Optical Tracking System For Target Following Camera

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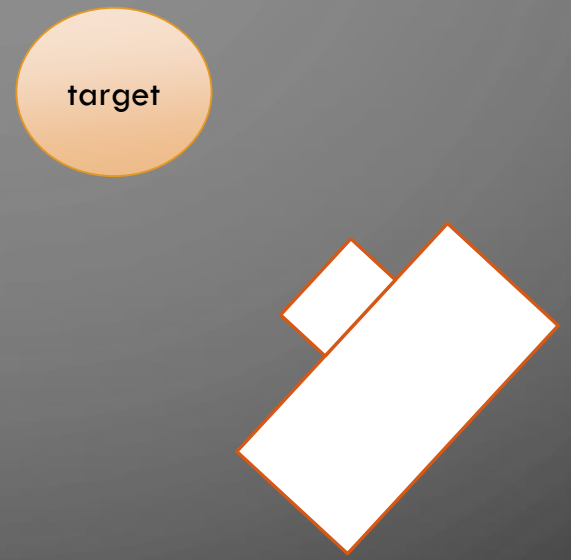
Target Following Camera



Keeps the target in frame

Can be used to track:
Performer on stage;
Specific player of outdoor sports game;
…

Goals of the Project

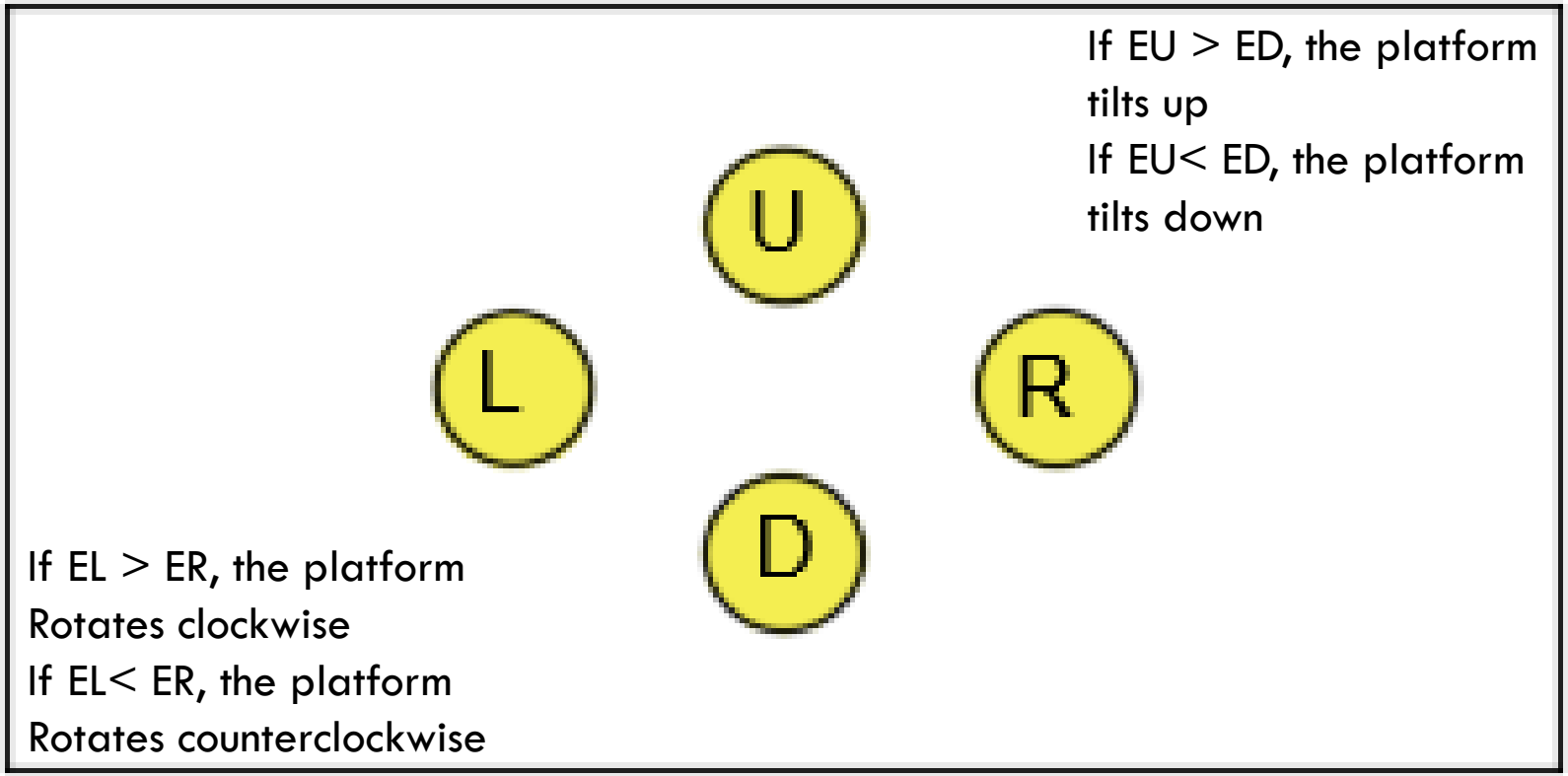
- Design a positioning system for a target following camera
- Build a prototype

Optical Tracking System

Wearable tag, that is worn by the target, consists of an infrared emitter, which is constantly transmitting encrypted signal.

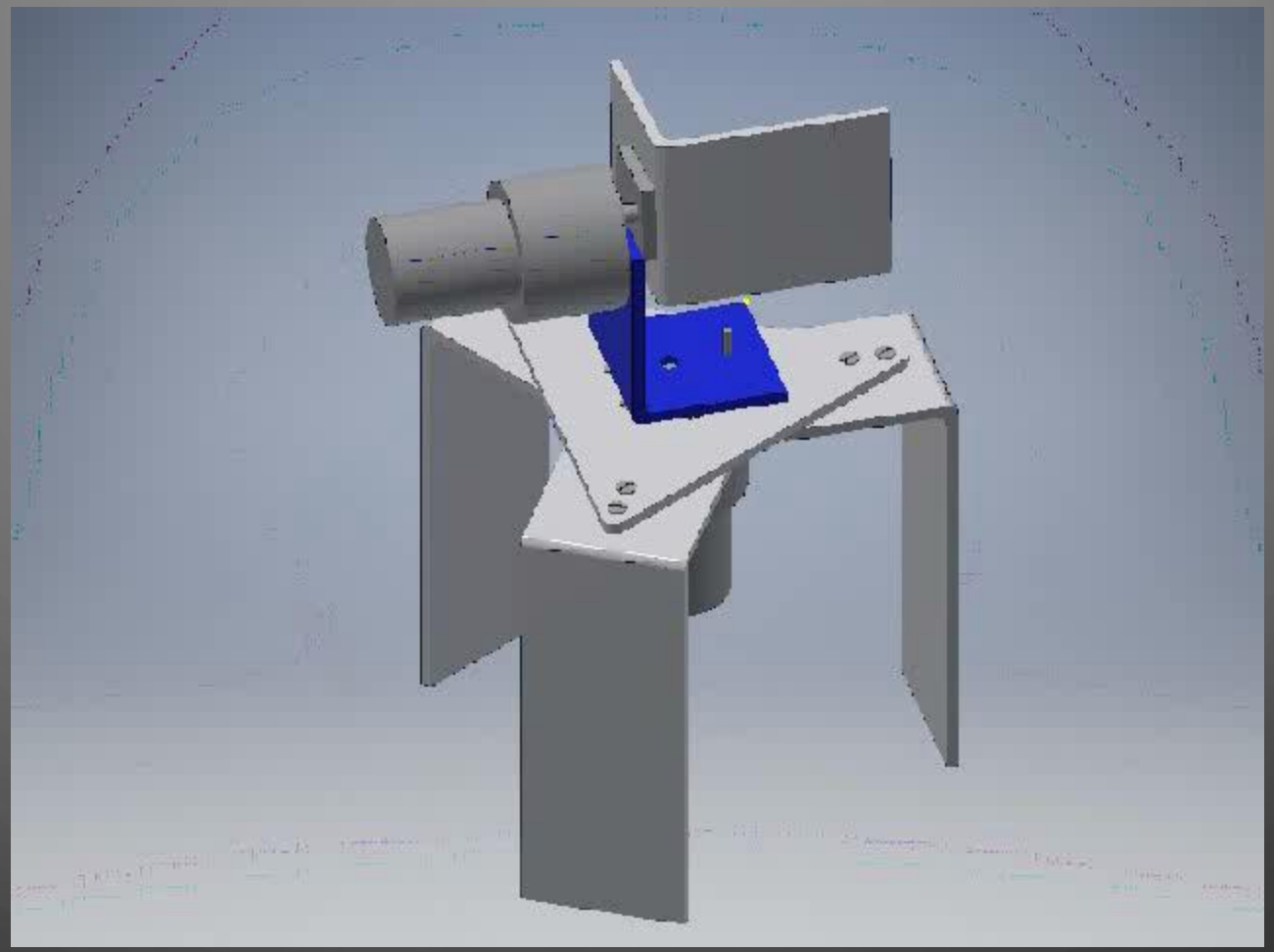
The device rotates the platform around two axes so that the angle between the light rays coming from the transmitter and the surface of the platform approaches 90^0.

