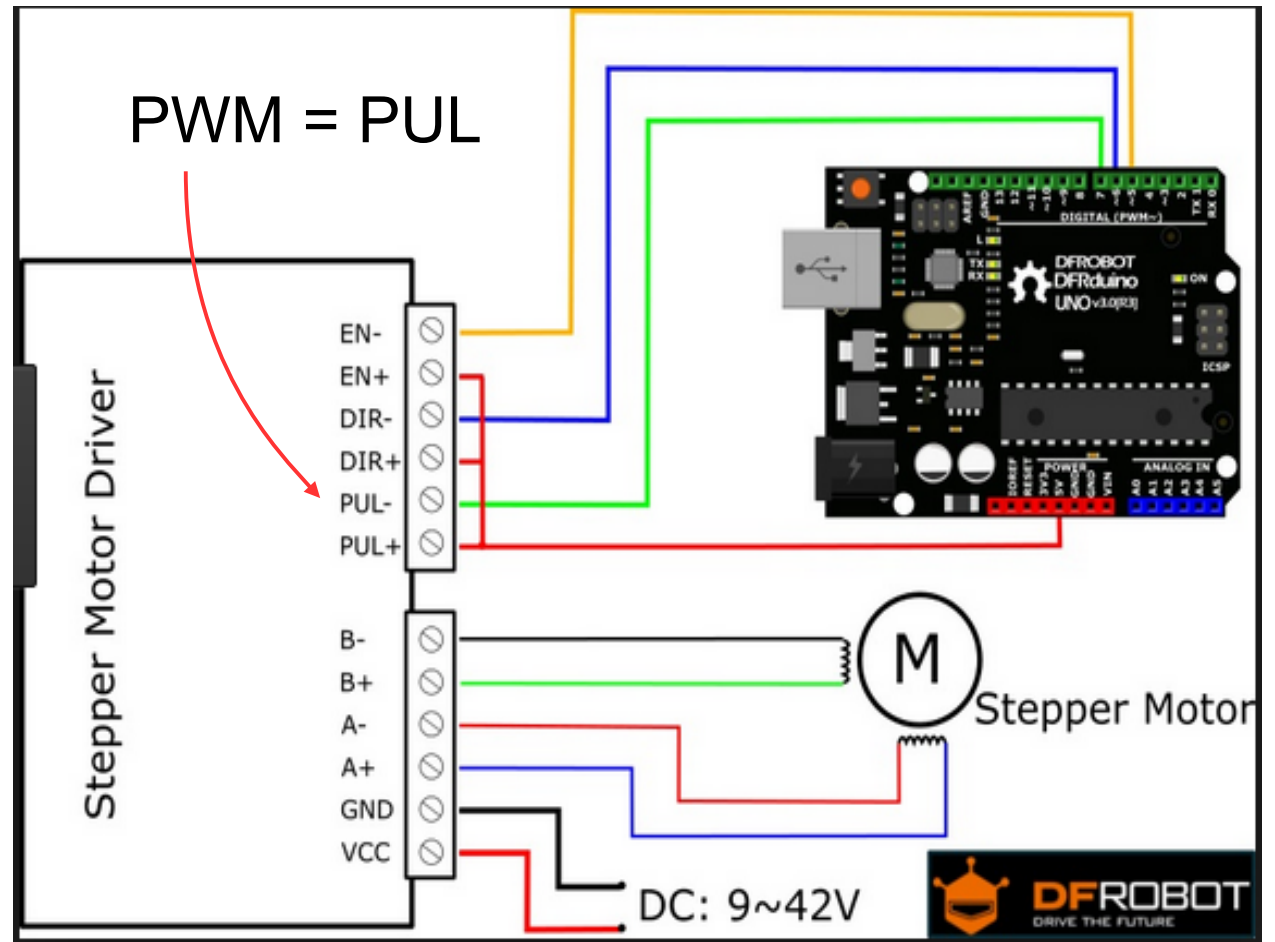


TB6600 4.5A CNC Single-Axis For LDR-40B

Stepper Motor Controller 1 15 USD

https://www.amazon.com/gp/product/B01DIK5IRI/ref=oh_aui_detailpage_o02_s00?ie=UTF8&psc=1

