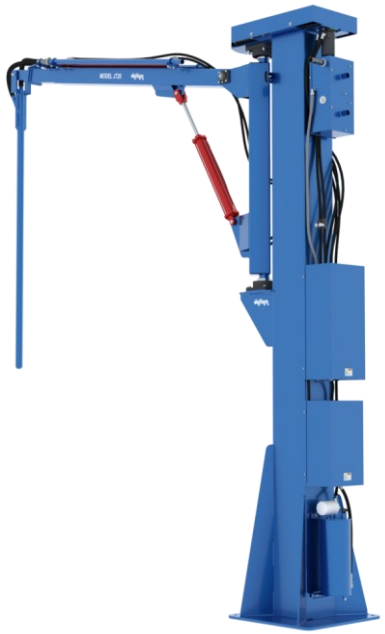
Automating Probe Sampling Process



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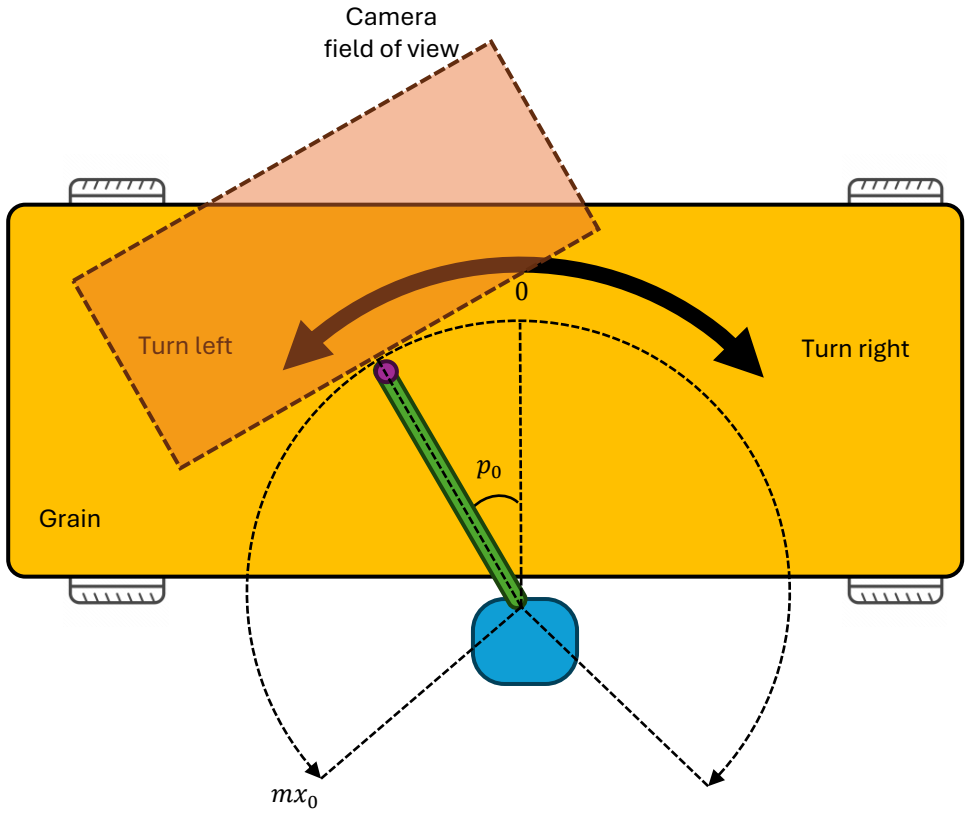
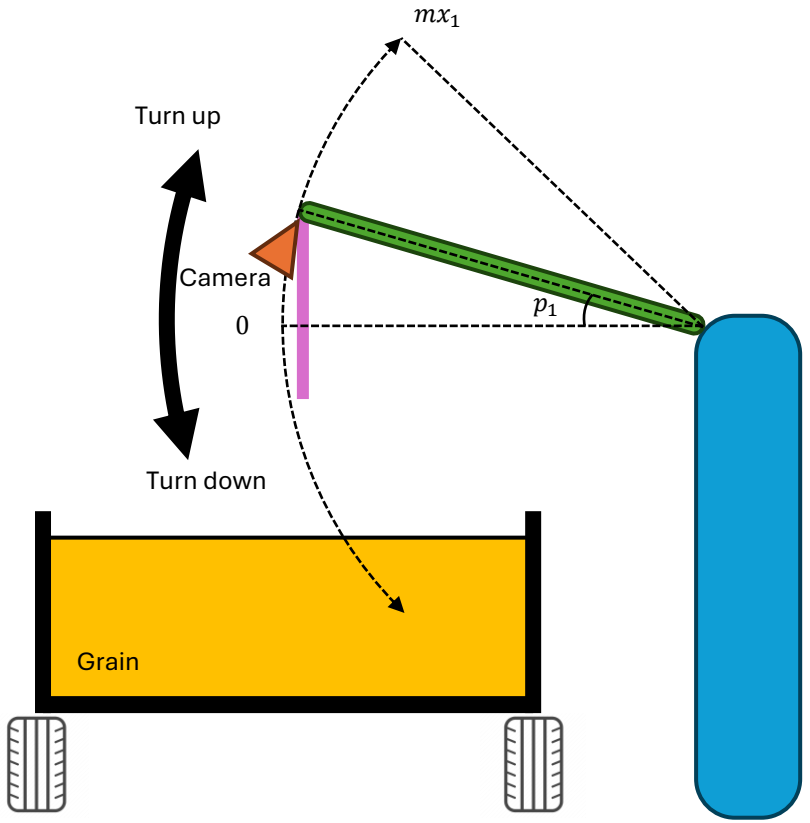
Probe kinematic