Phototransistor alignment

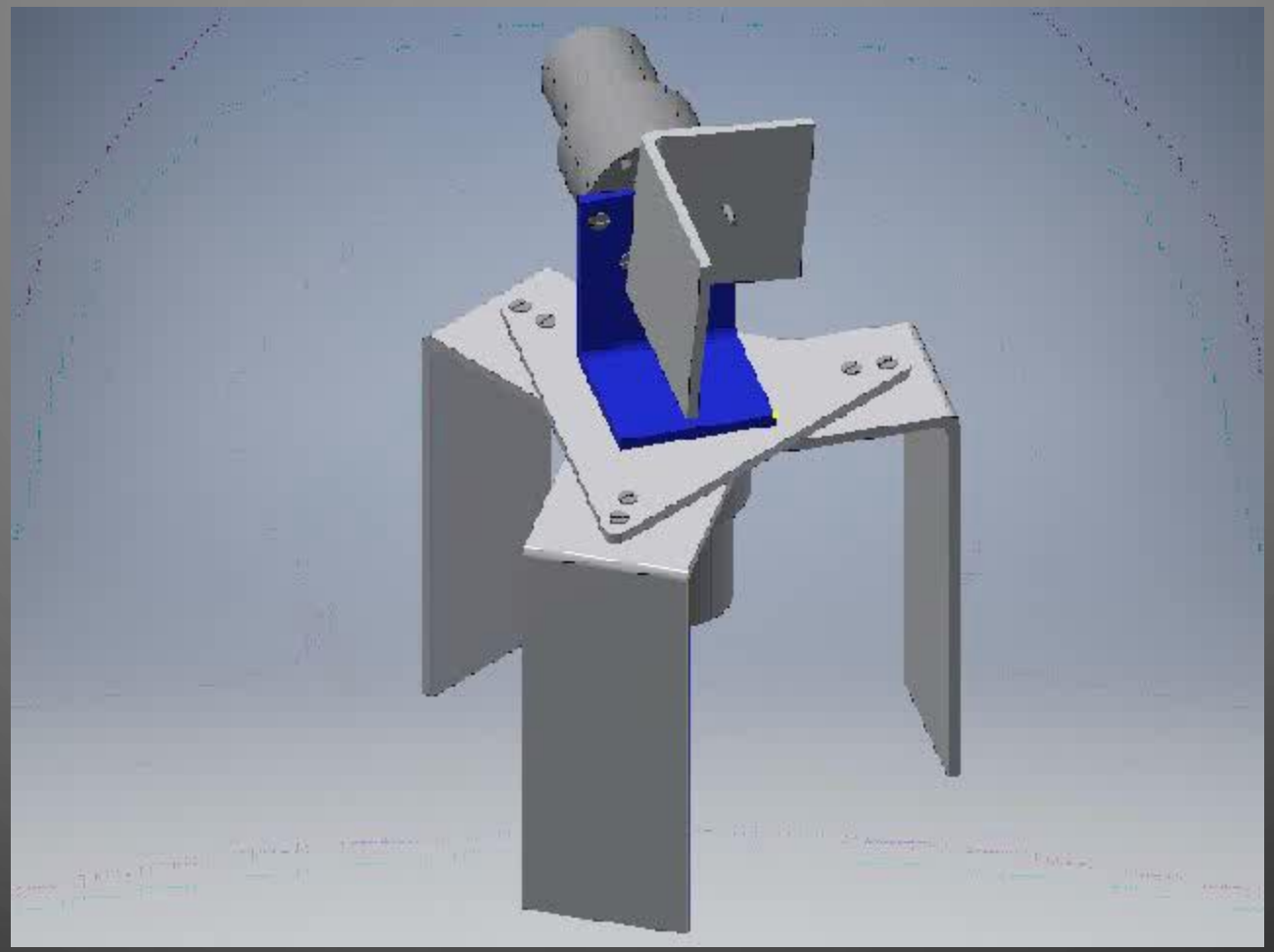


Finding starting point

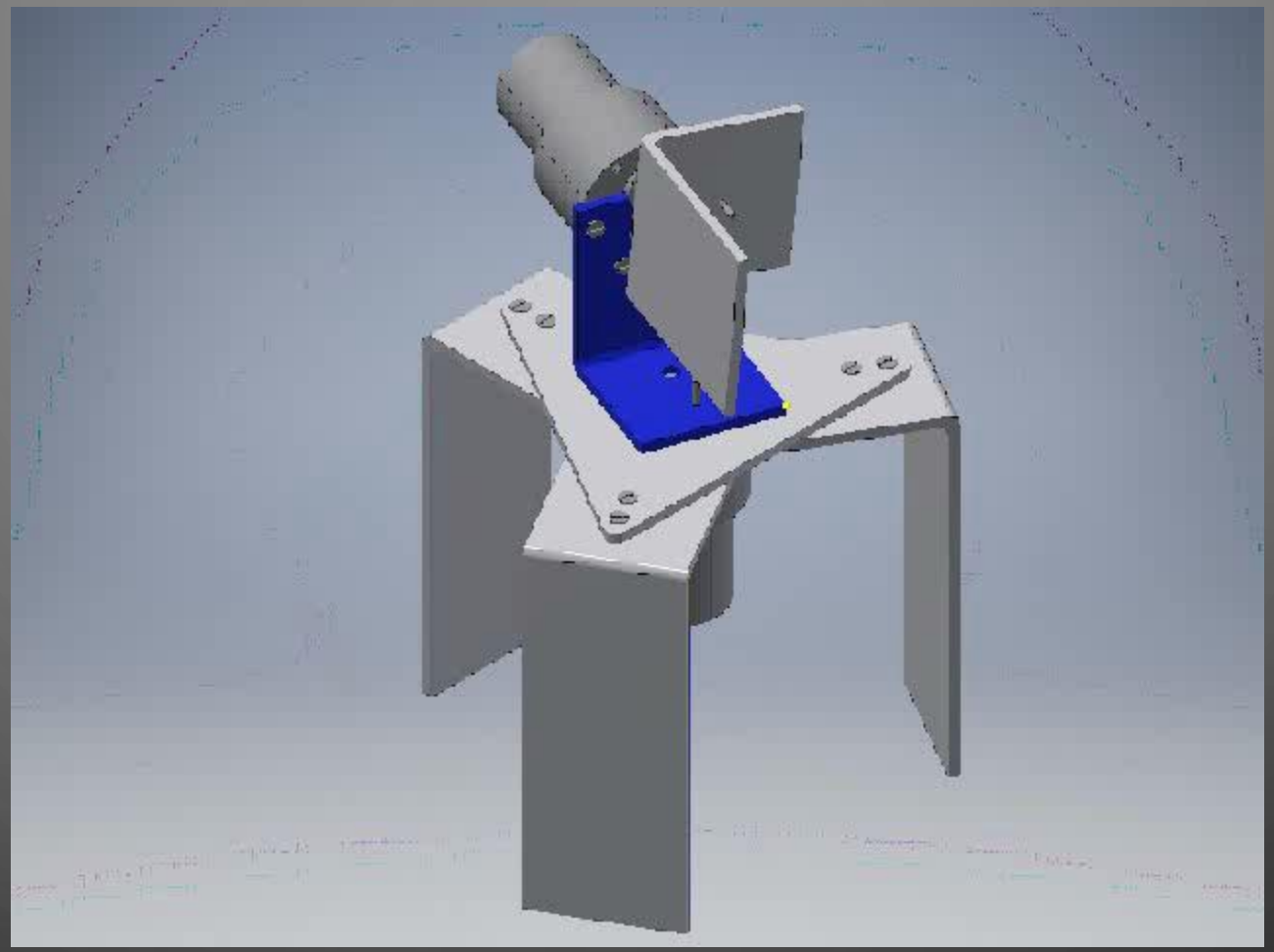
Limit switches are installed on the construction



