ME 586: **Biology-inspired robotics**

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Goals:

- advice for how to read a scientific paper
- Example paper presentation and discussion lead paper 0: McLeod & Dienes, “Do fielders know where to catch the ball or only how to get there”

how to read a paper

1. read the abstract: 2-5 min
2. look through the figures: 5-10 min
3. read the introduction: 5-20 min
4. read the conclusion: 10 min
5. read the rest of the paper: 1-10 hrs (depending on difficulty and detail desired)

this is a 3 unit course, so aim to spend about two hours per review

paper 0 presentation & discussion

Do fielders know where to go to catch the ball or only how to get there

Peter McLeod & Zoltan Dienes
Journal of Experimental Psychology, 1996

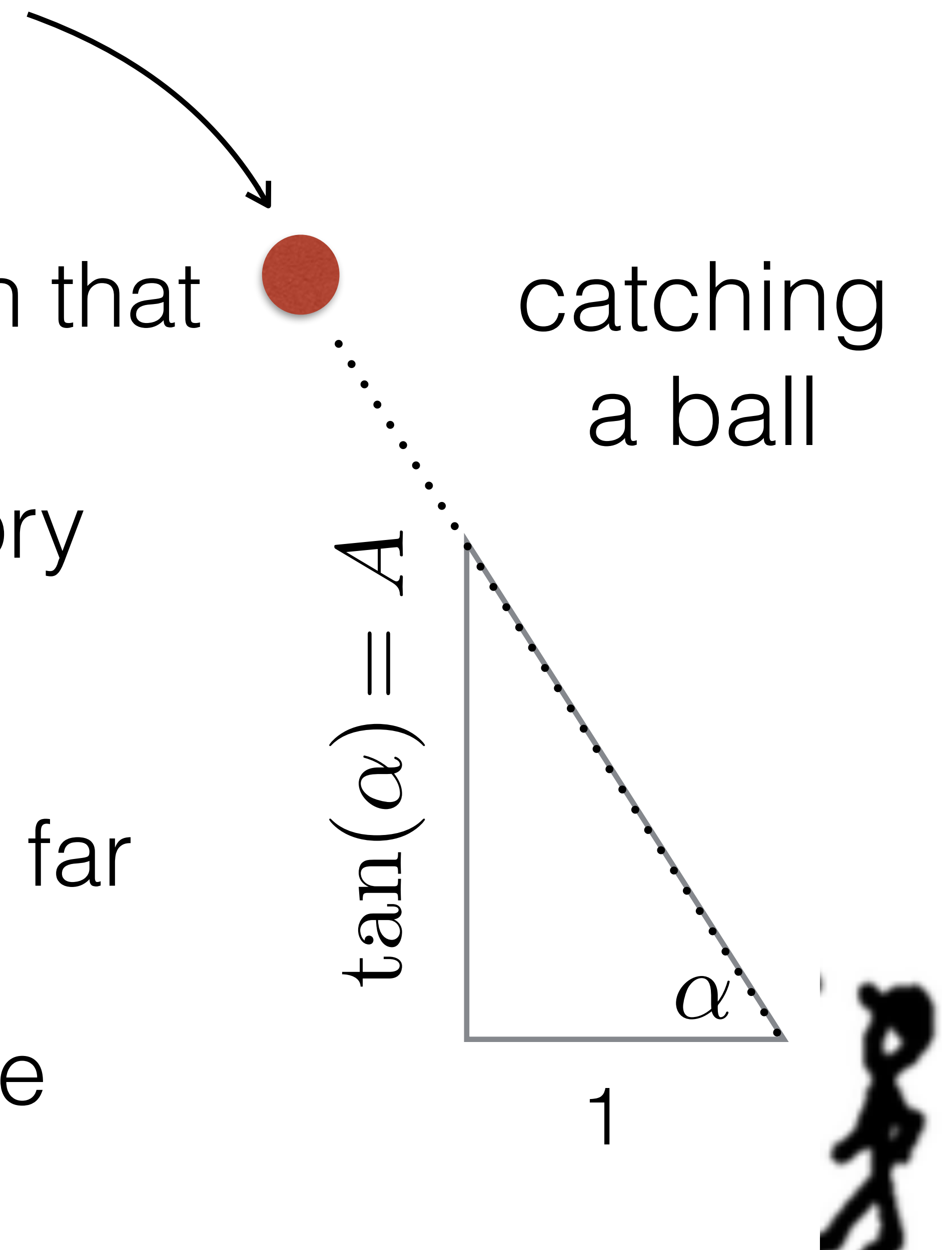
Presented by Sawyer Fuller

does this fielder know
where ball will land?

previous work

define: $A \triangleq \tan\alpha$ "slope" of angle to ball

- Chapman (1968) observed that if a fielder runs at a constant speed such that $\dot{A} = const$. (therefore, $\ddot{A} = 0$) she will intercept a parabolic trajectory
- problems:
  - because of air drag, path of ball is far from parabolic
  - does not specify how to choose the "constant running speed"

