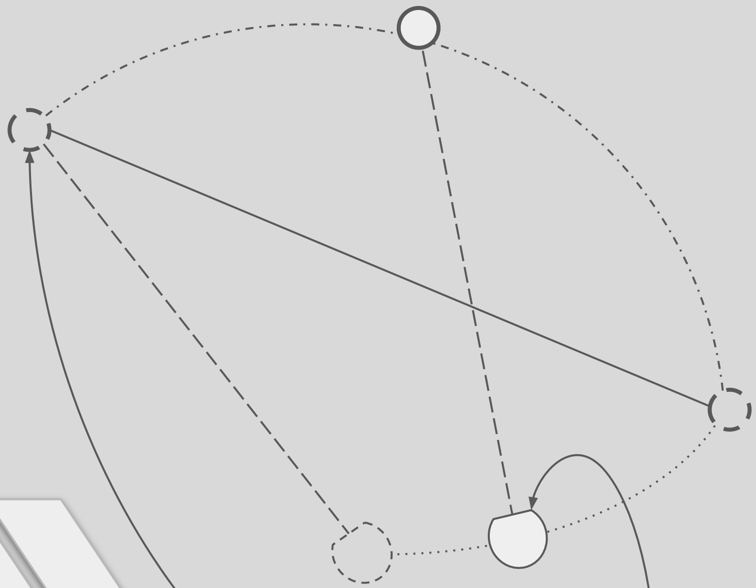
— The Outfielder Problem —

A Virtual Reality testing environment

Structure of this presentation

1. The Outfielder Problem
2. The goal of the project and the VR approach
3. My implementation and some example footage
4. Limitations

The Outfielder Problem — an overview



His job is simple: catch the ball before it hits the ground.

Two parts to this:

- ❑ Approach the landing spot of the ball
- ❑ Coordinate his hand to catch it in his glove

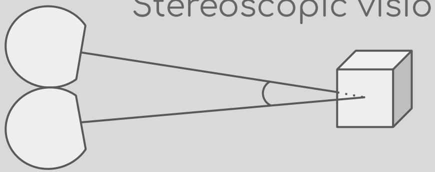
The outfielder is the catcher playing farthest from the batter.

The Outfielder Problem — an overview

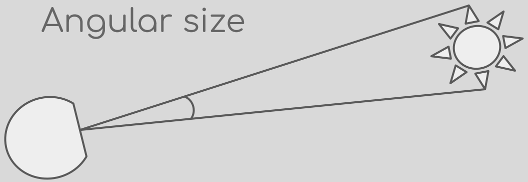
An example of the problem of interception

Usual feedback devices:

Stereoscopic vision

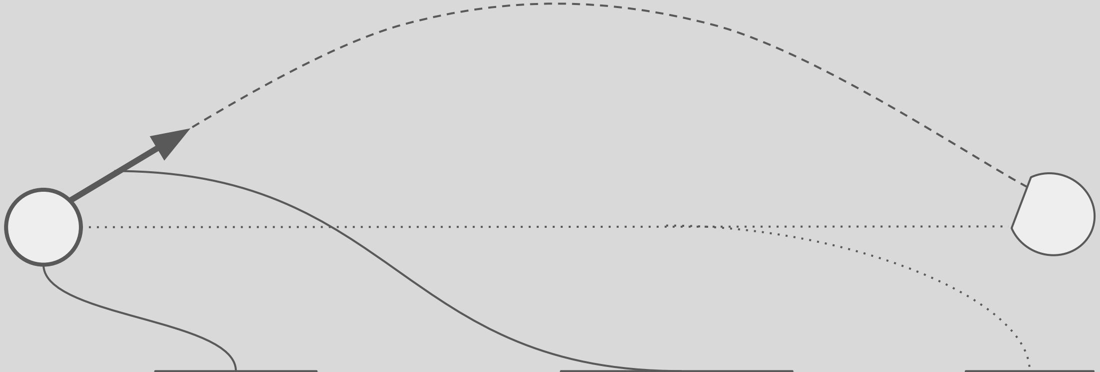


Angular size



Focal distance

All of these fail in the context of the outfielder, simply because of the scale of the task.