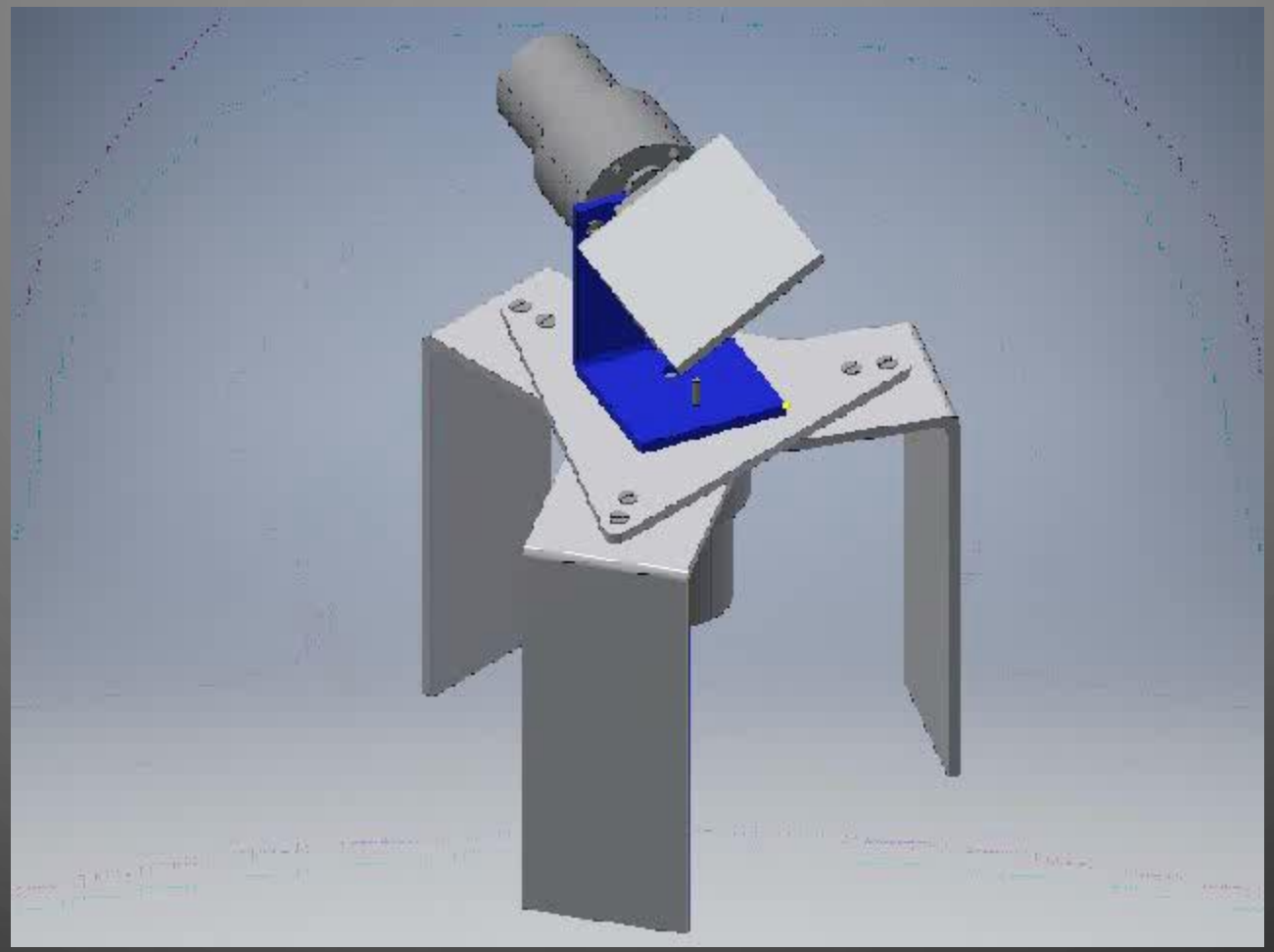
Finding starting point



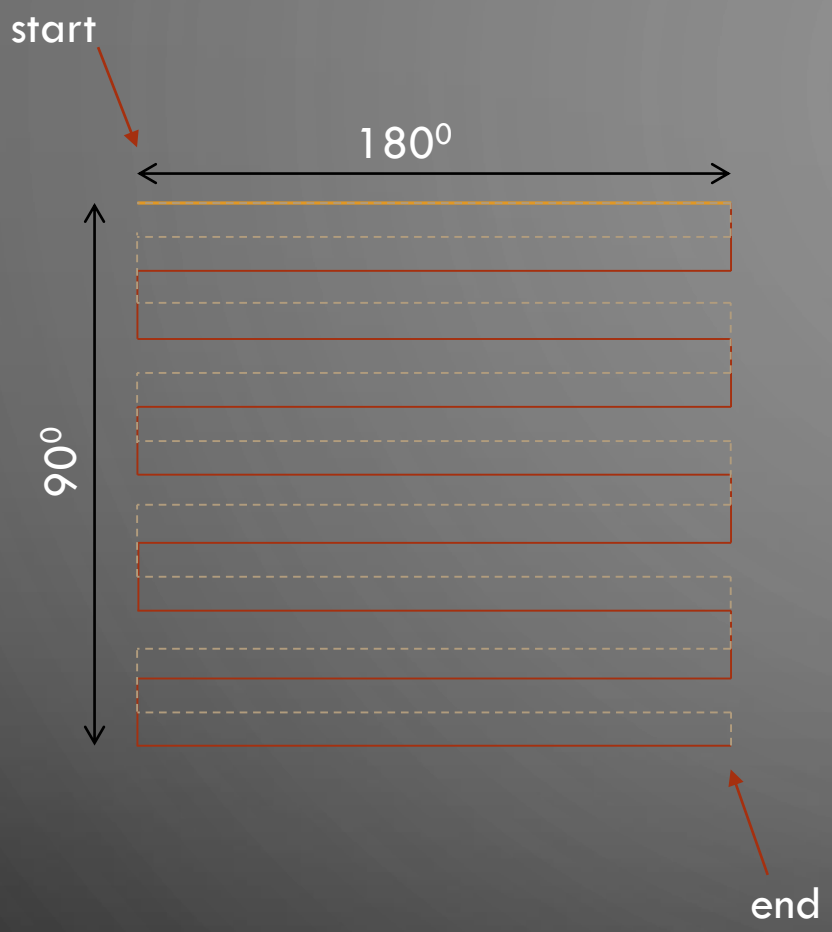
Finding starting point

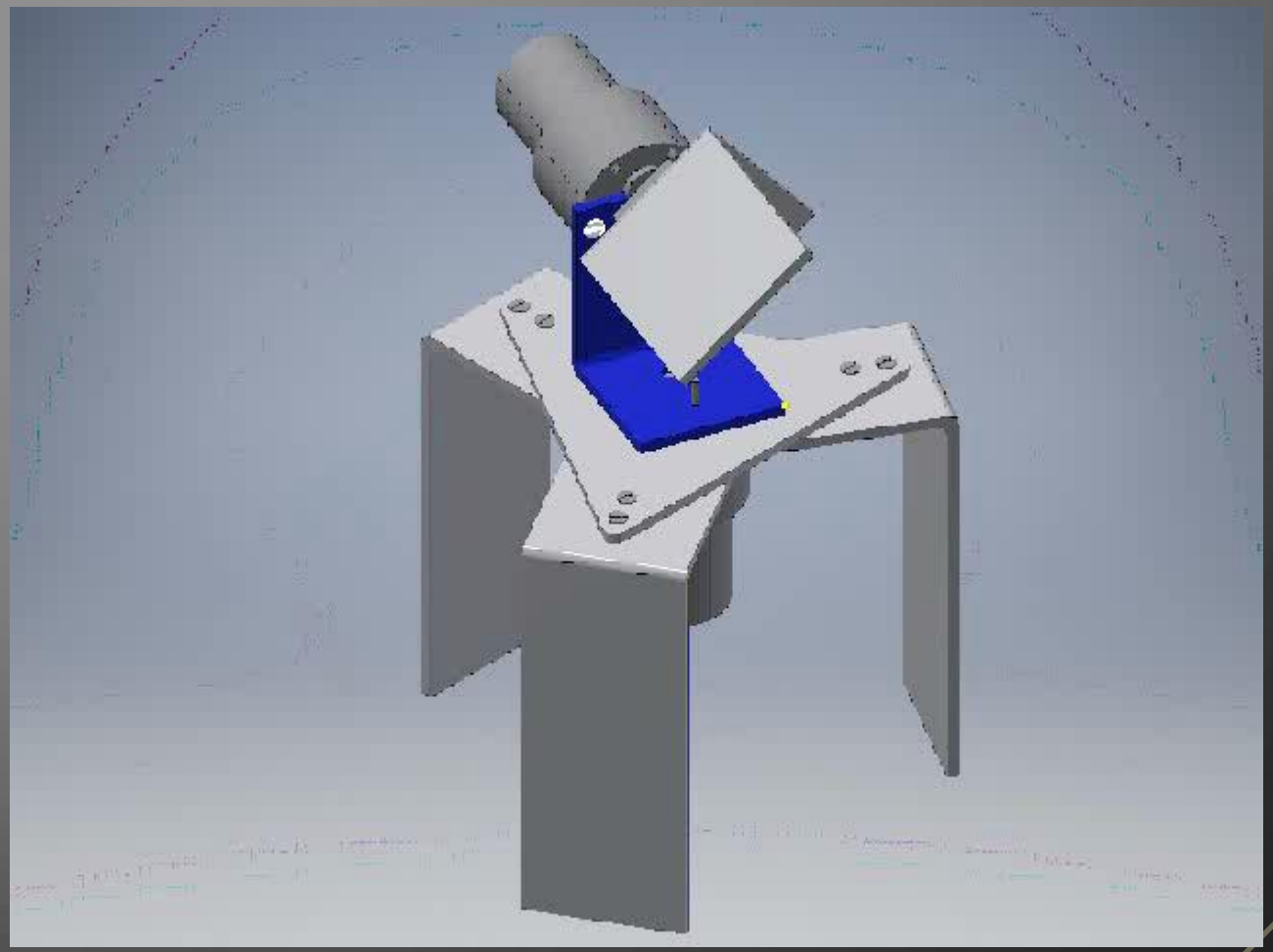


Finding starting point

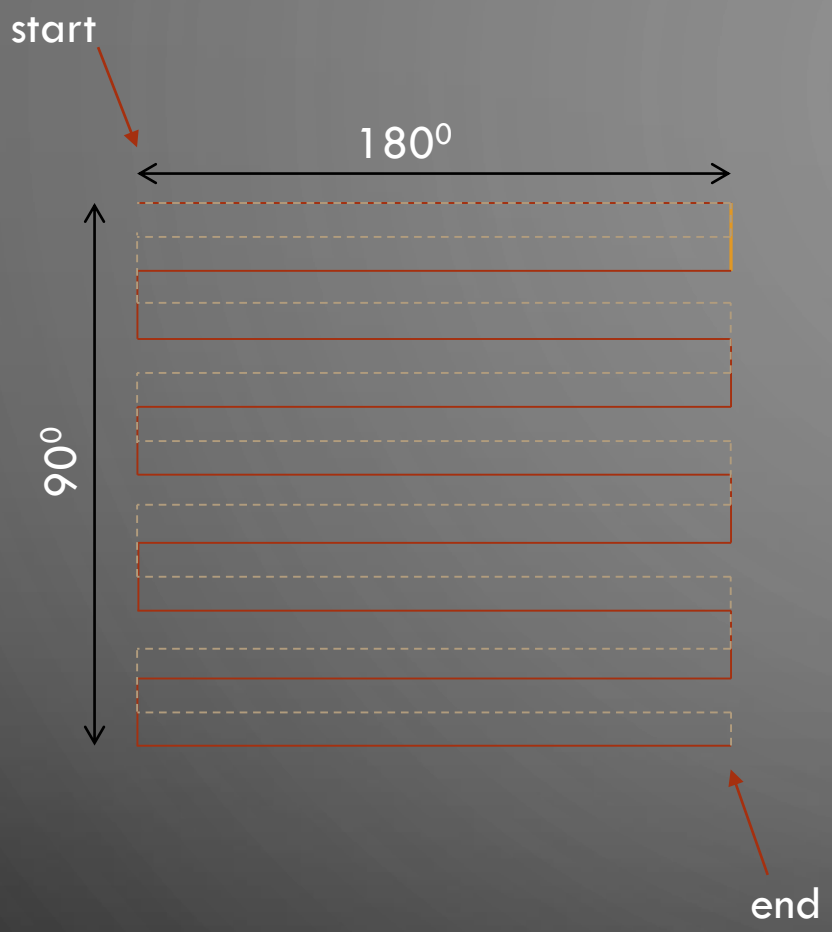