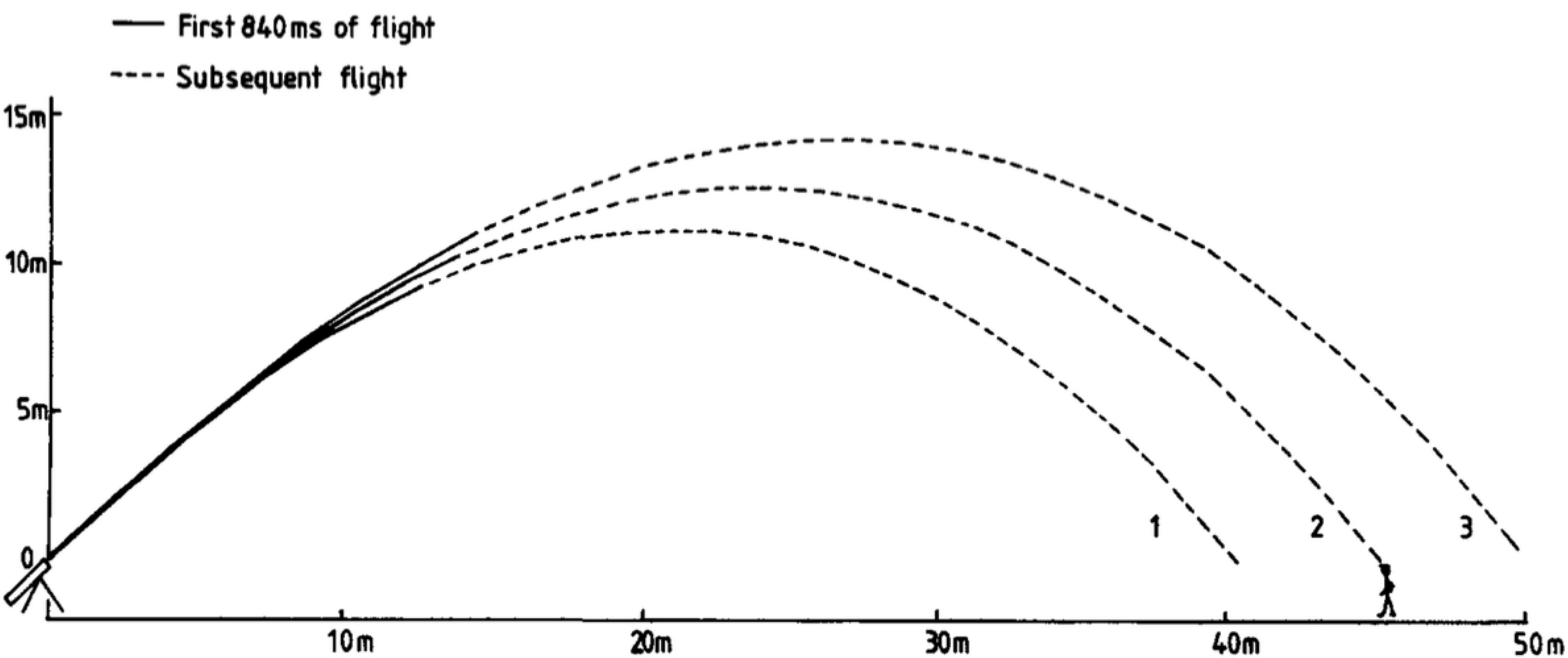


catching a ball

this paper hypothesizes an underlying mechanism

Experimental setup

- fielder catching fly balls
- only measures front-to-back motion, not side-to-side