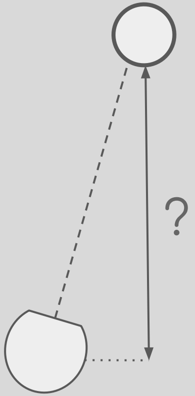
75mm diameter, at **180 km/h,** possibly **120m** away

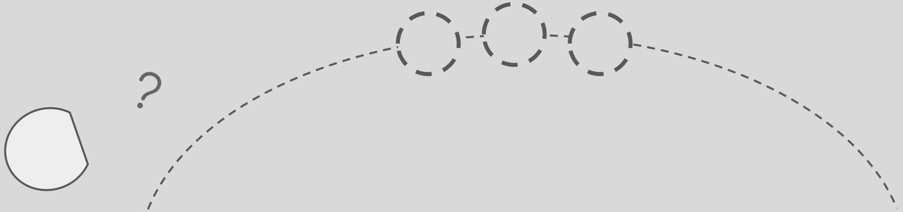
The Outfielder Problem — an overview

This implies:

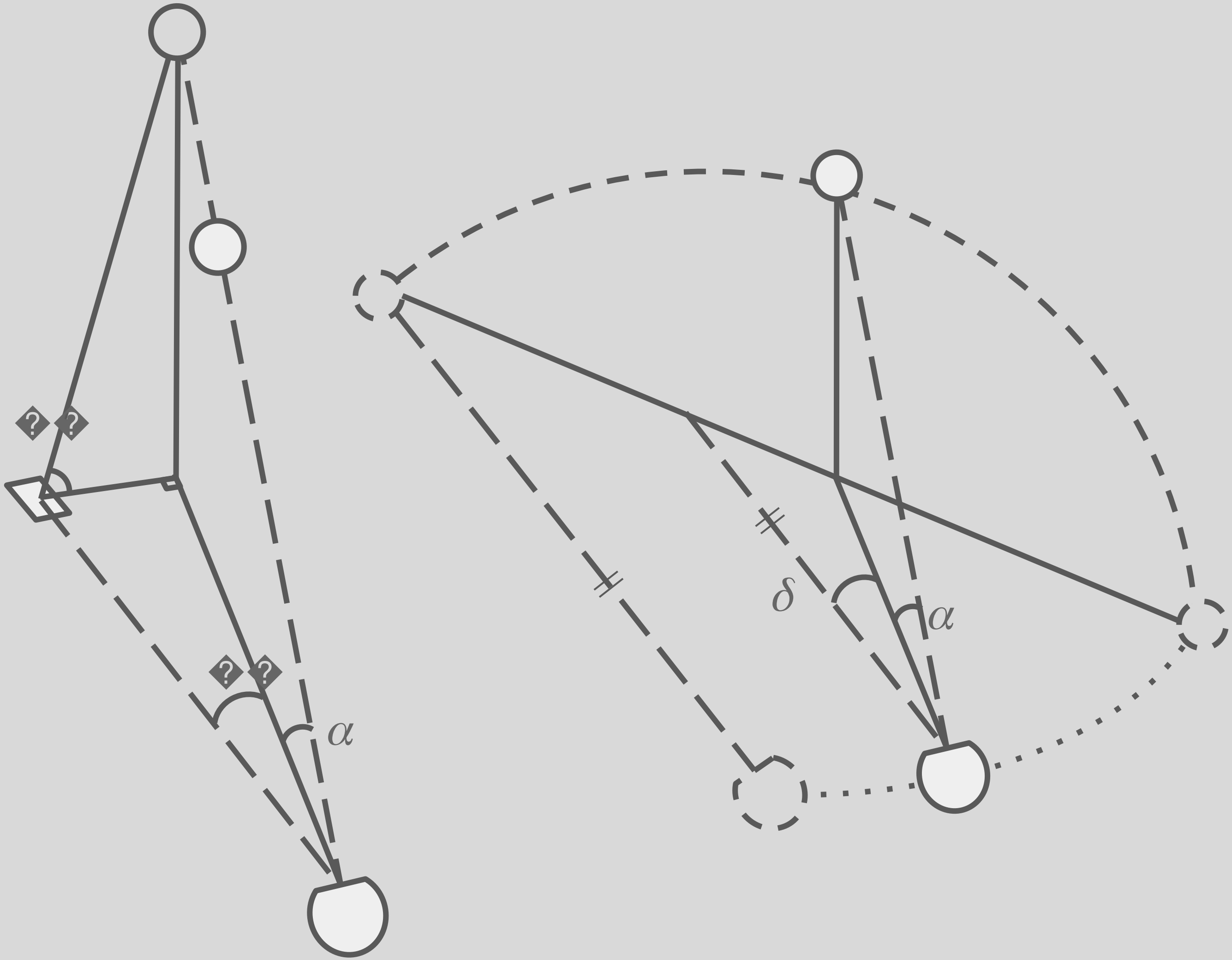
Poor appreciation of velocity

Particularly vertical velocity when the ball is above the catcher





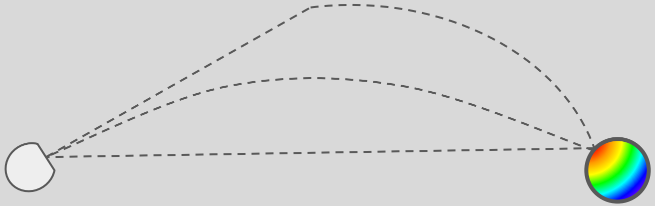
Which also leads to an inability to detect when the ball has reached the apex of the parabola



α
δ
α

Goal of the project

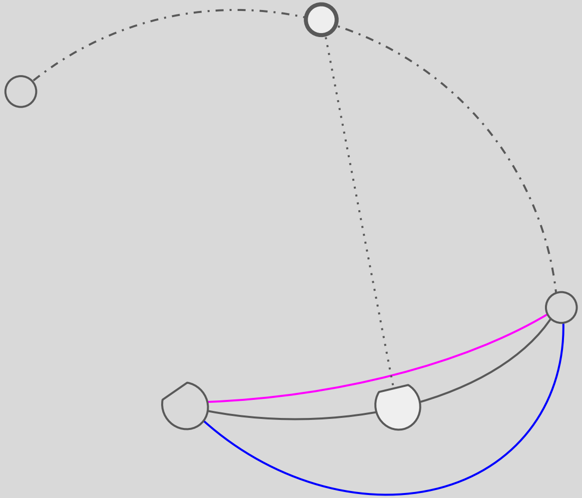
Develop a VR environment that



Can run highly configurable experiments

Collects data about the ball and subject

Implements proposed catching strategies and outputs their predictions in the contexts of the configured experiments