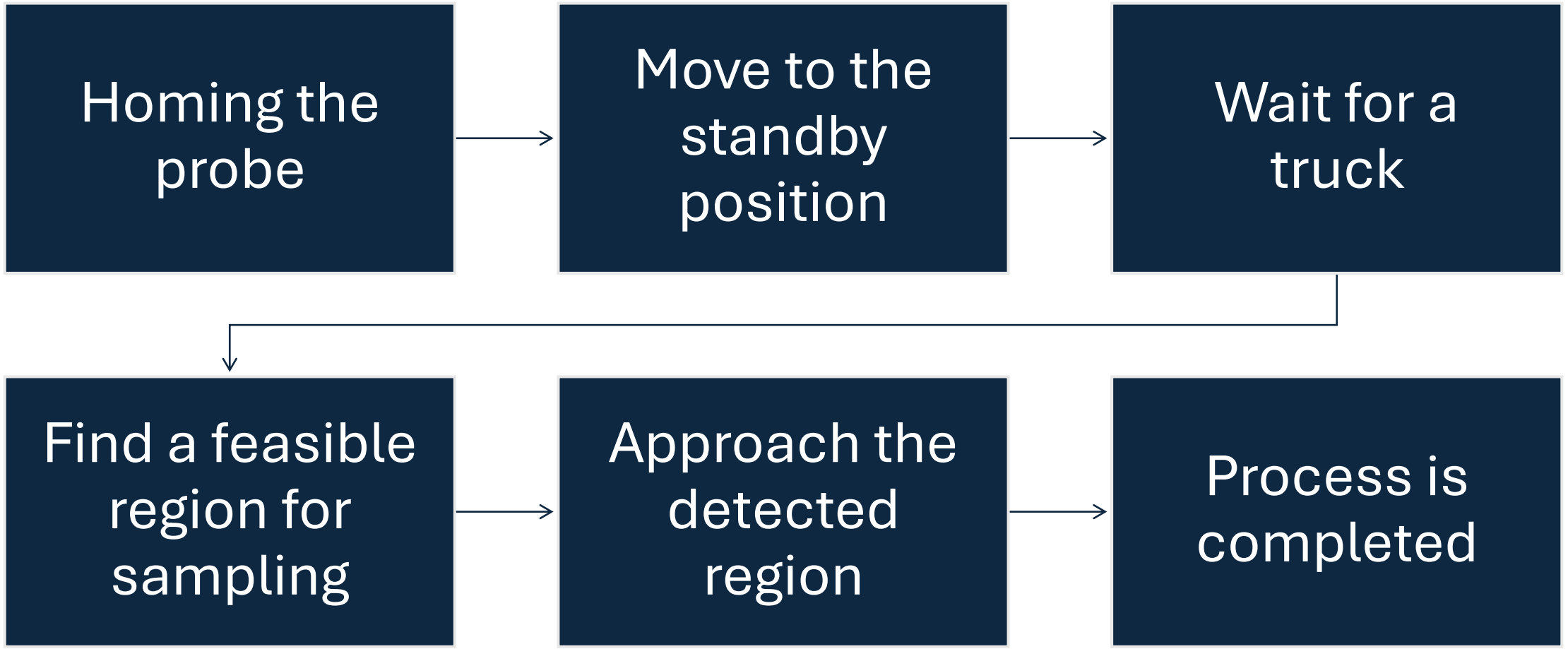


Top view



Side view

Grain sampling steps



Moving probe

Assumption

- Probe has two rotational joints p_0 (left and right) and p_1 (up and down).
- p_0 : Going left (+) and right (-).
- p_1 : Going up (+) and down (-).
- v_0 : A fixed and known number representing the rotational velocity of p_0.
- v_1 : A fixed and known number representing the rotational velocity of p_1.

How to move each joint for certain amount

- Moving the probe d degrees in p_0 direction, is equivalent to engaging the joystick left or right axis for $\frac{d}{v_0}$ seconds.
- Moving the probe d degrees in p_1 direction, is equivalent to engaging the joystick left or right axis for $\frac{d}{v_1}$ seconds.

