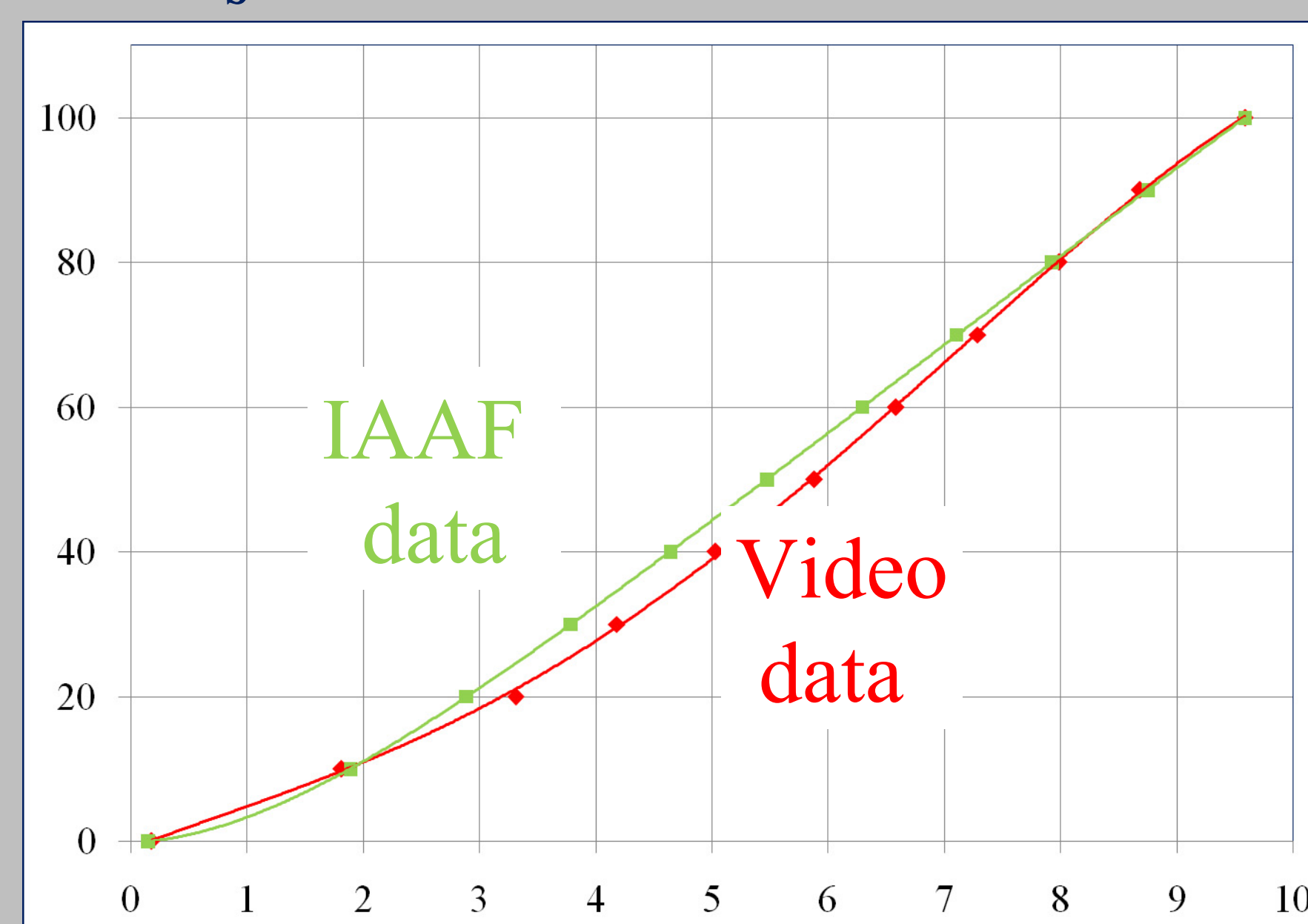
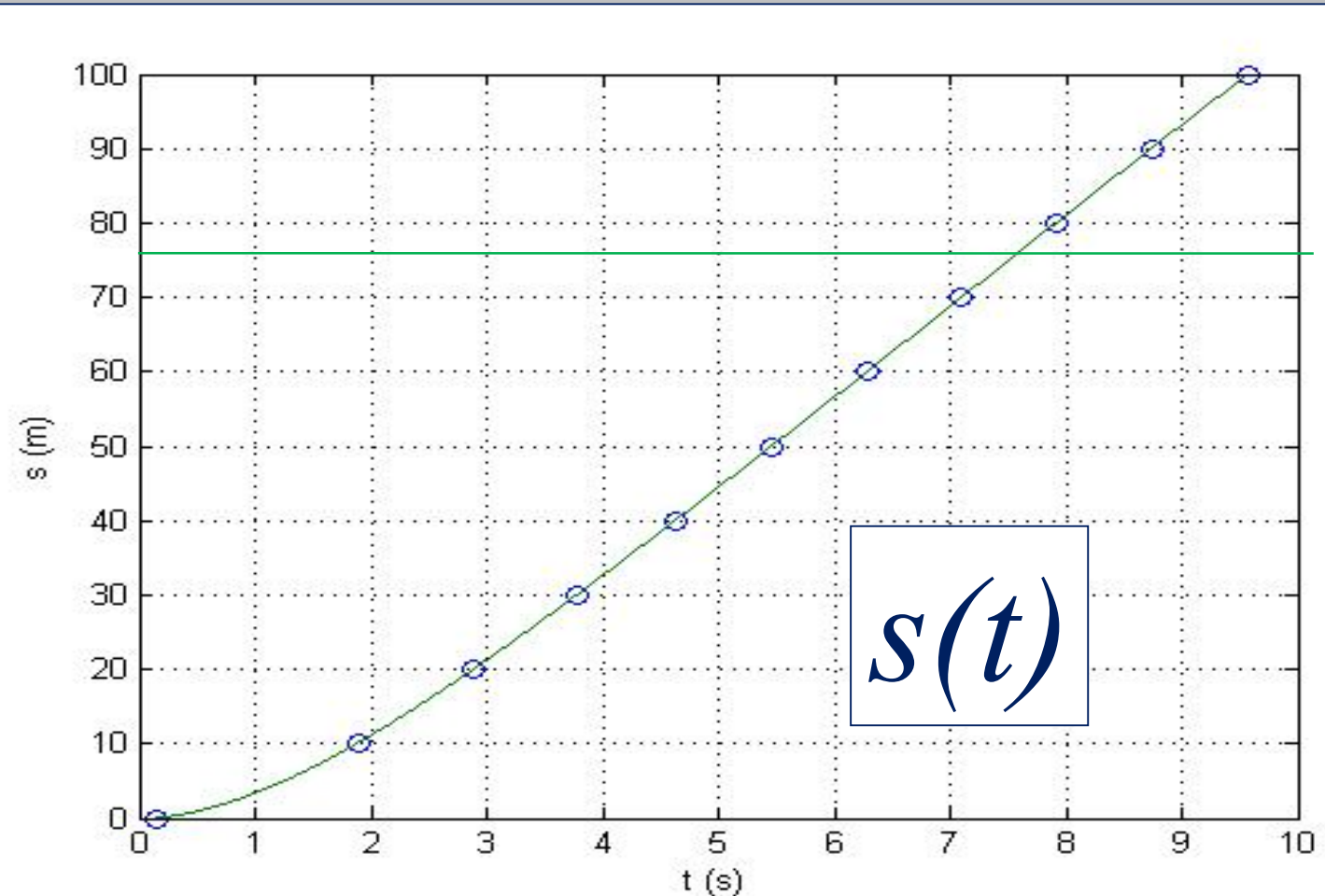
J.J.A.M. Sauren, Hogeschool Zuyd, Heerlen, The Netherlands