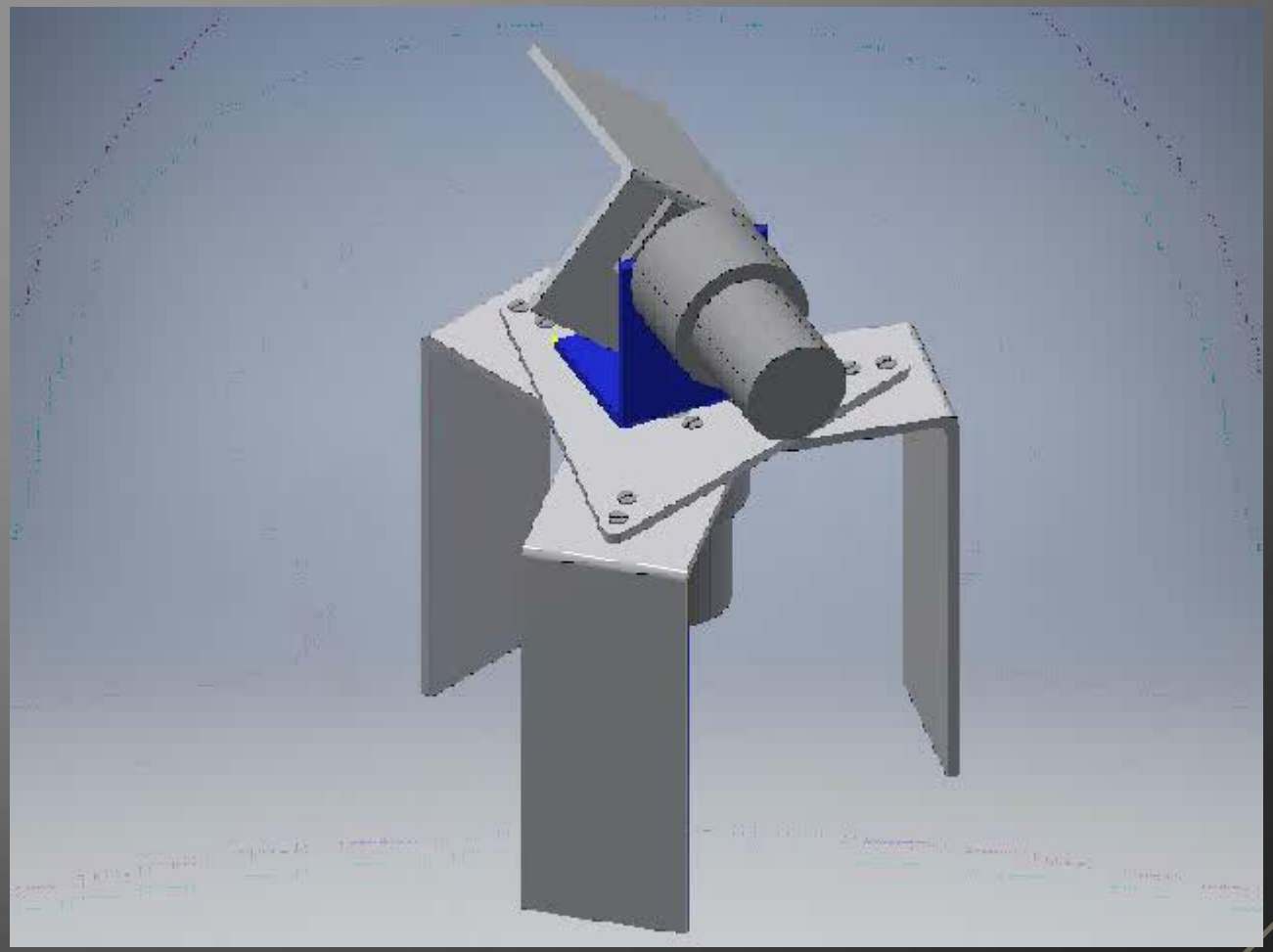
Searching trajectory



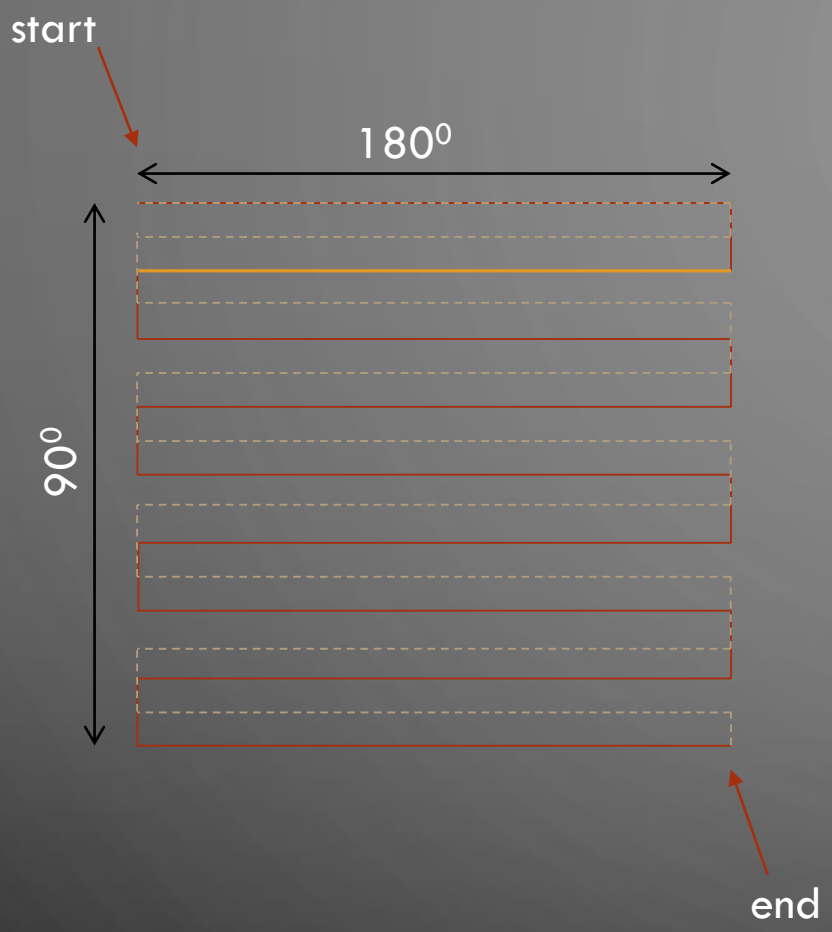


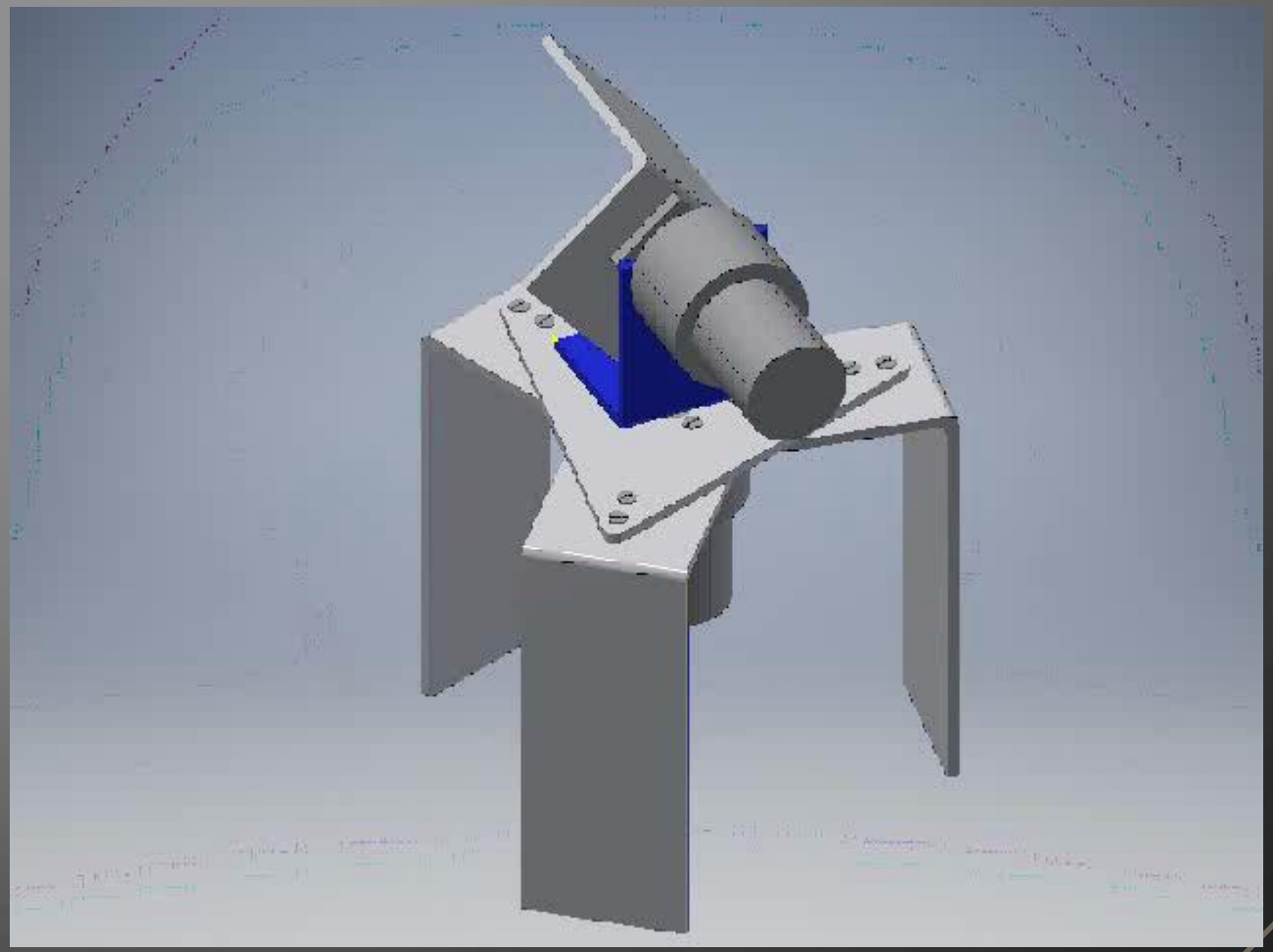
Searching trajectory



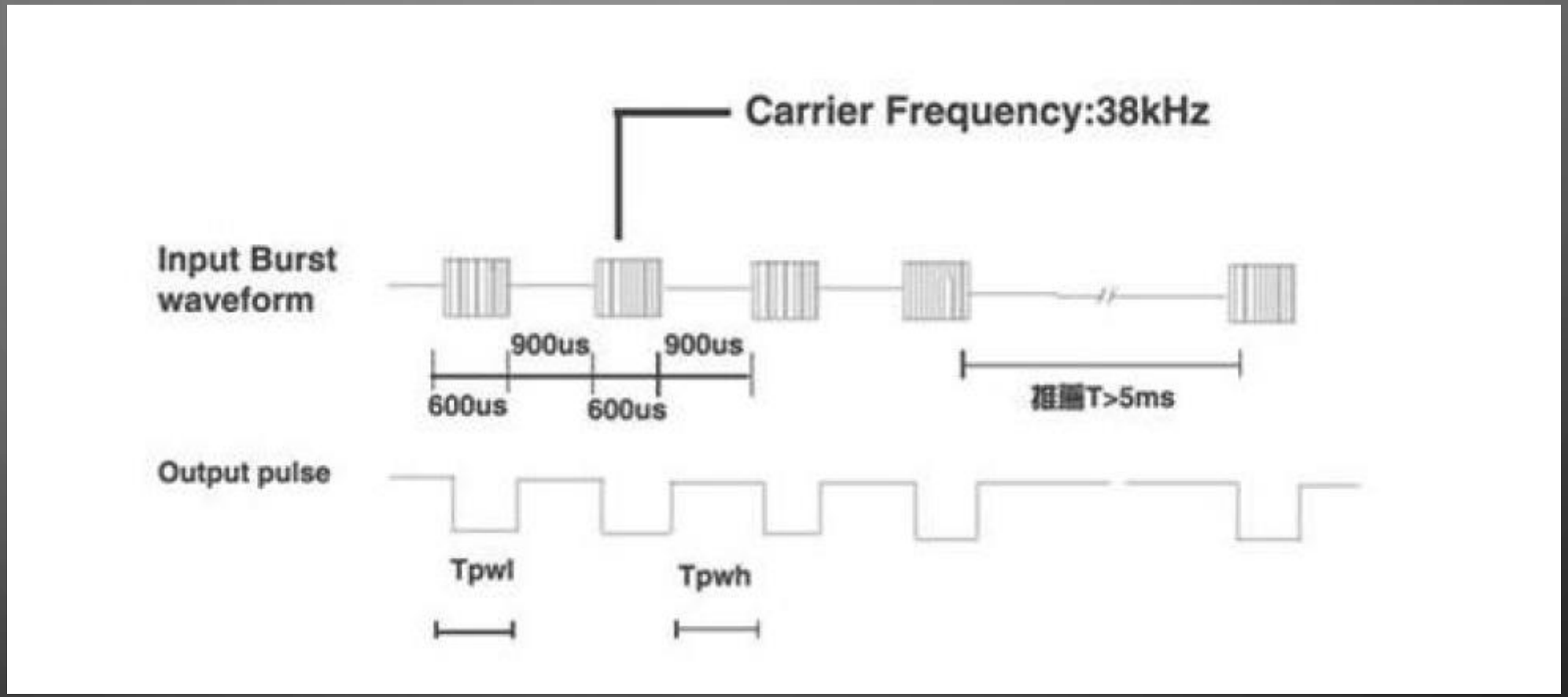


Searching trajectory