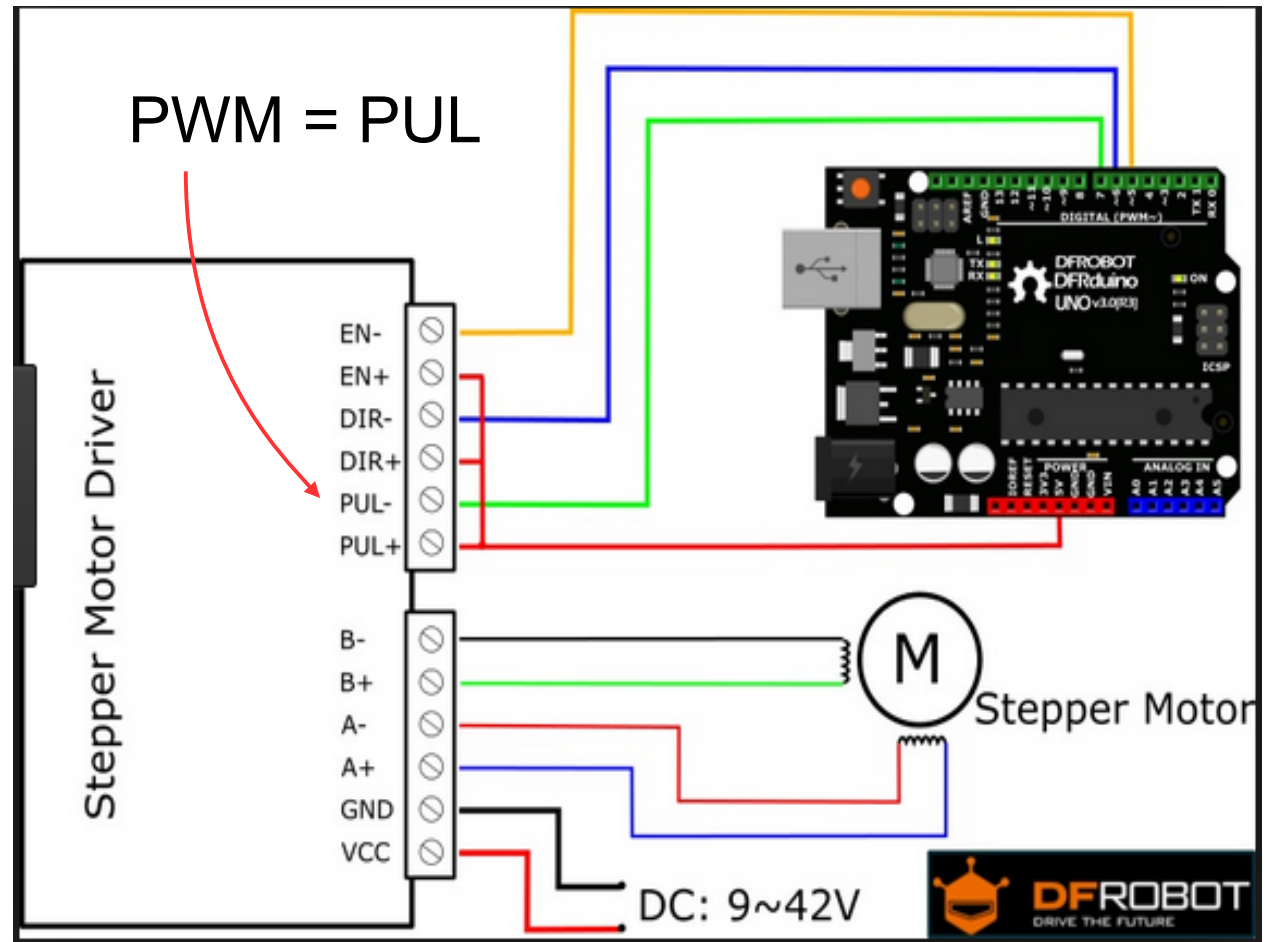


TB6600 4.5A CNC Single-Axis

Stepper Motor Controller 2