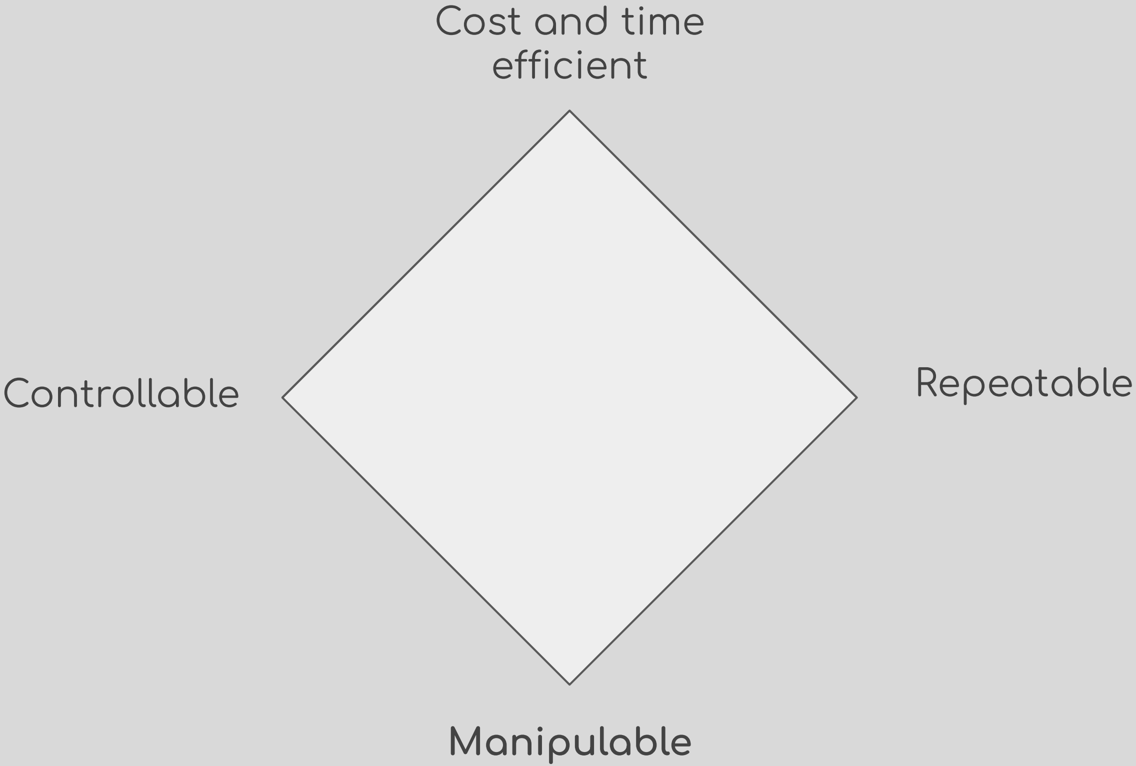
The VR approach - should we?

The elephant in the room:

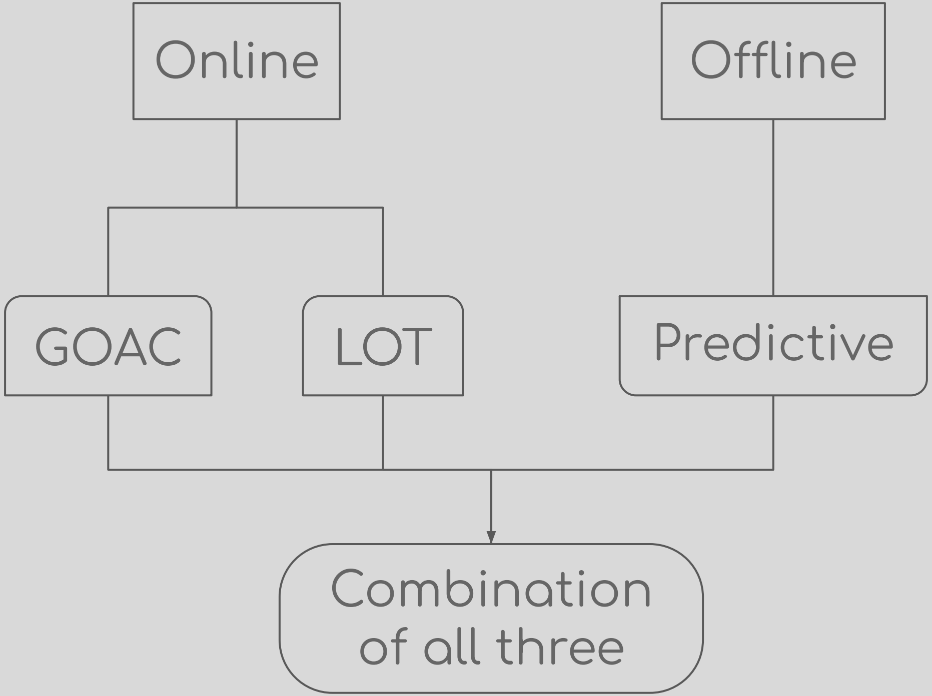
Would tests inside a virtual environment provide any real insight?