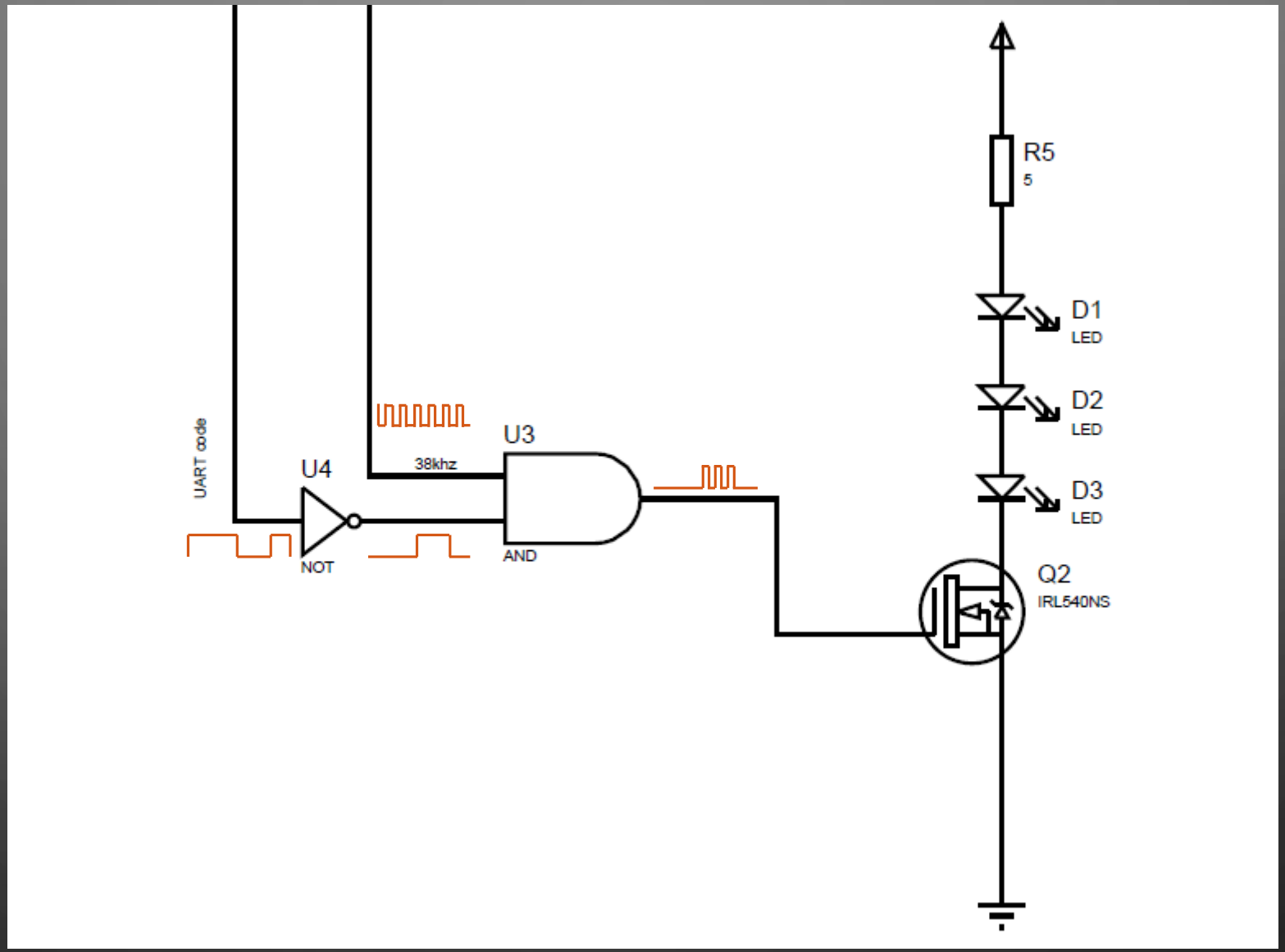




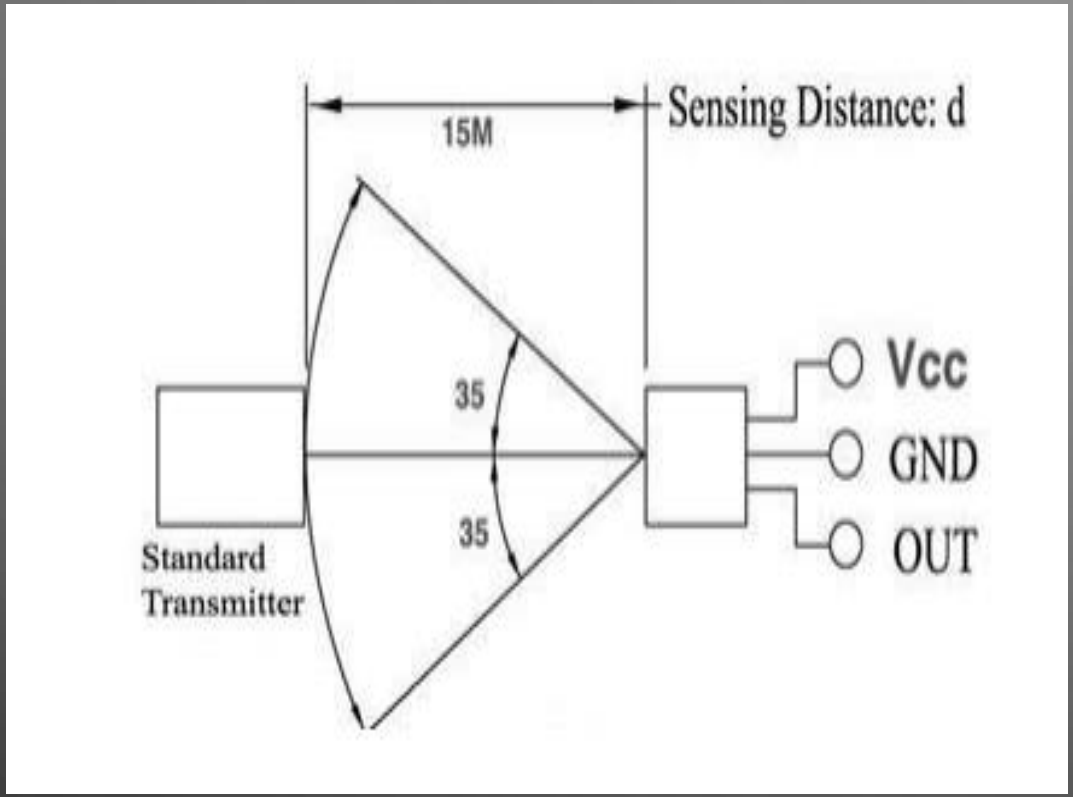
IR modulation



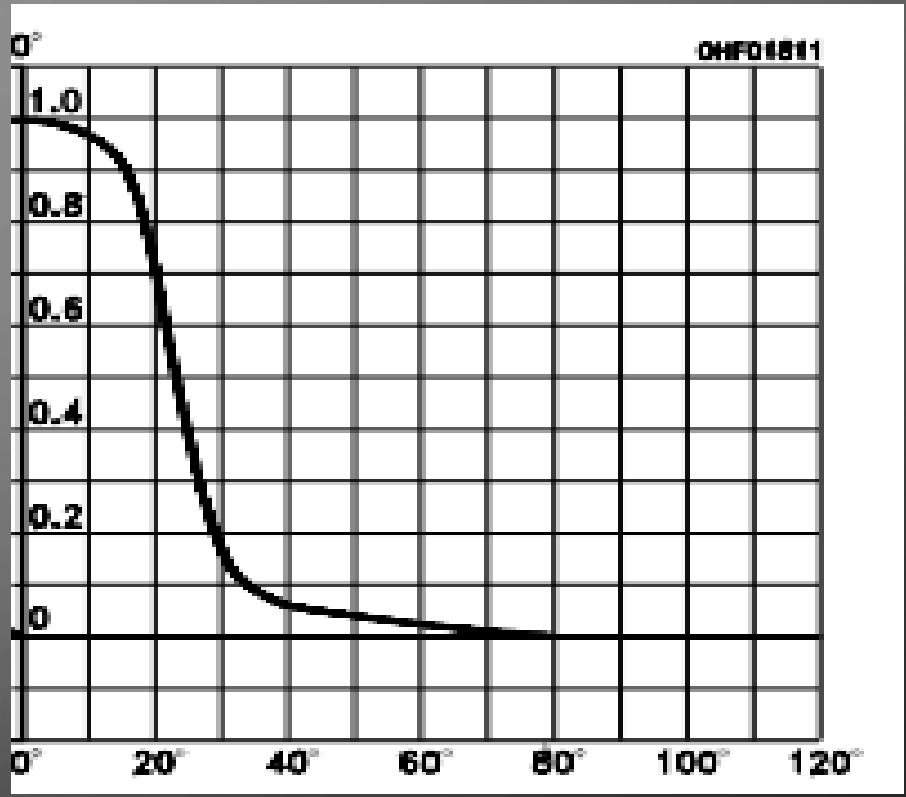
IR modulation



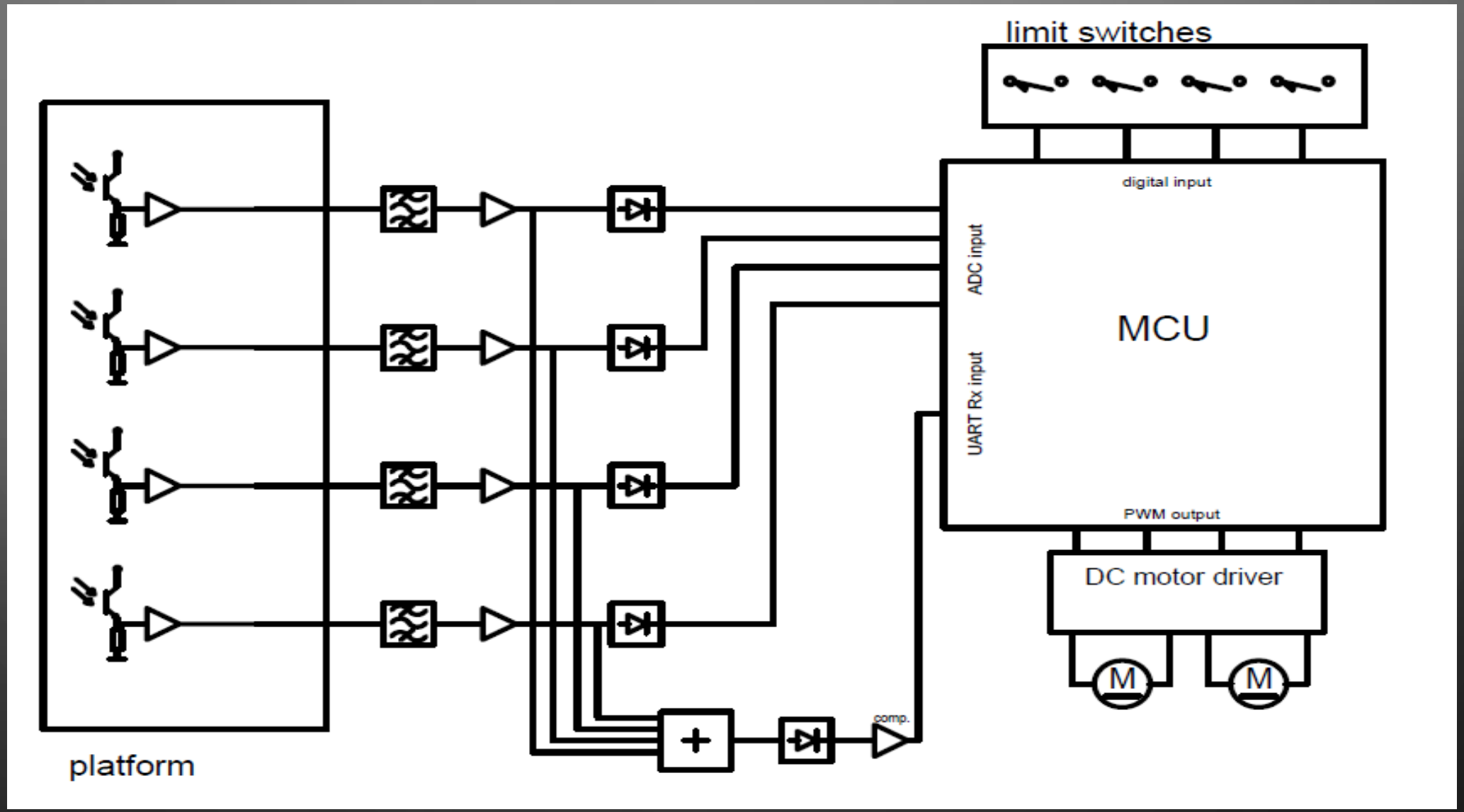
Digital infrared receiver's sensing angle is 35^0