B. Lieby and E. Schmidt, SRH Univ. of Applied Sciences, Heidelberg, Germany

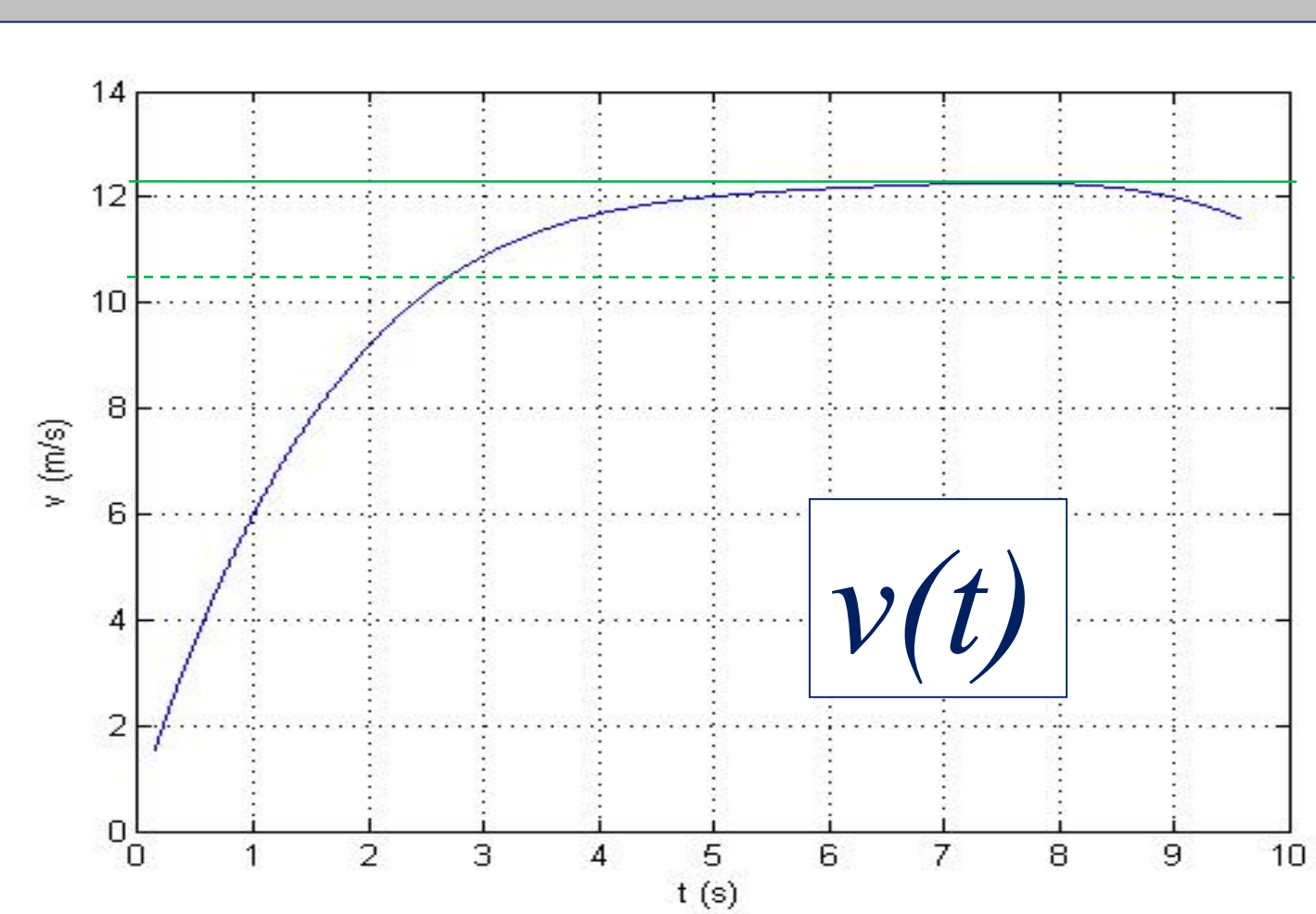
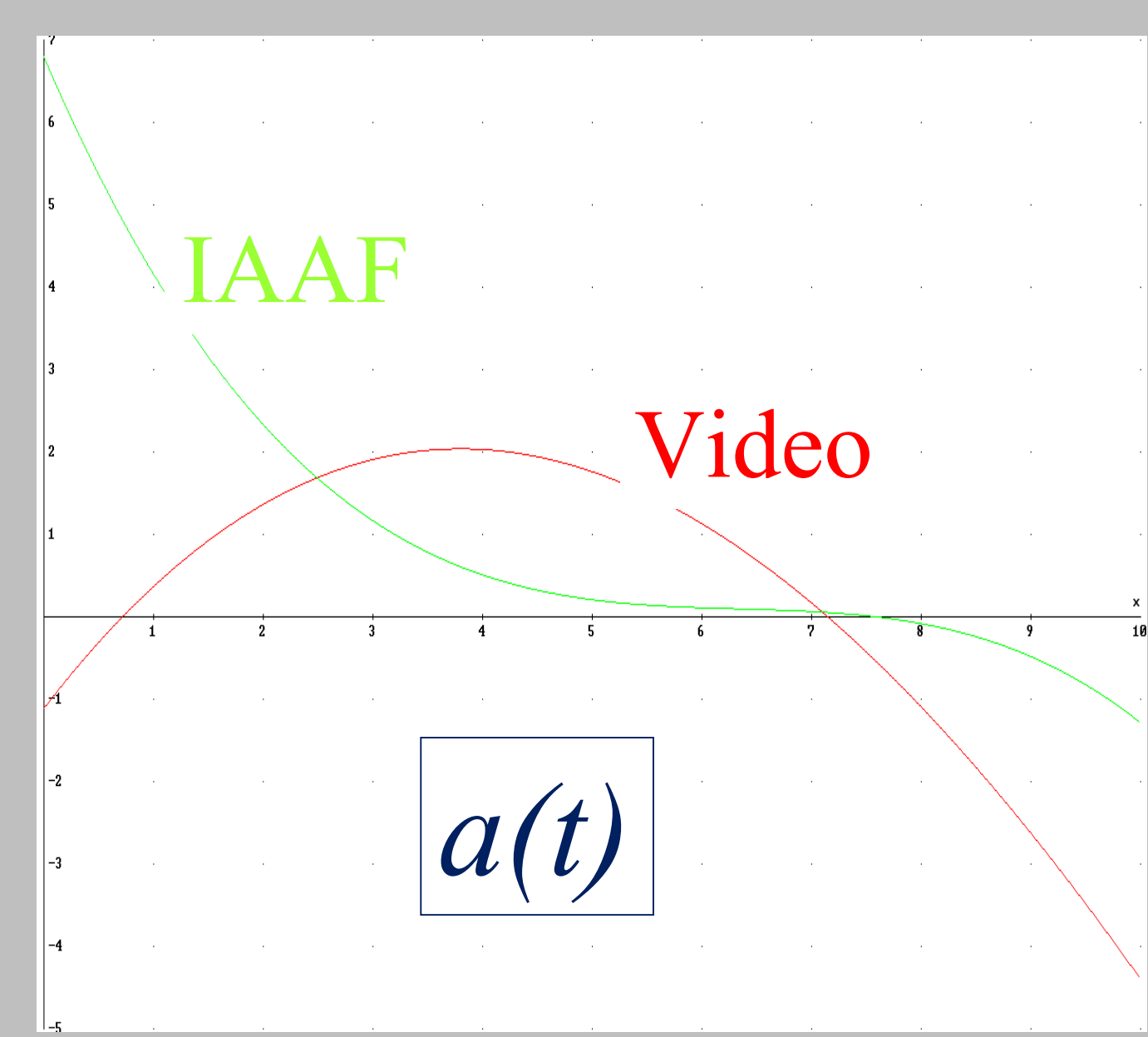