Experimental setup

- camera tracks fielder

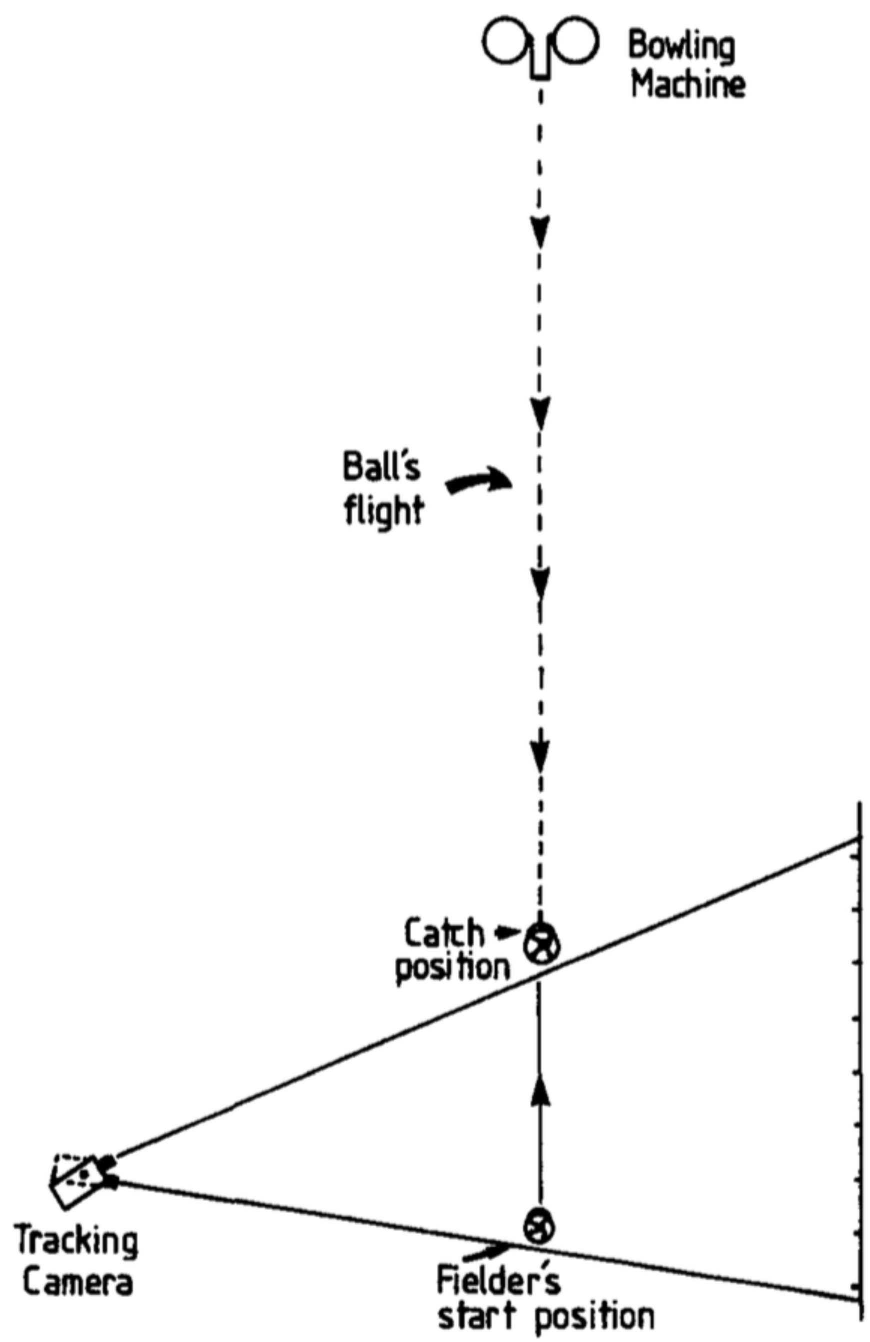
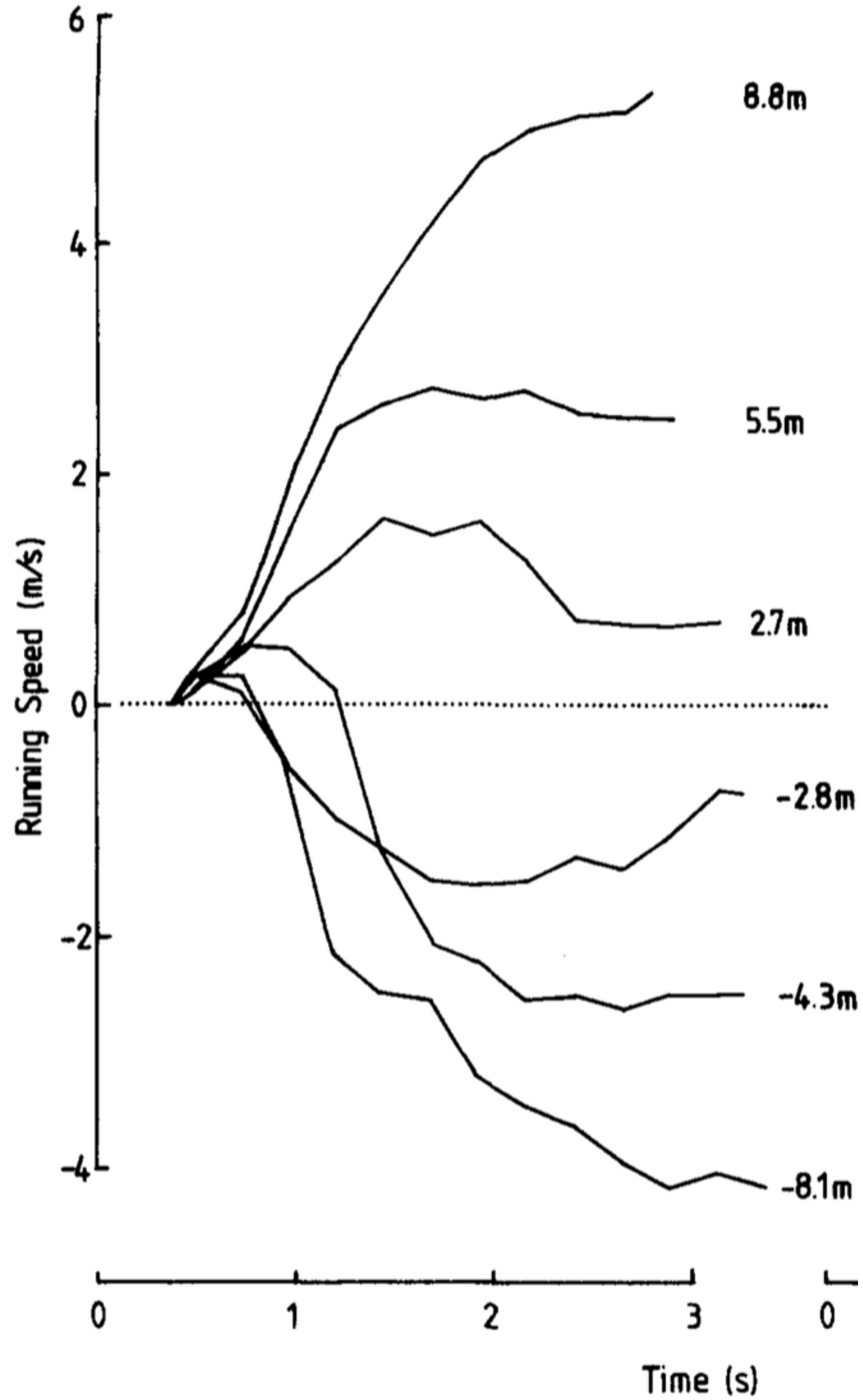