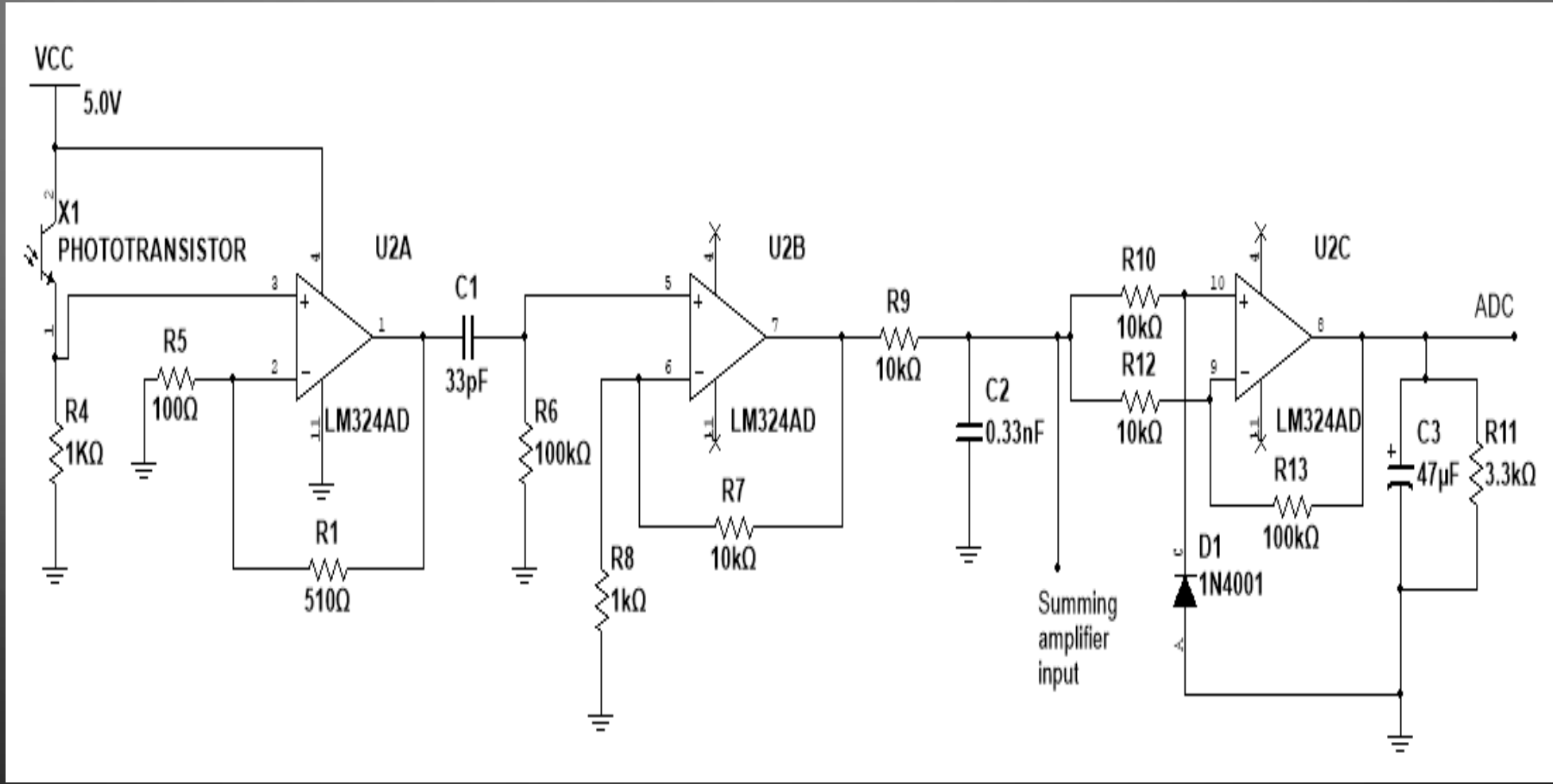
Phototransistor's sensitivity is very low for light that is directed at more than 20^0