Evaluation of IAAF split timing data

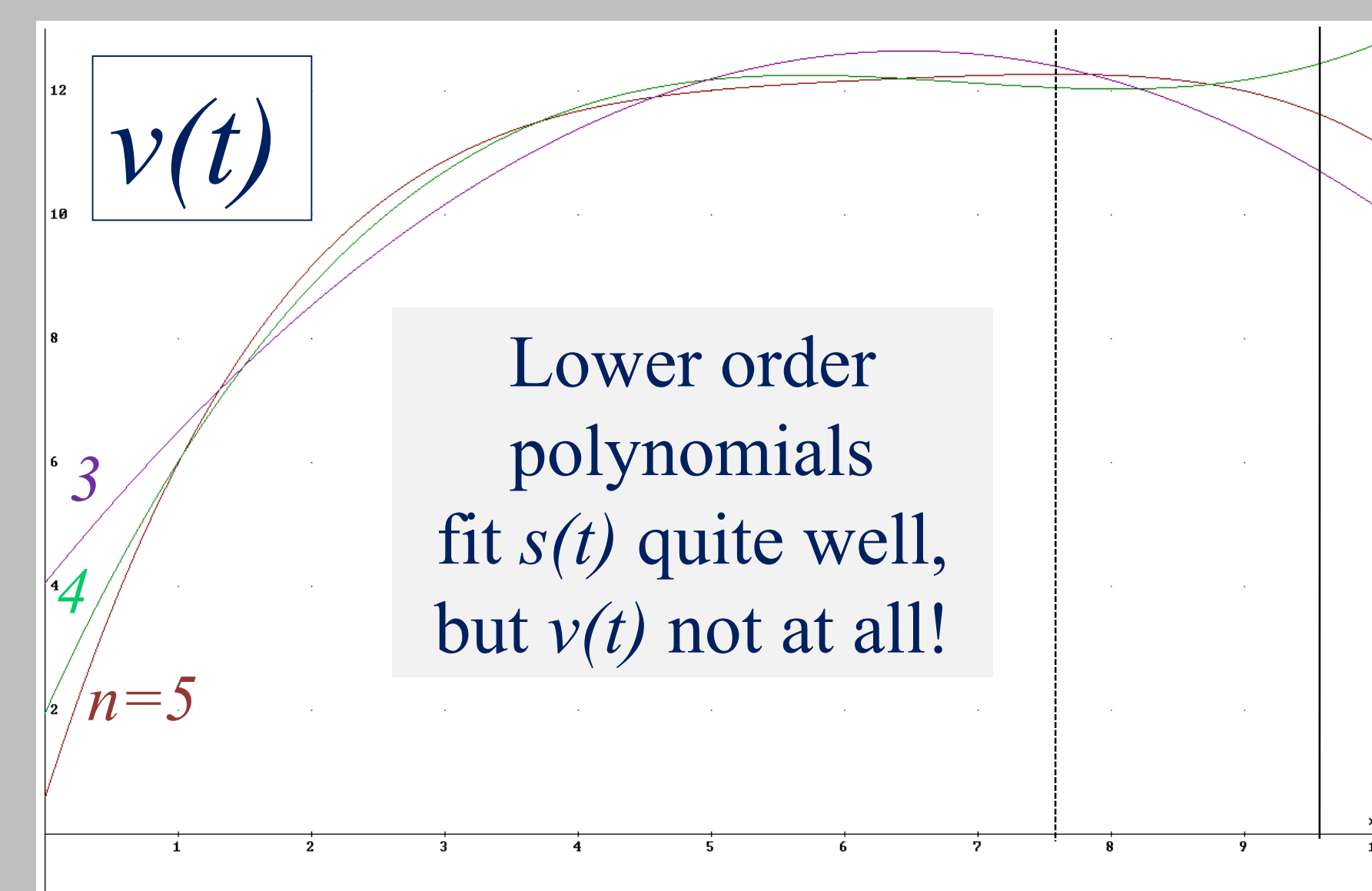
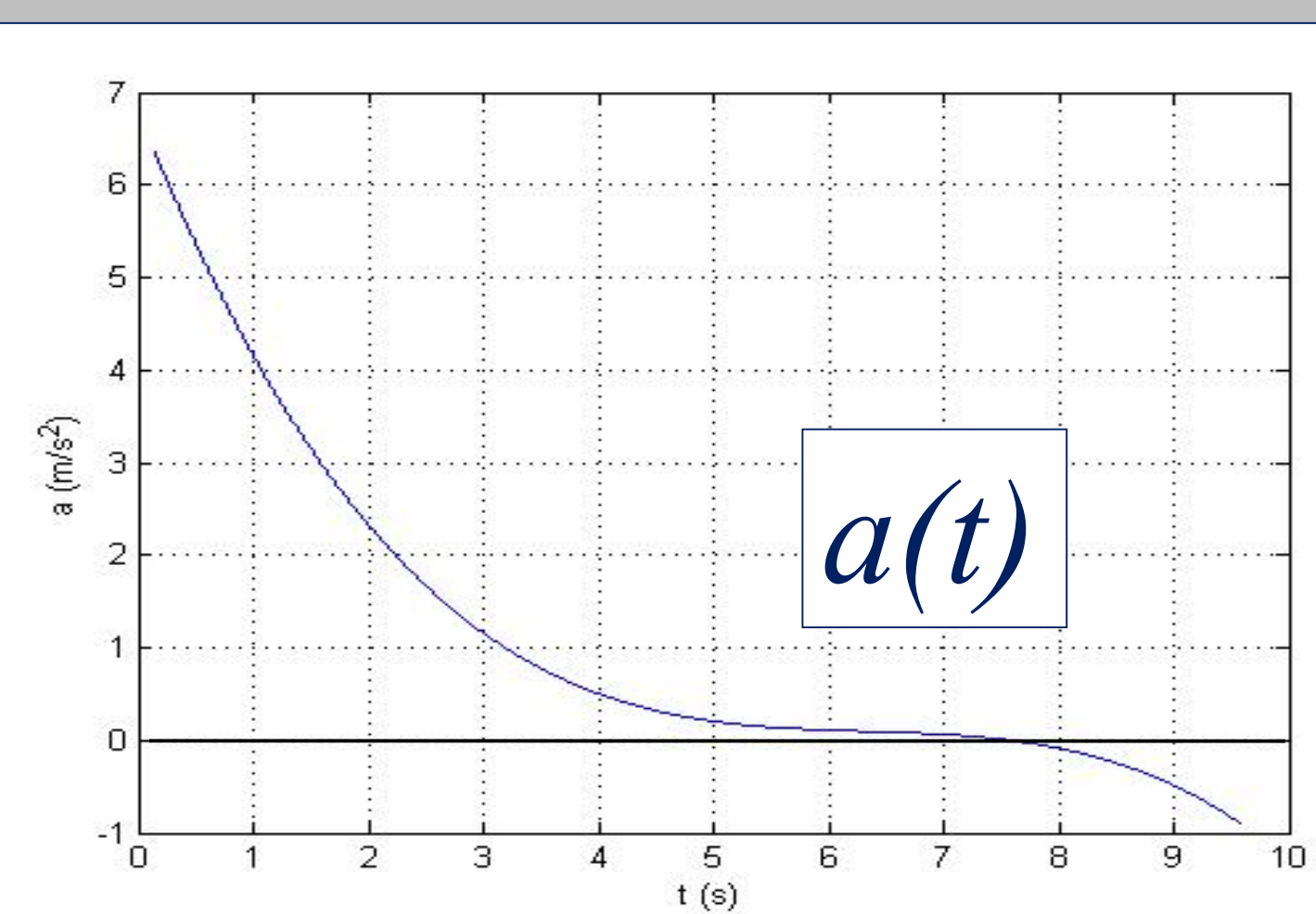
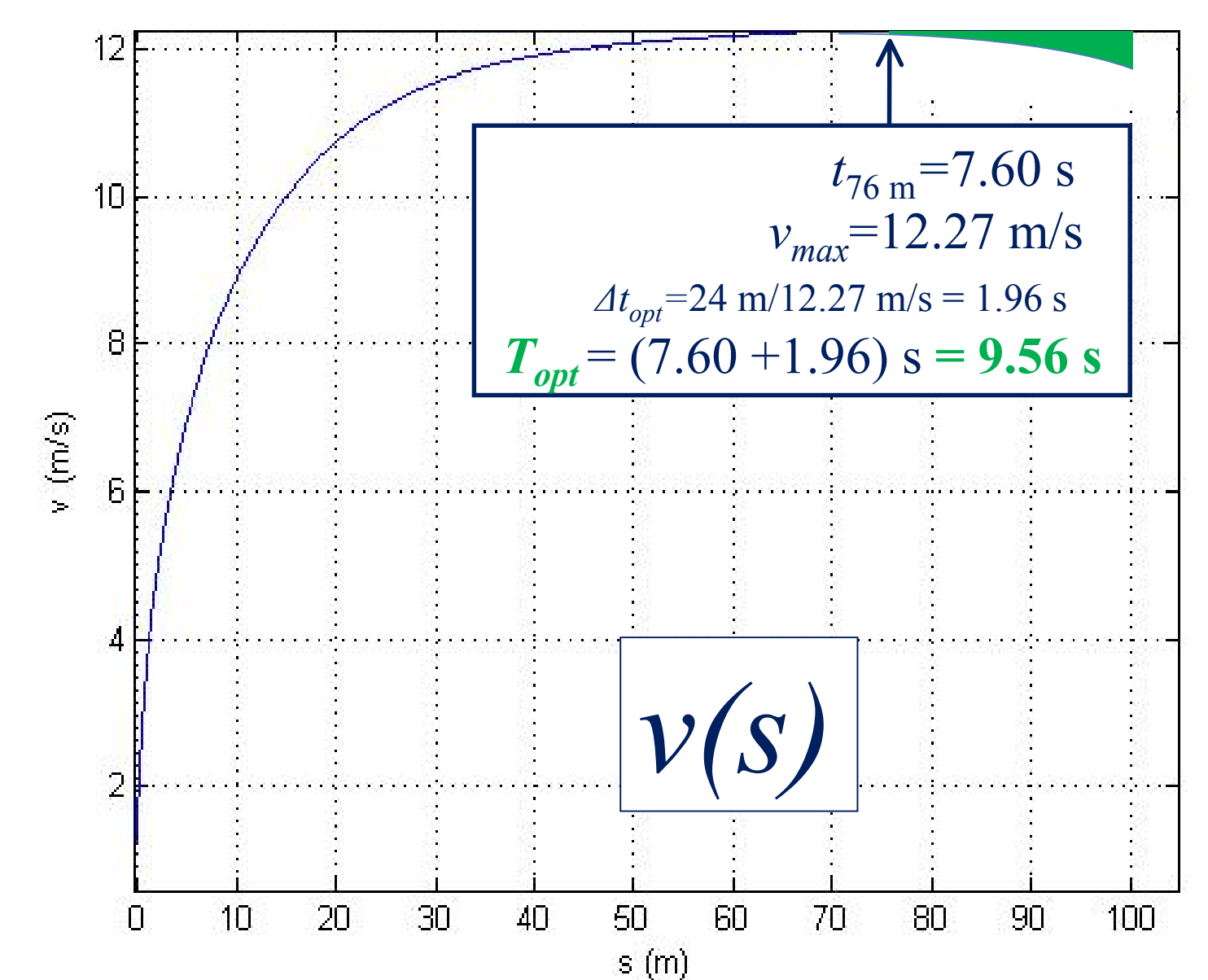
| Position / m | 0 m | 10 m | 20 m | 30 m | 40 m | 50 m | 60 m | 70 m | 80 m | 90 m | 100 m |
|--------------|-------|------|------|------|-------|------|------|------|------|------|-------|
| IAAF / s | 0.146 | 1.89 | 2.88 | 3.78 | 4.64 | 5.47 | 6.29 | 7.10 | 7.92 | 8.75 | 9.58 |
| Video, own / | 0.18? | 1.81 | 3.31 | 4.18 | 5.03? | 5.88 | 6.58 | 7.28 | 7.98 | 8.68 | 9.58 |