Homing probe

Task

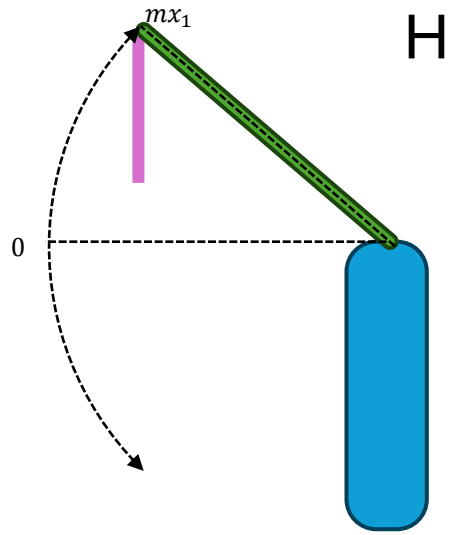
- The process of assigning the true p_0 and p_1 values to the probe joints.

Assumption

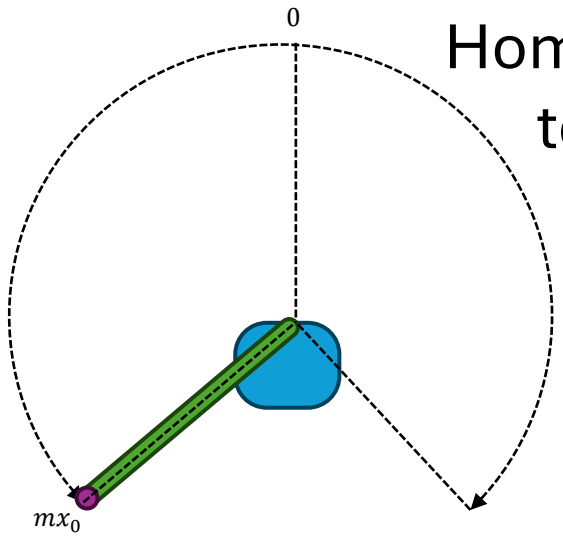
- mx_0: A fixed and known number representing the probe physical limit when traveling in the left direction (p_0 maximum value).
- mx_1: A fixed and known number representing the probe physical limit when traveling in the up direction (p_1 maximum value).

Process

- Moving p_1 to its up limit, at this position the value of p_1 is mx_1.
- Moving p_0 to its left limit, at this position the value of p_0 is mx_0.



Home position side view



Home position top view

Standby position

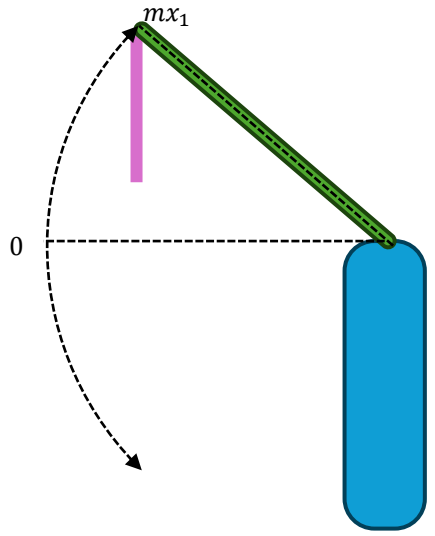
Task

- Moving the probe to $p_0 = 0$ and $p_1 = mx_1$.

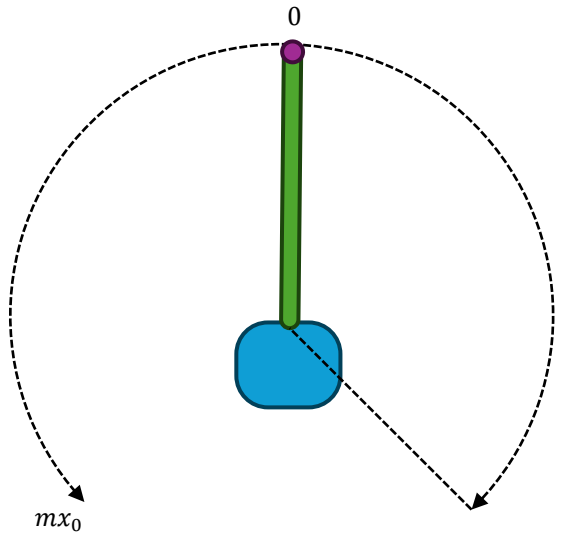
Process

- When homing process is completed, $p_0 = mx_0$ and $p_1 = mx_1$.
- Move the probe to $p_0 = 0$ by activating the right joystick for $\frac{mx_0}{v_0}$ seconds.
- The orientation of the probe at this position is $p_0 = 0$ and $p_1 = mx_1$.

Standby position side view



Standby position top view



Wait for a truck

Process

- At standby position activate the camera and run grain detection module every 10 seconds.
- If for 12 consecutive images (2 minutes total) grain is detected, then there is a truck with grain.

Find a region for sampling

Process

- At $p_0 = 0$ and $p_1 = mx_1$ (standby position), run the grain detection module.
- Inside all the grain detected regions, select a window of $width = 20px$ and $height = 20px$, where it only contains grains (no obstacle), and the region is achievable by only moving p_1 down.
- If the window is found, calculate the desired p_1 and move the probe accordingly.
- Otherwise, run the same process for $p_0 = 45$ and $p_0 = -45$.

Camera attachment

- Attach the camera on top of the probe.
- Make sure to measure the distance between the camera and the tip of the probe.
- Connect the camera USB cable to the designated computer.