Turns out, *yes*

The VR approach - why?



Proposed Models

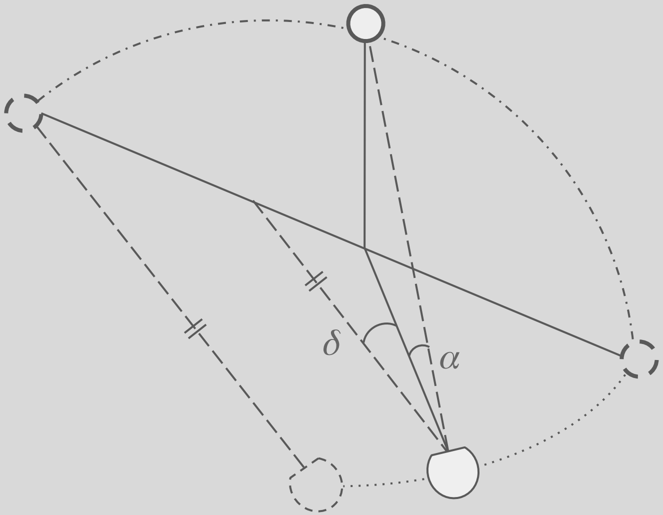


GOAC

General Optical
Acceleration Cancellation

α — elevation angle

δ — rotation angle



GOAC Try to keep the *acceleration of* α constant and the *acceleration of* δ constant, independently.

LOT

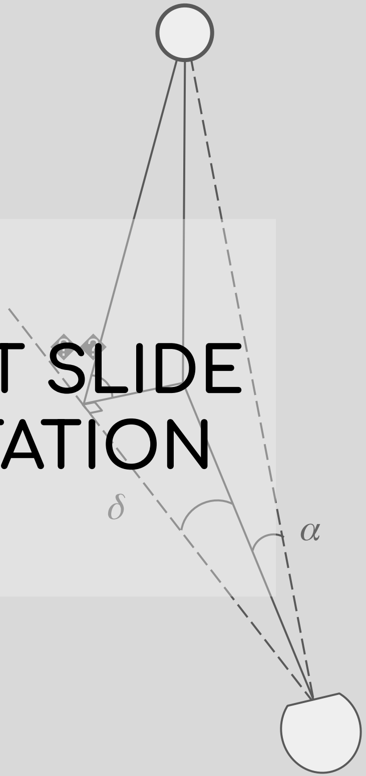
Linear Optical Trajectory

α — elevation angle

δ — rotation angle

Ψ — picture plane optical angle

INCORRECT, SEE THE NEXT SLIDE FOR A CORRECT PRESENTATION



LOT Try to keep the *acceleration of* Ψ constant. This implies the acceleration of α and δ are kept constant and equal.