Video-based data show a complete lack of fit in $a(t)$, and must be erroneous



If Bolt had not slowed down →



Polynomial coefficients

$$s = a_5 t^5 + a_4 t^4 + a_3 t^3 + a_2 t^2 + a_1 t + a_0$$

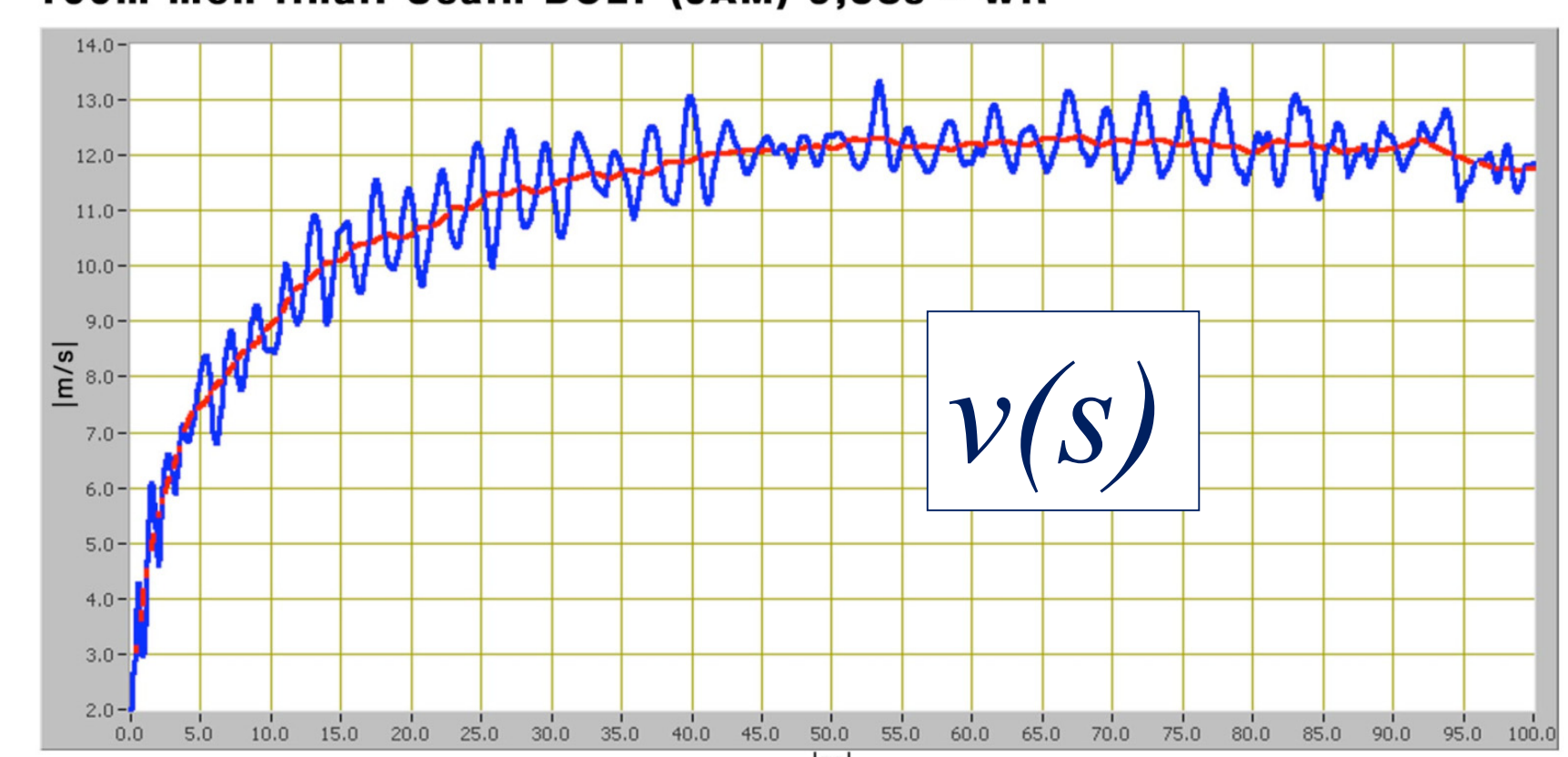
| | |
|-------|------------|
| a_5 | -0.0012685 |
| a_4 | +0.0402025 |
| a_3 | -0.515942 |
| a_2 | +3.39842 |
| a_1 | +0.5841 |
| a_0 | -0.165 |
| r^2 | 0.9999958 |

Independent LAVEG speed measurement¹ for Bolt's race

http://berlin.iaaf.org/mm/document/development/research/05/31/54/20090817073528_httpostedfile_analysis100mnenfinal_bolt_13666.pdf



Biomechanical analysis
12th IAAF World Championships in Athletics • Berlin, 15.–23.08.2009
100m men final: Usain BOLT (JAM) 9,58s – WR



Discussion

- Split timing $s(t)$ -data fitted very well and gave consistent $v(t)$ -, $a(t)$ -curves
- a video-based analysis failed for lack of on-track distance markers
- Bolt's run was near-perfect for him, and confirmed an extrapolation² of his Beijing 2008 world record (9.69 s)
- Powell (the second in that final) started faster by 0.012 s, but was beaten by Bolt's higher top speed
- improvements are expected to be
 - up to 0.05 s by faster start & acceleration
 - less than 0.05 s by maintaining the present-day top speeds to the finish line

¹R. Góralczyk et al., J. Human Kinetics, 10, 107 (2003)

²H.K. Eriksen et al., Am. J. Phys 77, 324 (2009)

Some characteristics

- start acceleration: 6.80 m/s²
- average speed: 10.44 m/s
- top speed: 12.27 m/s at 7.6 s and 76 m
- speed at finish: 11.16 m/s