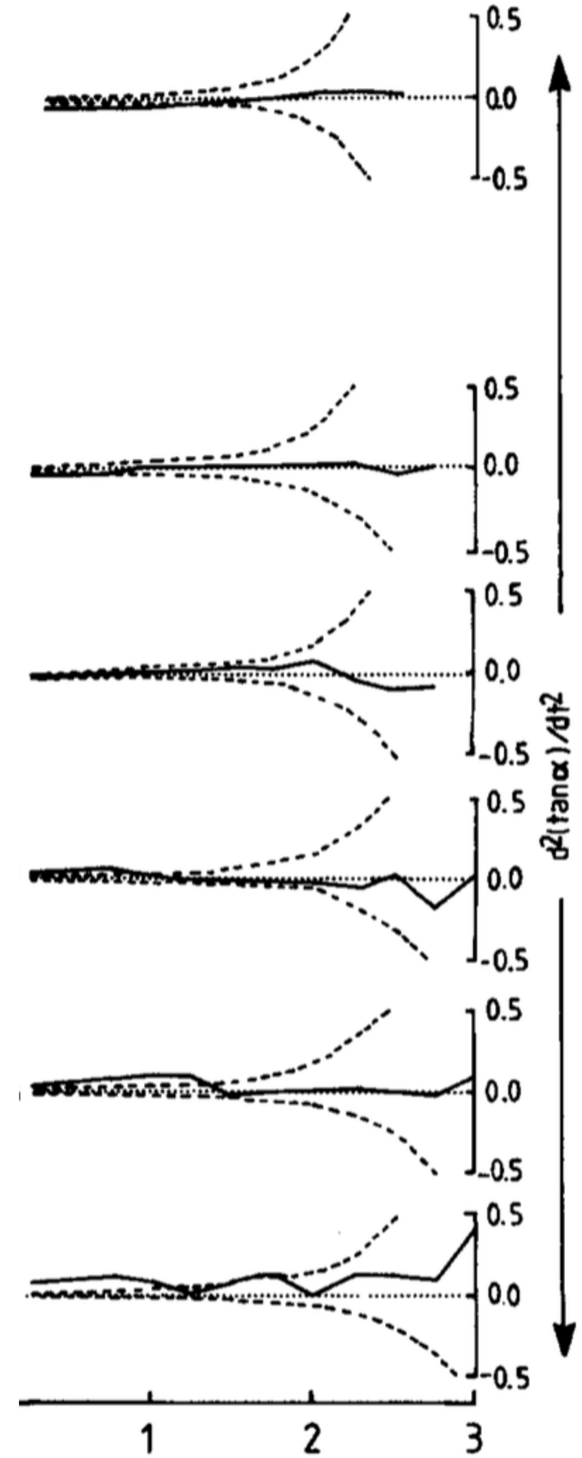
Figure 2. The experimental setup as viewed from above. A