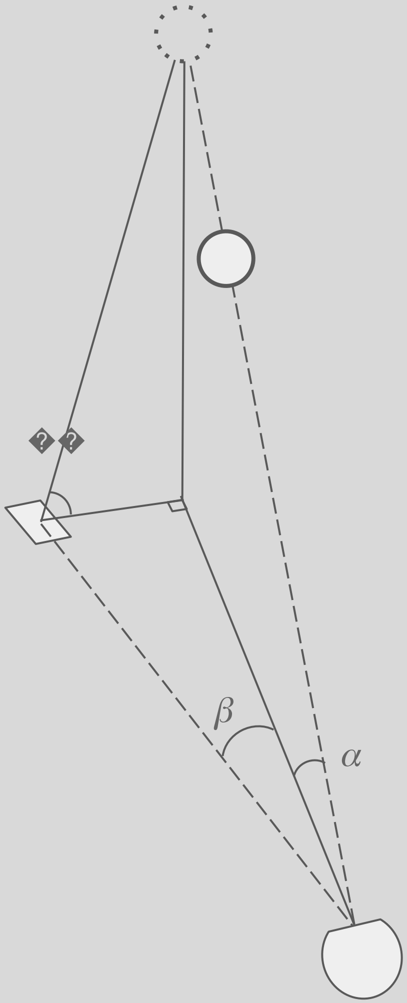
LOT

Linear Optical Trajectory

α — elevation angle

β — bearing angle

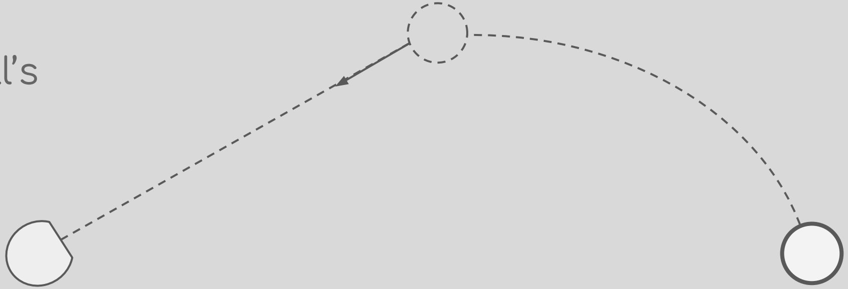
Ψ — picture plane optical angle



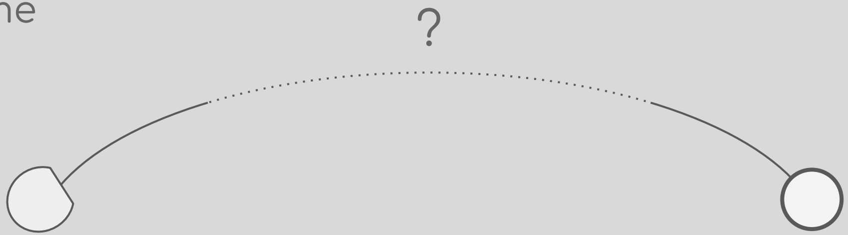
LOT Try to keep the *acceleration of* Ψ constant. This implies the acceleration of α and β are kept constant and equal.

Examples of manipulation

Artificially altering the ball's trajectory mid-flight



Hiding the ball from view for periods of time



Some example footage

Experiment View

Test No.	Target X (m)	Target Y (m)	Max Height (m)	Speed (m/s)	Launch Angle (°)	Deviation (°)	Initial Velocity X (m/s)	Initial Velocity Y (m/s)	Initial Velocity Z (m/s)
#0	90	0	30	30.29	51.95	0	18.67	23.85	0
#1	86.23	7.82	30	29.86	53.13	5.18	17.89	23.85	1.62
#2	77.77	9.75	30	28.87	55.93	7.14	16.13	23.85	2.02
#3	70.99	4.34	30	28.05	58.31	3.5	14.73	23.85	0.9
#4	70.99	-4.34	30	28.05	58.31	-3.5	14.73	23.85	-0.9
#5	77.77	-9.75	30	28.87	55.93	-7.14	16.13	23.85	-2.02
#6	86.23	-7.82	30	29.86	53.13	-5.18	17.89	23.85	-1.62

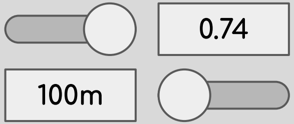
Last CATCH 35% (32/91)

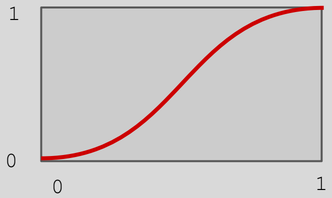
Running test #2

Exit Stop Start Experiment Pause Back

Key features

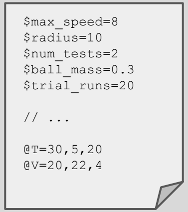
Basic configurability through UI

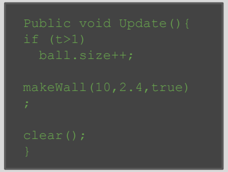




Controller configuration

In-depth configuration via a config file





Ball script for virtually unlimited configuration

Limitations

Although intuitive, control is not realistic

Specific to FOVE control: data interference

Resolution is still a limiting factor