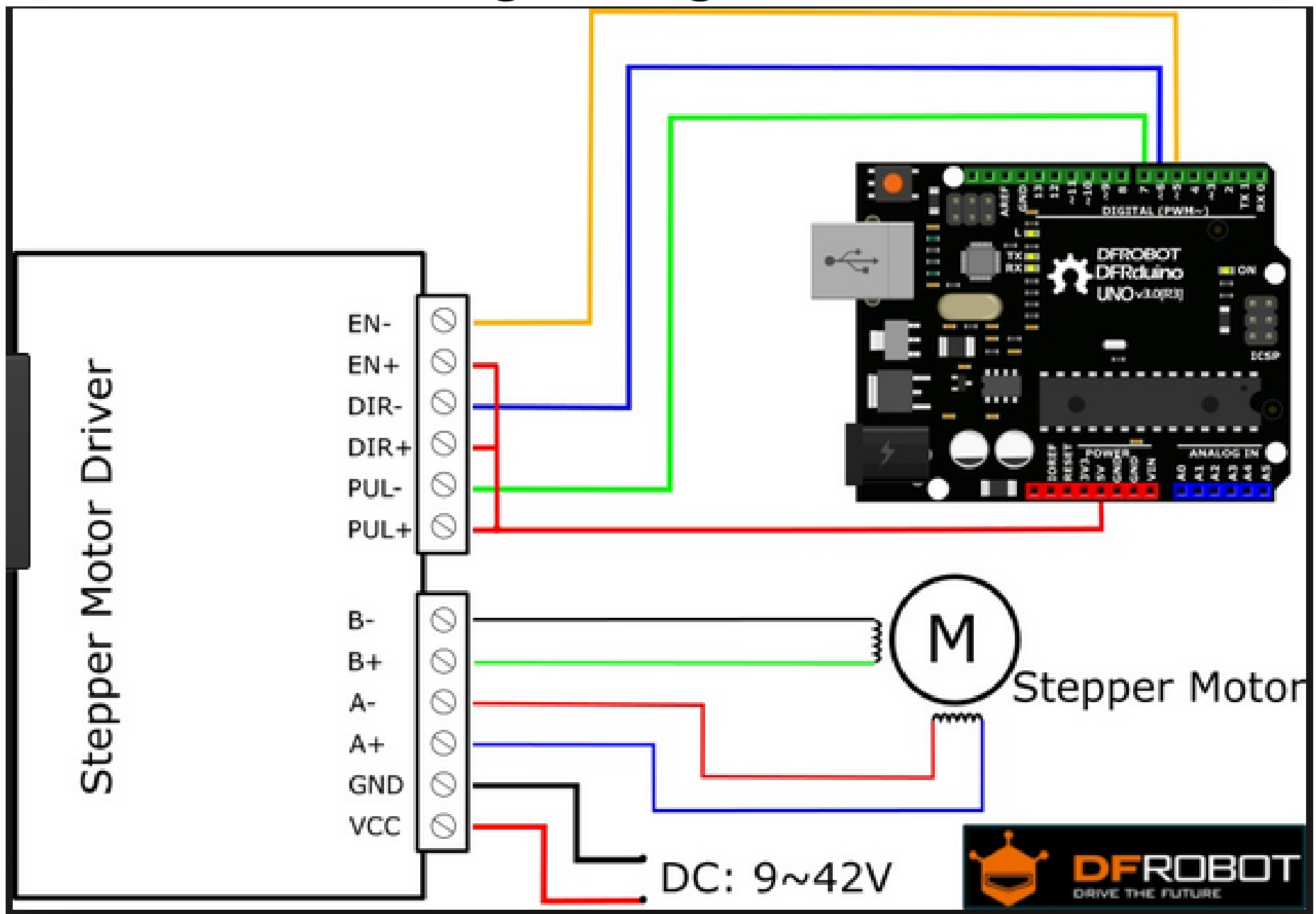
https://www.amazon.com/gp/product/B01DIK5IRI/ref=oh_aui_detailpage_o02_s00?ie=UTF8&psc=1