experiment 1: 45deg at different speeds

variable running speed



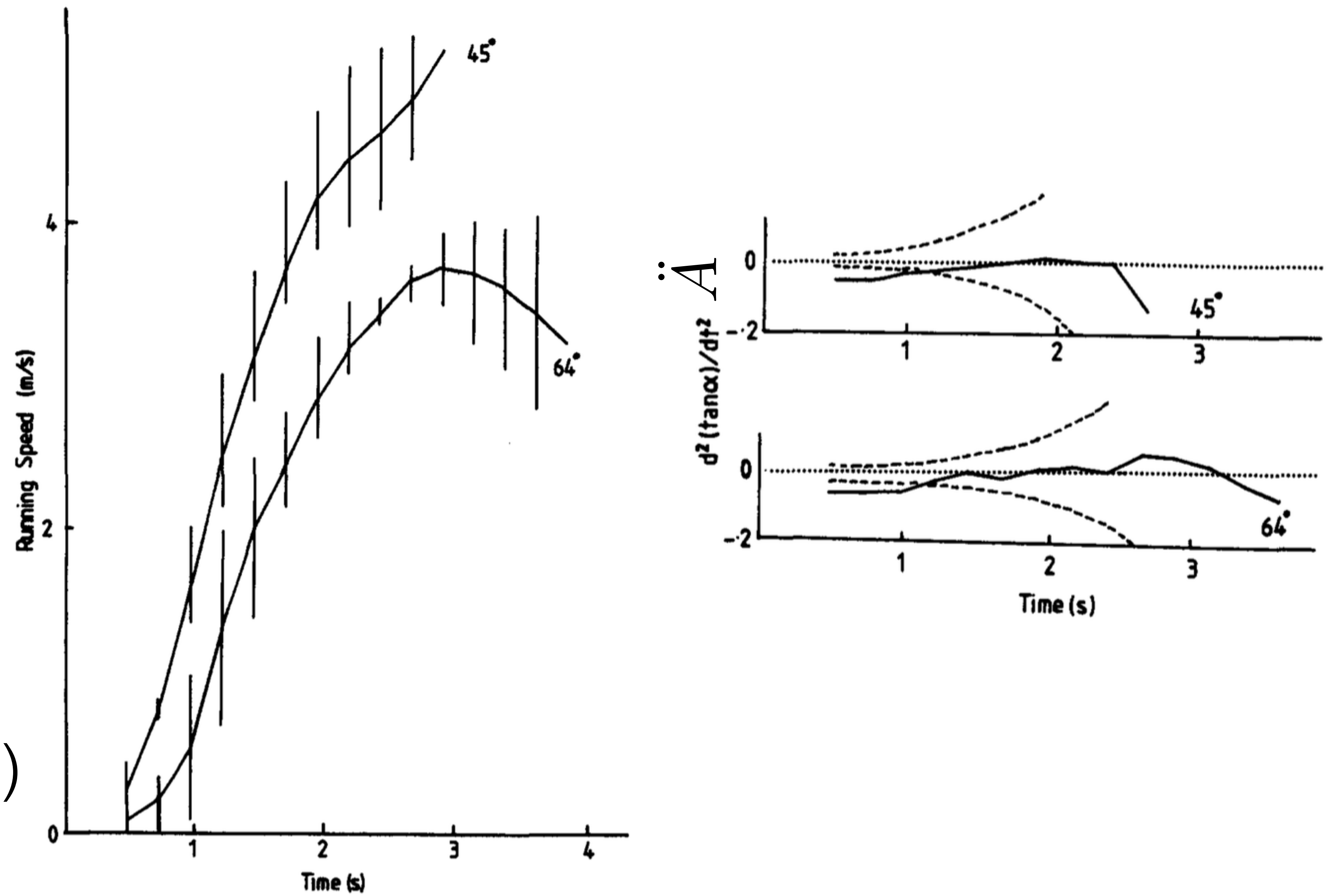
but $\ddot{A} \approx 0$



$\ddot{A}$

experiment 2: change launch angle (45 and 64 deg)

- result is runner runs slower if ball takes longer, rather than running full speed and arriving early



(figure 4)