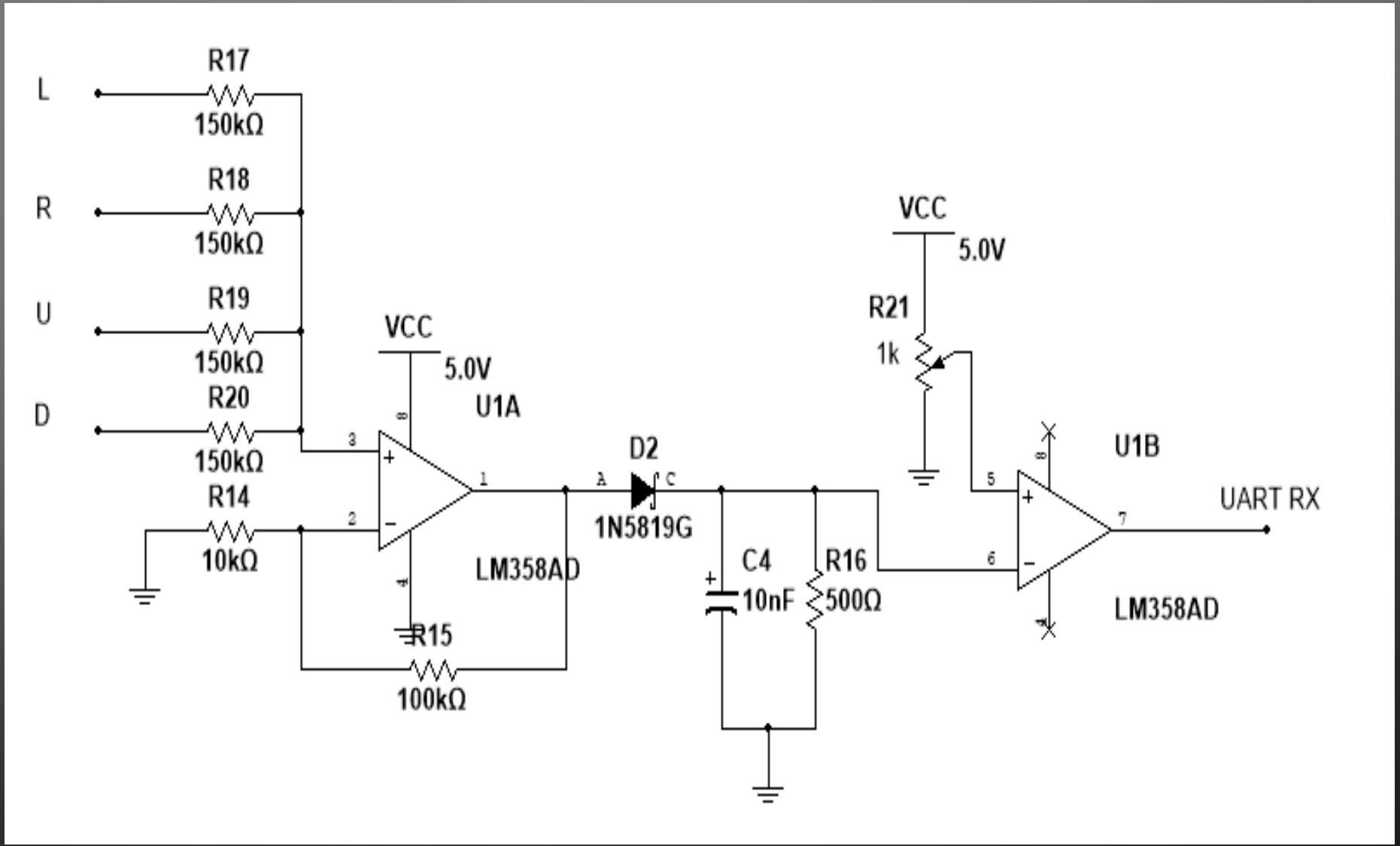
Block diagram



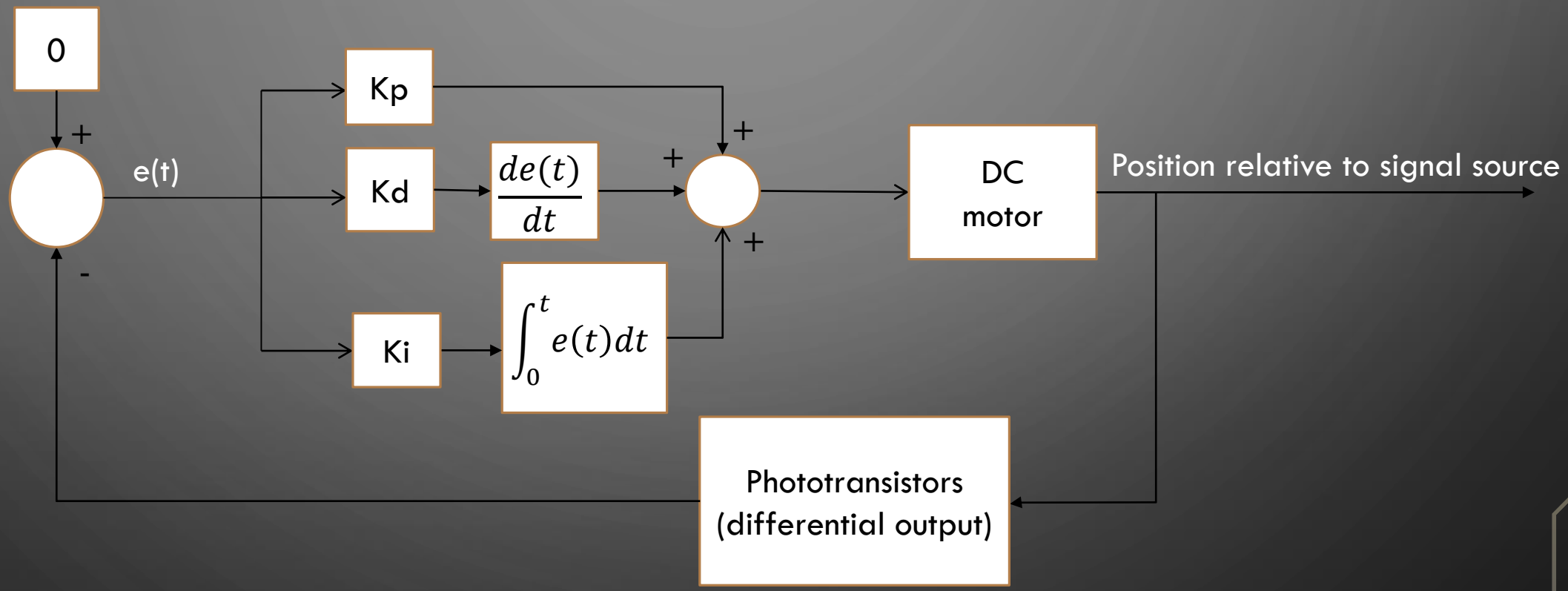
Electrical circuit



Electrical circuit



PID control

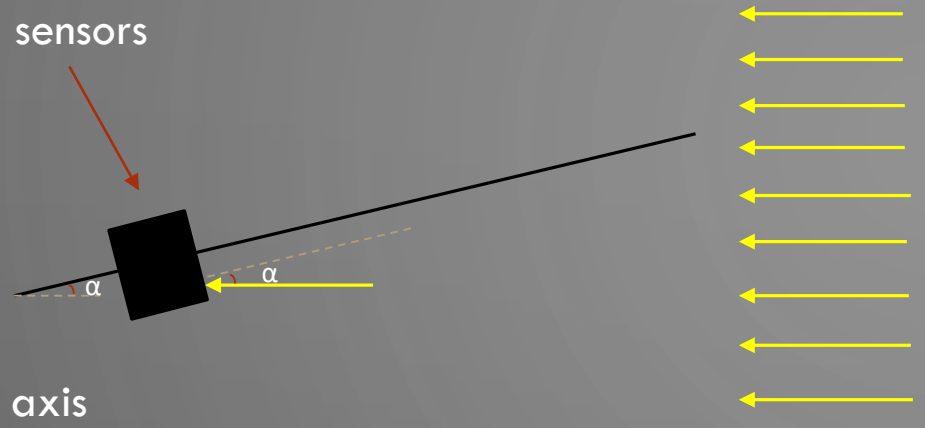

0
+
-
e(t)
Kp
Kd
Ki
$\frac{de(t)}{dt}$
$\int_0^t e(t)dt$
+
+
+
DC
motor
Position relative to signal source
Phototransistors
(differential output)

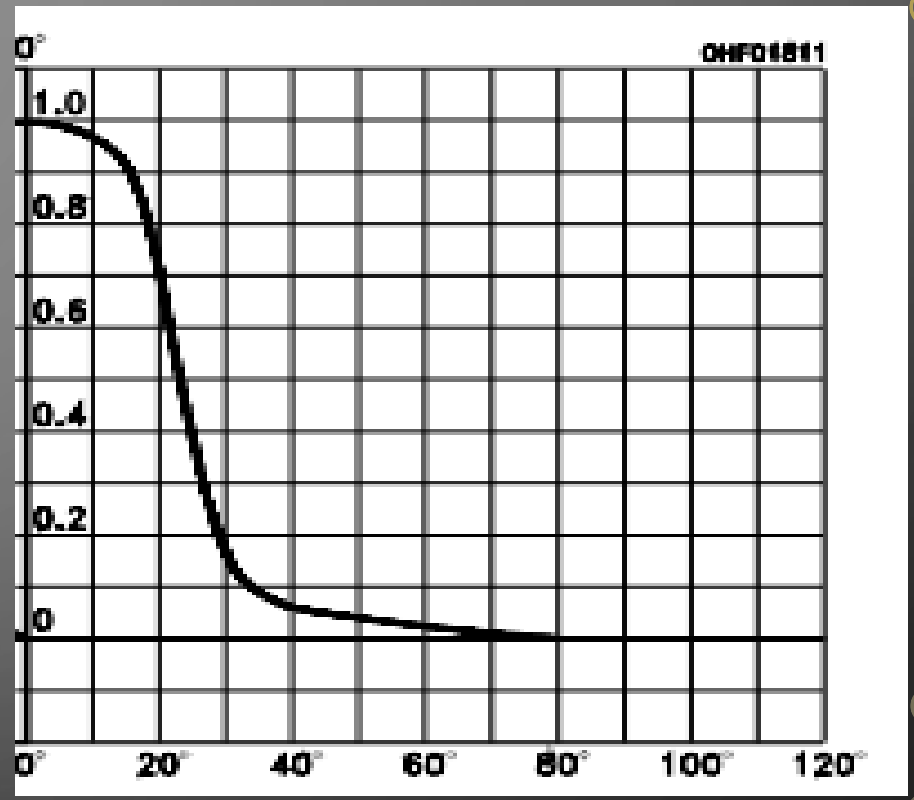
Modeling the system for a single axis

input-output relationships to determine:

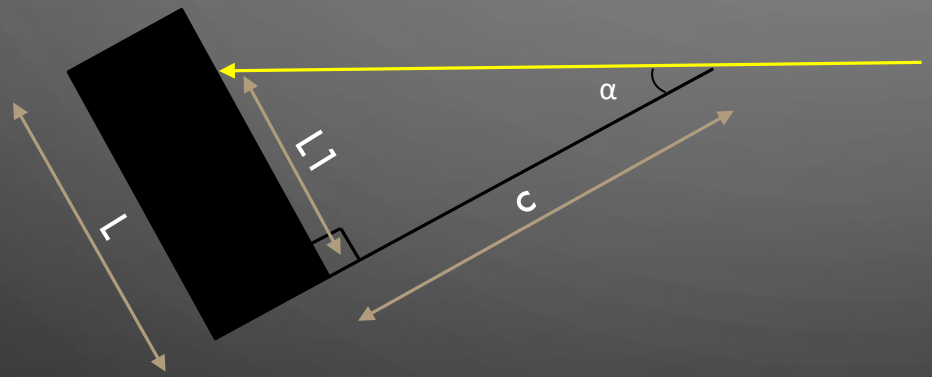
- Angle relative to the transmitter θ – phototransistor outputs_ $V_p=f(\theta)$
- Electrical circuit _ $V_{out}=f(V_p)$
- DC motor _$\omega=f(V_{in})$

Light coming from the transmitter





L1 _ length of the shadow



L1 = ctgα

Simulating DC motor

Back emf, E ~ ω

$V = E + IR$

When E = 0, V = IR

For approximating inertia:

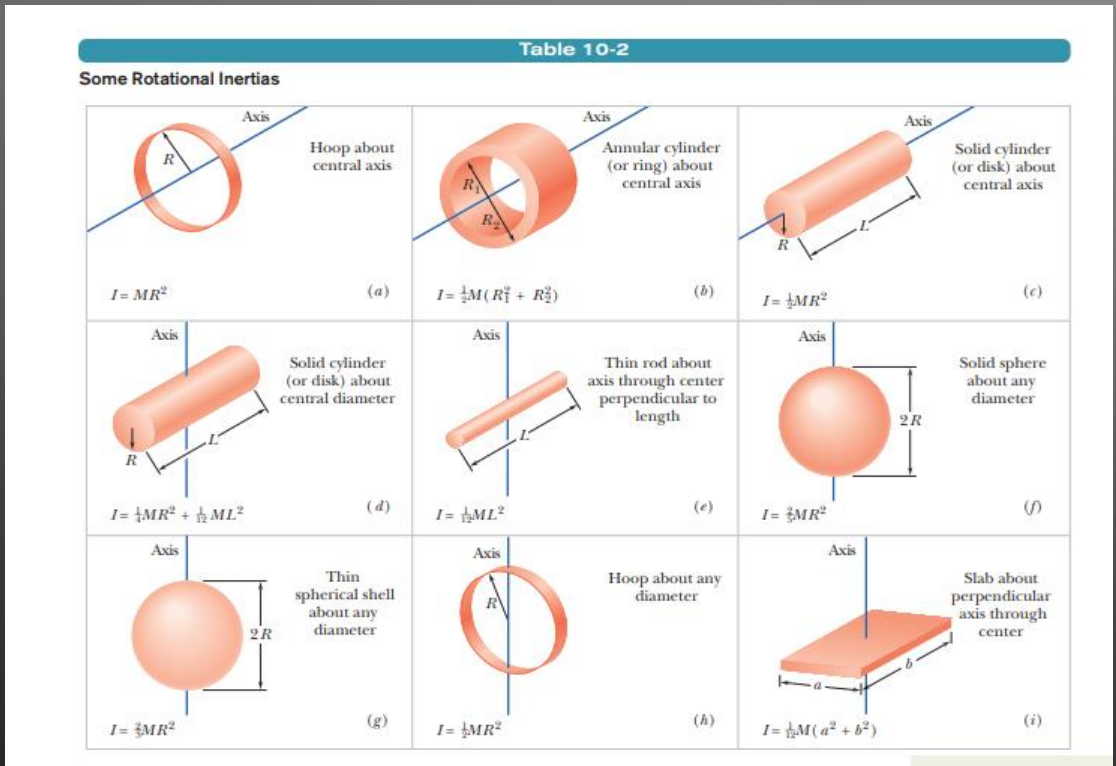
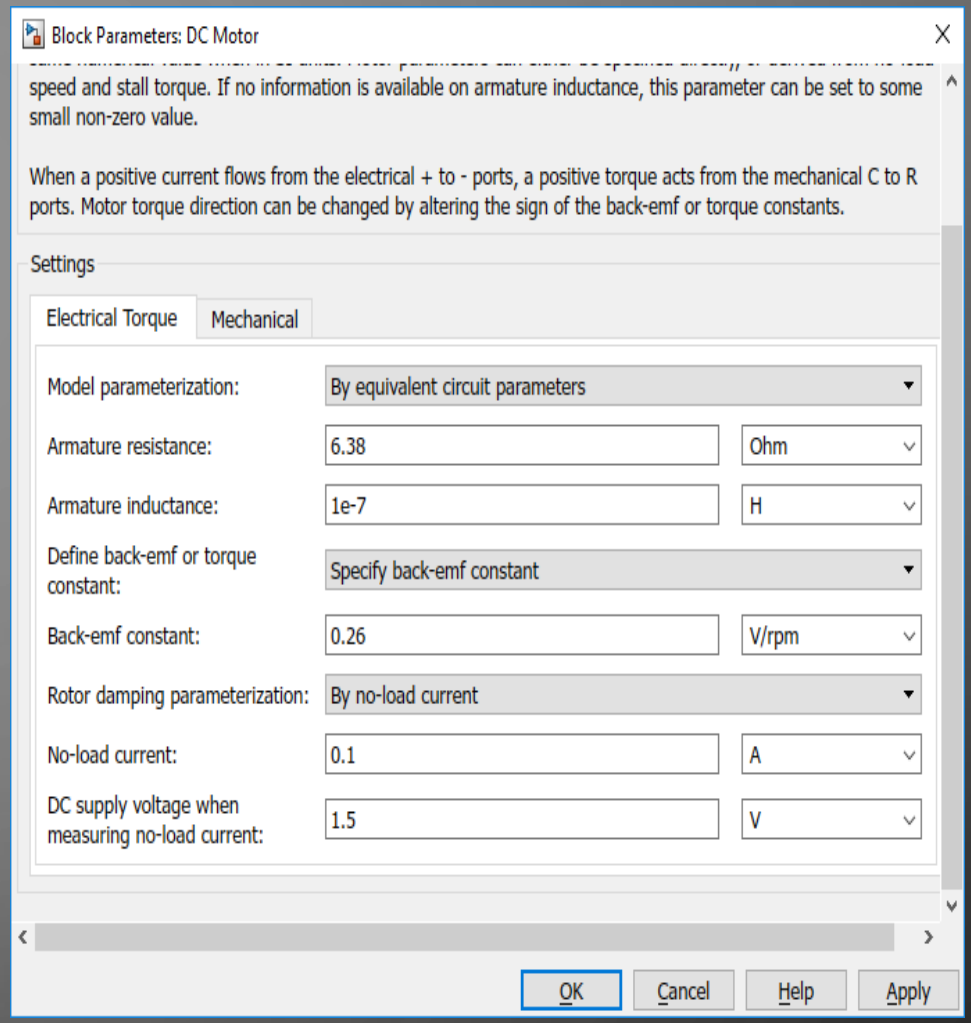