15 USD



TB6600 4.5A CNC Single-Axis

Wiring Diagrams



TB6600 4.5A CNC Single-Axis Arduino Sample Code

https://www.dfrobot.com/wiki/index.php/TB6600_Stepper_Motor_Driver_SKU:_DRI0043

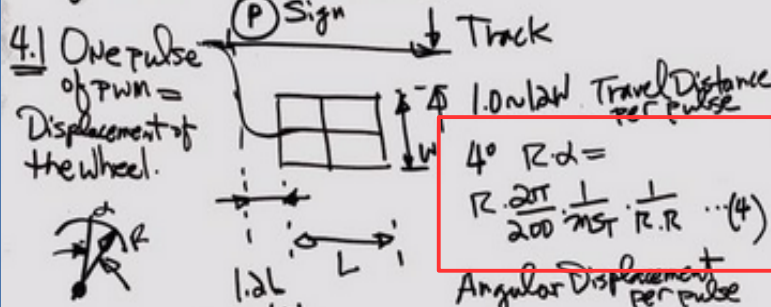
```
int PUL=7; //define Pulse pin
int DIR=6; //define Direction pin
int ENA=5; //define Enable Pin
void setup() {
    pinMode (PUL, OUTPUT);
    pinMode (DIR, OUTPUT);
    pinMode (ENA, OUTPUT);
}
void loop() {
    for (int i=0; i<6400; i++)    //Forward
5000 steps
    {
        digitalWrite(DIR,LOW);
        digitalWrite(ENA,HIGH);
        digitalWrite(PUL,HIGH);
        delayMicroseconds(50);
        digitalWrite(PUL,LOW);
        delayMicroseconds(50);
    }
    for (int i=0; i<6400; i++)    //Backward
5000 steps
    {
        digitalWrite(DIR,HIGH);
        digitalWrite(ENA,HIGH);
        digitalWrite(PUL,HIGH);
        delayMicroseconds(50);
        digitalWrite(PUL,LOW);
        delayMicroseconds(50);
    }
}
```

April 25 18 WHLMOT Wheel

April 25 2018 HL EX.

- 1) 1.5T Motor Drive.
Schedule 3-Party meeting.
9:00 AM (CHN) - 6:00 PM.
- 2) FLK 4000 - Instrument
Before The Enclosure/Frame.
End of the Week (April 28)
- 3) Run Experiment, 1 km/Day = 300 km
ON New Track (H.Z.)

4) LPC1769 Source Code.



$$1^\circ \frac{360}{200} \left(= \frac{2\pi}{200} \right) \text{ For Full Step full revolution. } \dots (1)$$

$$2^\circ \frac{2\pi}{200} \cdot \frac{1}{mst} \left(mst: \text{microstep}, mst = \frac{1}{4} \text{ rev} \right) \dots (2)$$

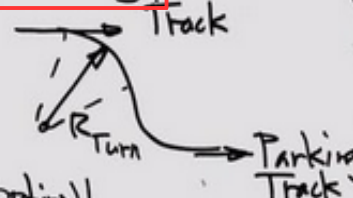
$$3^\circ \frac{2\pi}{200} \cdot \frac{1}{mst} \cdot \frac{1}{RR} \left(RR: \text{Reduction Ratio}, 28:1 \right) \dots (3)$$

5° Experimental Verification.
1000 pulses (15% Duty Cycle ON AGV 4000)

Dist
Displacement Distance for 1000 pulses.

$$\frac{\text{Dist}}{1000} = R \cdot \frac{2\pi}{200} \cdot \frac{1}{mst} \cdot \frac{1}{RR} \dots (5)$$

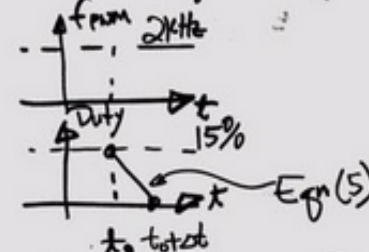
4.2 Turning



Option 1

1° Forward motion can be isolated from Analysis. (AGV Stationary). 2°

5. Soft Start/Stop. (S^3 -Algorithm)



t_0 : "Stop" Received. (Emergency Stop) "Hot" PWR ON
(Normal Stop) "Cold" PWR off

Eqn (5) for S^3 Stop

$$\frac{x_2 - x_1}{x_2 - x_1} = \frac{y_2 - y_1}{y_2 - y_1}, \frac{t - (t_0 + t_{tot})}{(t_0 + t_{tot}) - t_0} = \frac{\text{Duty}_2 - \text{Duty}_1}{\text{Duty}_2 - \text{Duty}_1}$$

$$y = f(x), \text{Duty}(t) = f(t)$$

$$\text{Duty}_2 + \frac{\text{Duty}_1 - \text{Duty}_2}{(t_0 + t_{tot}) - t_0} (t - (t_0 + t_{tot})) = \text{Duty}_1$$

$$\text{Duty} = \frac{\text{Duty}_1 - \text{Duty}_2}{\Delta t} (t - t_0 - t_{tot}) + \text{Duty}_2 \dots (5)$$

April 26 18 WHLMOT Testing

April 26 2018 HL.ZX.