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missing the ball

- happens if running too slowly so that $\ddot{A}$ never goes to zero

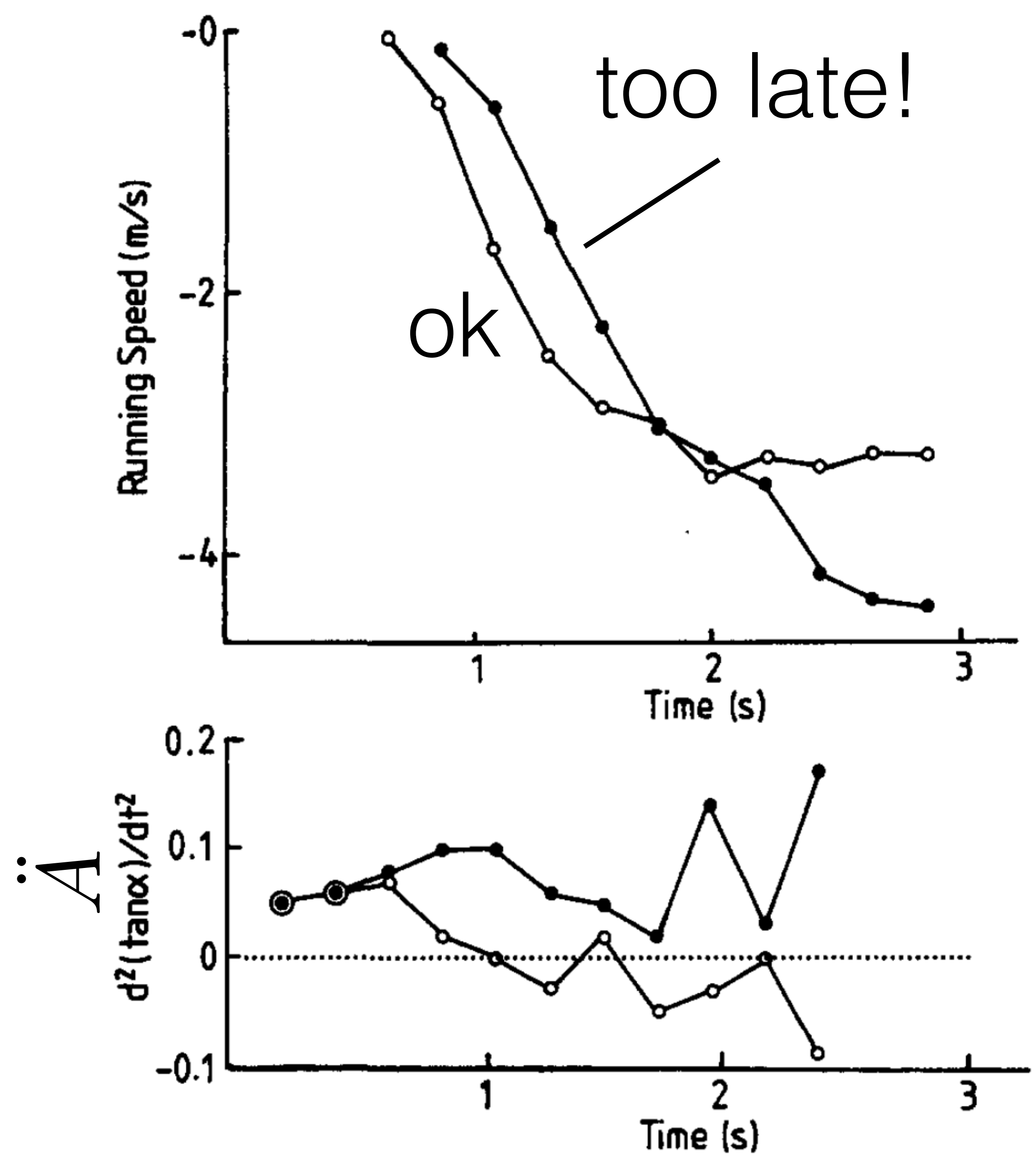

Figure 5. Velocity and $d^2(\tan\alpha)/dt^2$, as in Figure 3, for two

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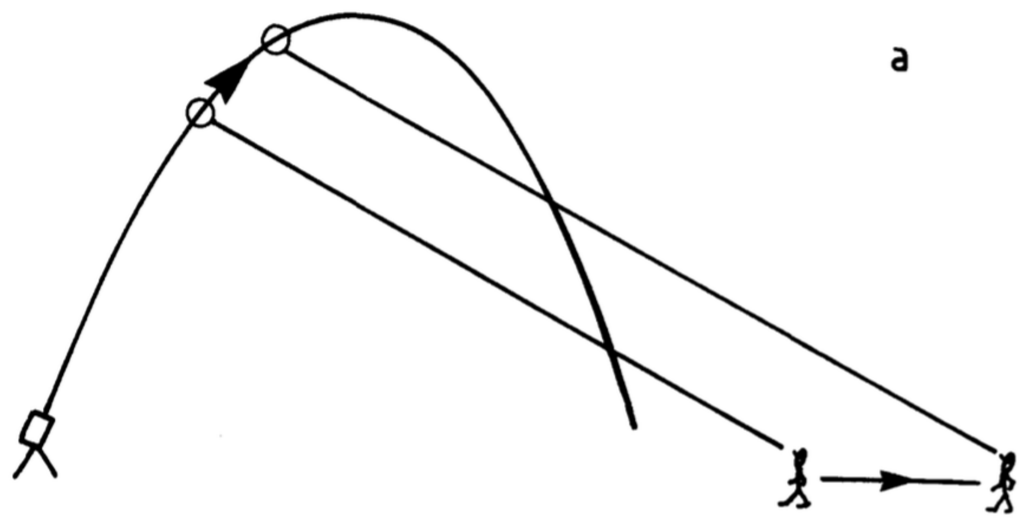
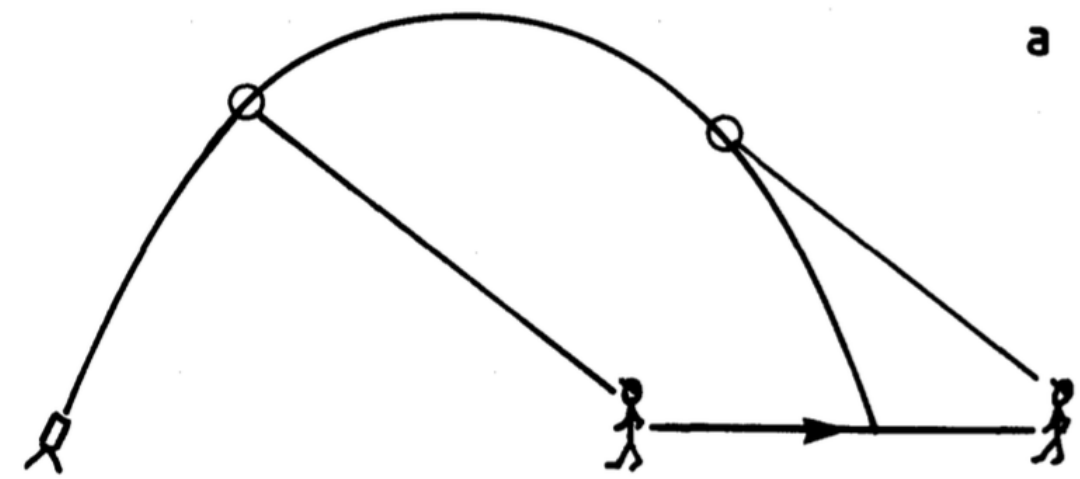
alternative hypotheses