Table 10-2

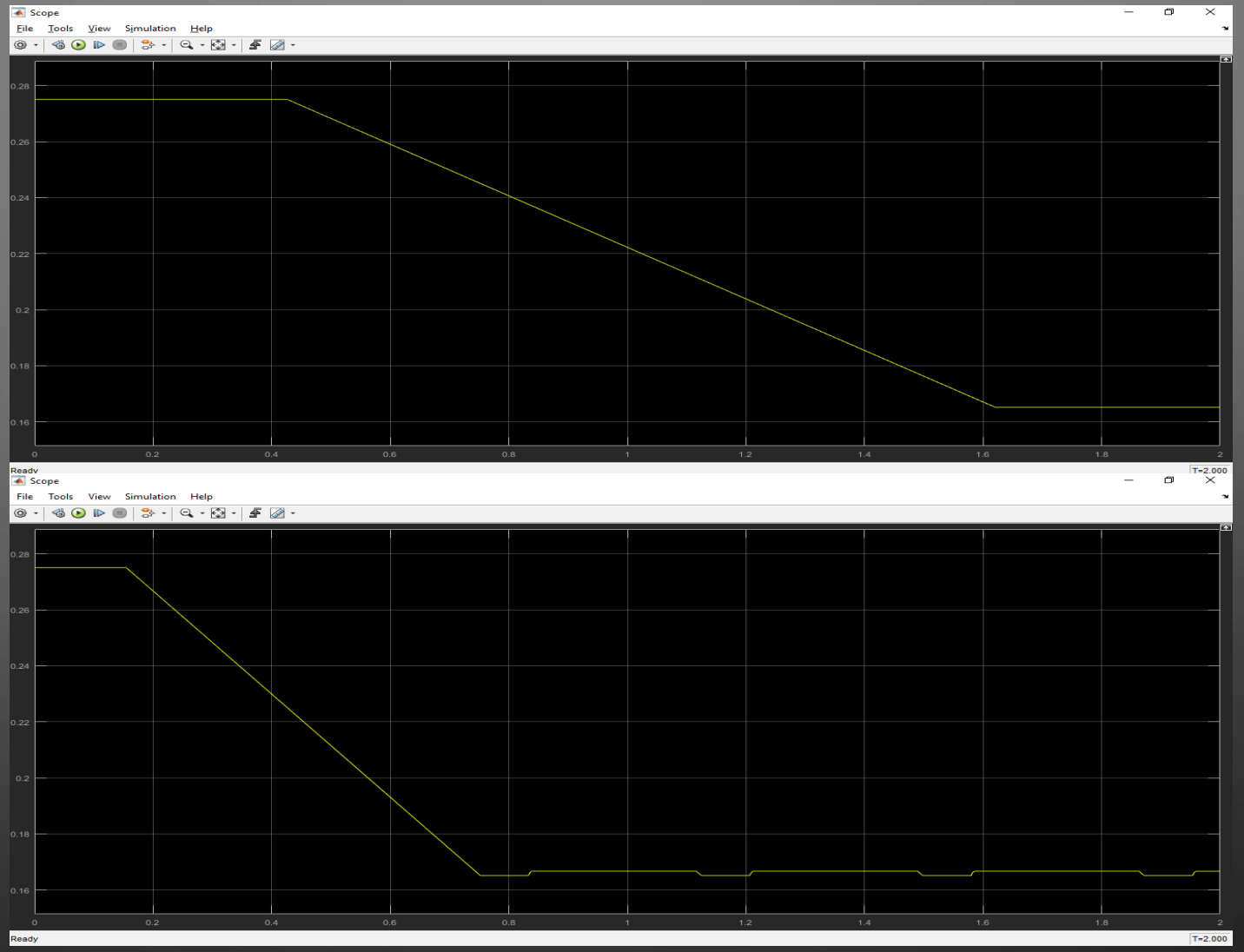
Some Rotational Inertias

Axis, R — Hoop about central axis — $I = MR^2$ (a)	Axis, R_1, R_2 — Annular cylinder (or ring) about central axis — $I = \frac{1}{2}M(R_1^2 + R_2^2)$ (b)	Axis, R, L — Solid cylinder (or disk) about central axis — $I = \frac{1}{2}MR^2$ (c)
Axis, R, L — Solid cylinder (or disk) about central diameter — $I = \frac{1}{4}MR^2 + \frac{1}{12}ML^2$ (d)	Axis, L — Thin rod about axis through center perpendicular to length — $I = \frac{1}{12}ML^2$ (e)	Axis, 2R — Solid sphere about any diameter — $I = \frac{2}{5}MR^2$ (f)
Axis, 2R — Thin spherical shell about any diameter — $I = \frac{2}{3}MR^2$ (g)	Axis, R — Hoop about any diameter — $I = MR^2$ (h)	Axis, a, b — Slab about perpendicular axis through center — $I = \frac{1}{12}M(a^2 + b^2)$ (i)



Source: Halliday _ fundamentals of physics

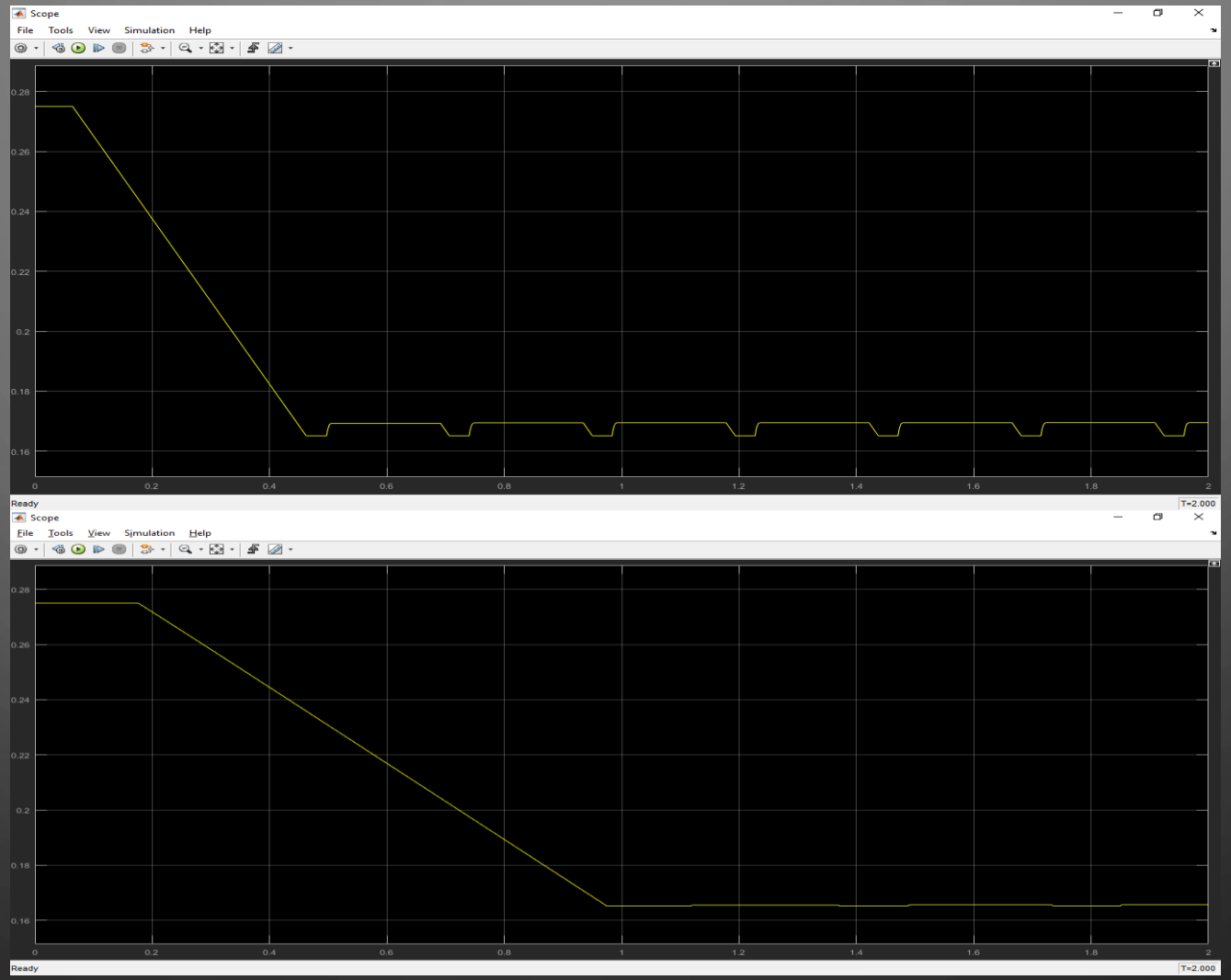
Simulation results



Kp = 100

Kp = 200

Simulation results



Kp = 300

Kp = 150
Kd = 10

Future plans

- Install lenses for phototransistors
- Reduce electrical noise
- Add sensors to measure position

Thank you for your attention