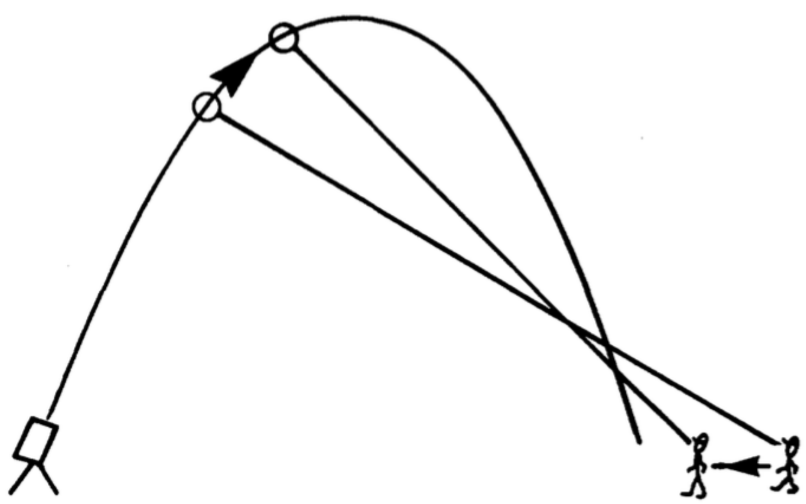
- tan(alpha)/A = constant

predictions:





observations:



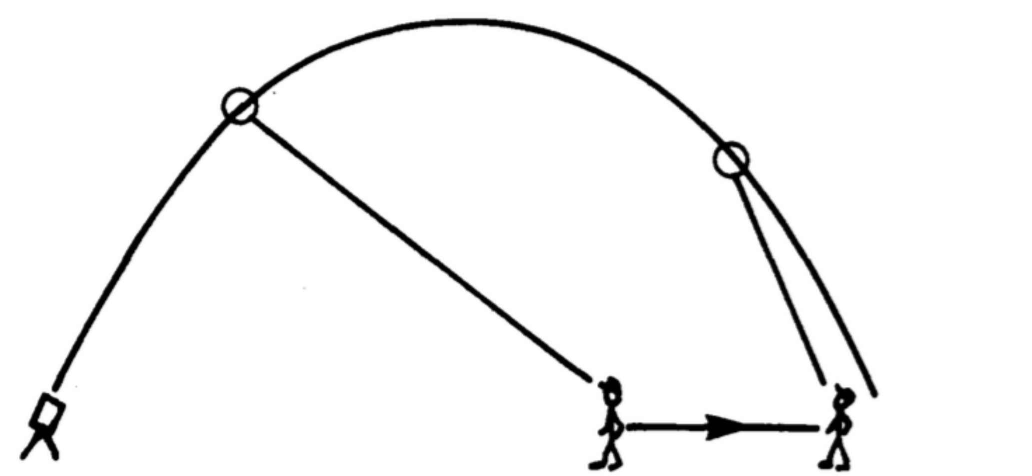


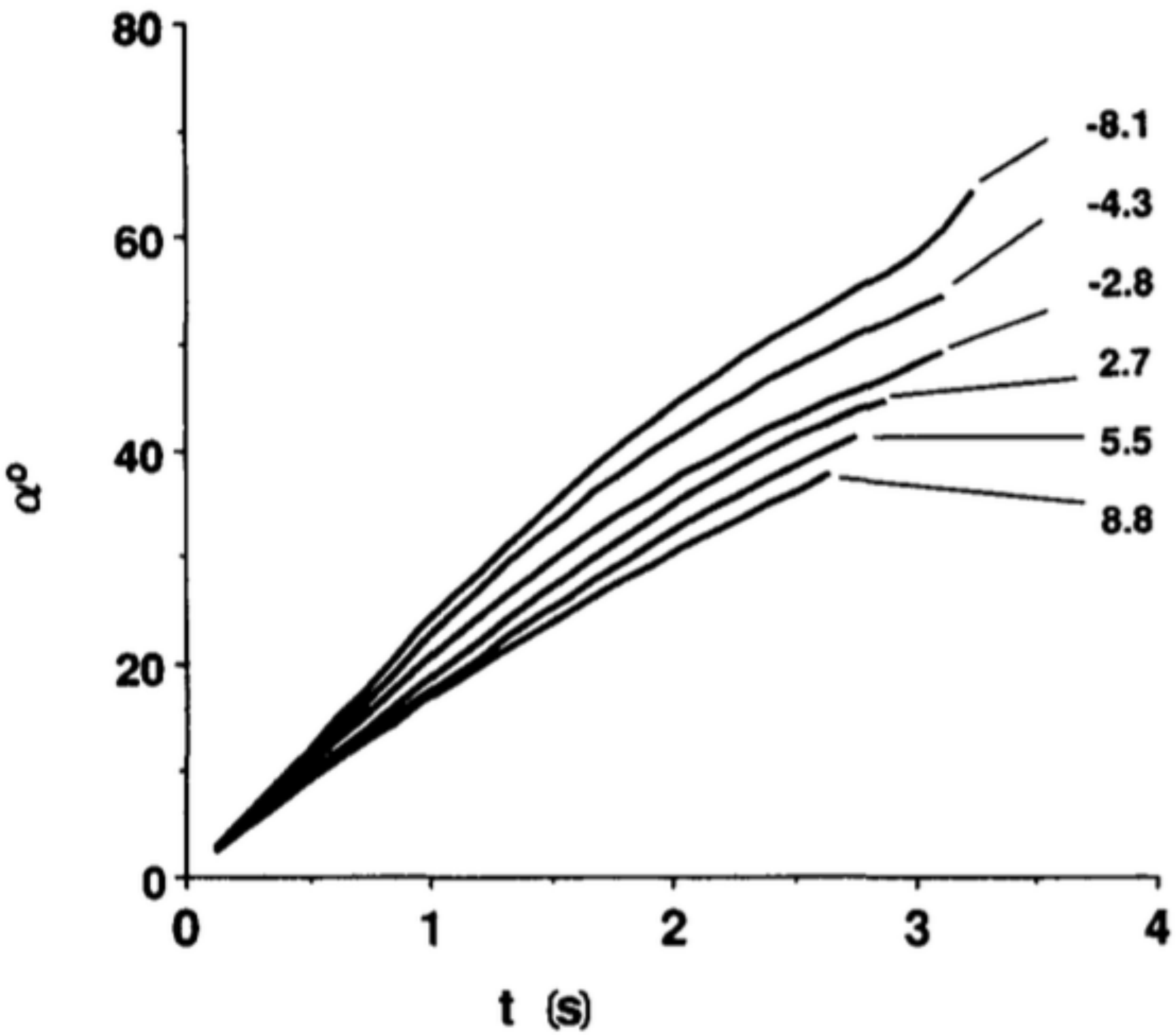
Figure 8. Two strategies for interception when the fielder should run forward. (a) Keeping the

Figure 9. Two strategies for interception when the fielder is running backward. (a) Keeping the

⇒ rejected

alternative hypotheses

$$\ddot{\alpha} = 0$$



rejected because lines not straight

summary

- fielders are not running at constant speed to ball
- consistently, they are running at the moment they intercept it
- they didn’t use spare time to run to where the ball would fall
    - this suggests they don’t know where that will be
- dynamic behavior suggests a simple *feedback law*

conclusion:

runner implements a *feedback* controller ("servo"):

$dv/dt = K\, d^2\tan\alpha/dt^2$

$$\dot{v} = -K\ddot{A}$$

Reminder for when you are presenting a paper

- In addition to presenting, you will also lead the discussion of the paper
- don't write a review
- Instead, make a blank post so you can read other reviews. Then, skim through the reviews and come prepared to bring up their questions and comments

discussion comments

- Is this really general? Can we learn more if we try extremely non-ballistic balls like waffle balls?

- calculating a second derivative is noisy

- "good players often stop and wait for the ball to land"

- great thing to test with a simulation!

- next question: how is this learned?