1) Testing WHLMOT Control Equation.

	Dist. (Physical)	Egn Prediction
1) N_1 1×10^6 pulse.		
2) $1.5 N_1$		
3) $2.0 N_1$		

\uparrow
 $\times 15$. Note! S^3 Algorithm.
 2° 2 wheels in same motion.
 3° One wheel stationary, one wheel moving only.

Apr. 26 Experiment design

$$\frac{360}{200} = 1.8^\circ$$

$$\frac{1}{MST} \cdot \frac{1}{RR} = \frac{1}{8} \cdot \frac{1}{35} = \frac{1}{280}$$

$$Dis/pulse = \frac{1.8^\circ}{360^\circ} \cdot 2\pi \cdot \frac{1}{280} \cdot 15\%$$

\nwarrow Duty cycle

$$= 3.42 \times 10^{-6} \text{ m/pulse}$$

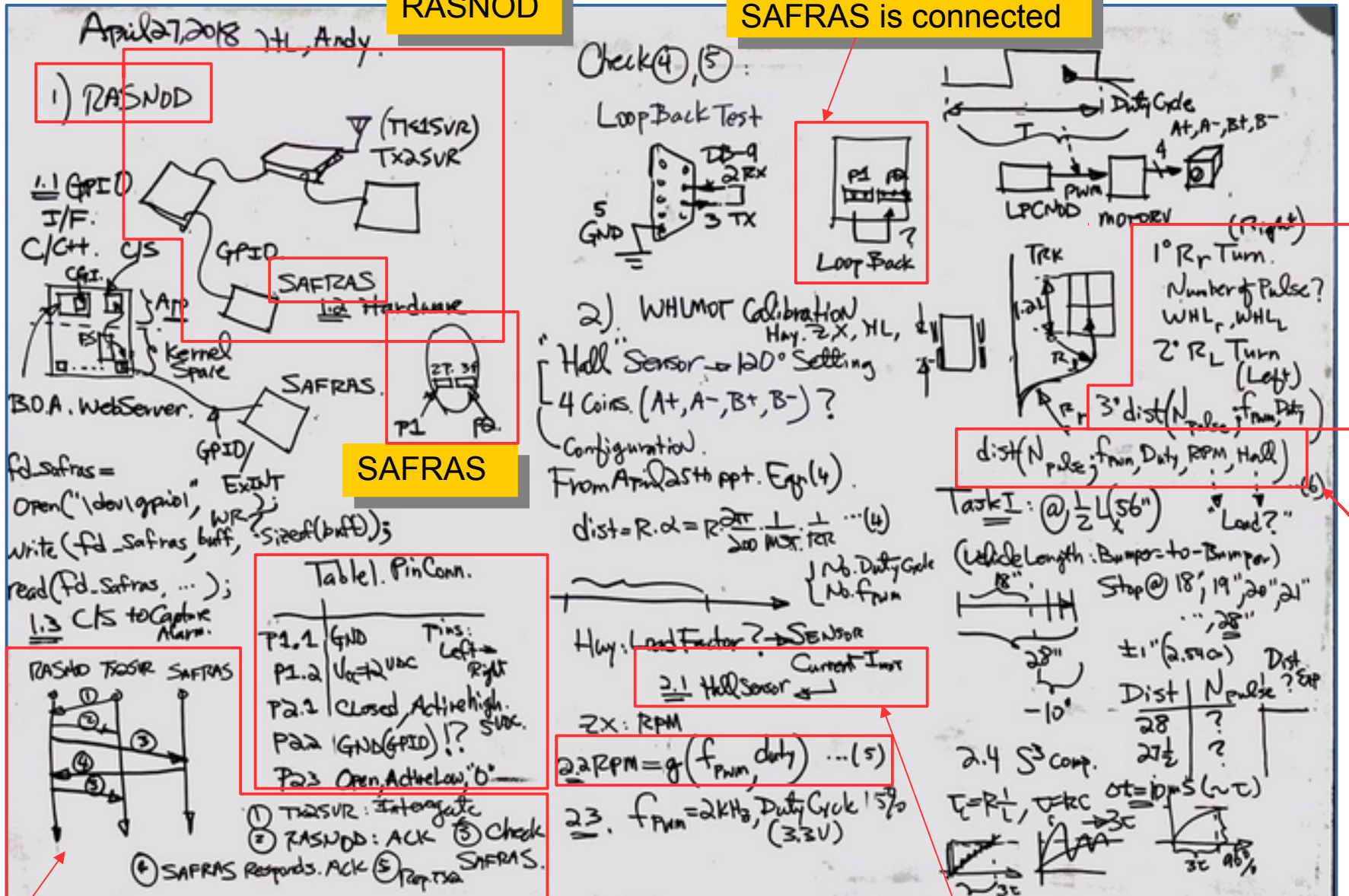
Physical testing:

$$\approx 3.68 \times 10^{-8} \text{ m/pulse}$$

April 27 18 WHLMOT Testing

RASNOD

Loopback to test
SAFRAS is connected



RASNOD+SAFRAS+TX2SVR space-time diagram

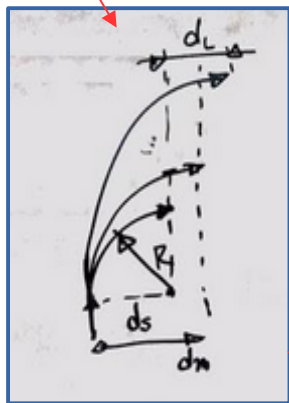
1. Current (hall sensor); 2. RPM (from MOTDRV) affect the number of pulses
formula ???

April 30 18 WHLMOT Testing

Not using this equation, going back to April 25 eqn(4)

1 million pulses = 38 mm ??? use eqn (4), April 25, to verify

Fastest speed leads to Large Turn, stationary leads to Smallest Turn, Speed in between leads to M Turn



April 30, 2018 JHL, Z.X.
 1) Parking: Table (April 27)
 1.1 #define MILDIS 38 /mm.
 #define MILMST 1000000 //MST=1/8

1.2 Formula To Compute No. of Pulse,
 Given Distance. X

$$f_{No}(x) = (x + \text{Const}) / \text{SSlop} * \text{MILMST}$$

Where X: distance in mm. ... (1)

SSlop (Speed Slope) =



From April 25, Eqn (4), For One Pulse,

$$\text{dist} = R \cdot \alpha = R \cdot \frac{2\pi}{200} \cdot \frac{1}{\text{MST}} \cdot \frac{1}{\text{RR}}$$

To find Slop, $\Delta \text{dist} / \text{No. of Pulse} = \text{SSlop}$

= Eqn (4) (April 25)

$$\text{dist} = \text{SSlop} * \text{No. of Pulse} \quad \dots (1)$$

$$\text{No. of Pulse} = \text{dist} / \text{SSlop} \pm \Delta \text{No. of Pulse}$$

Constant

Theoretical plus experimental lead to this formula, use this formula to build all motion control actions

Experiment: Eqn (1)

Dist	No. of Pulse	Exp. Dist
:	:	:

$$\Delta \text{Dist} = \text{Dist} - \text{Dist. Exp.} \quad \dots (2)$$

Error

No. of Pulse = Eqn (1)

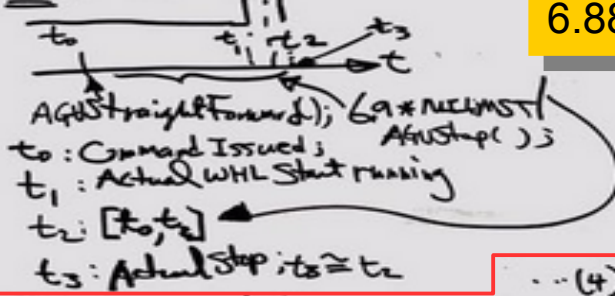
Z.X: Based ON April 26 Data

First 6.5 mil Not Run / Motion

use (No. of Pulse - 6.5 million) ... (3)

Dist	No. of Pulse Eqn (1)	Exp. Dist	Extra No. of Pulse Eqn (3)	Final Dist.
:	:	:	:	:

CONDITIONS:



6.88 million ?

$$\text{No. of Pulse} = \frac{\text{dist}}{\text{SSlop} * 8826} + 6.9 \text{ mil MST} \quad \dots (4)$$

$$\text{SSlop} = R \cdot \alpha \quad \dots (5); \alpha = \frac{2\pi}{200} \cdot \frac{1}{\text{MST}} \cdot \frac{1}{\text{RR}} \quad \dots (6)$$

May 1 WHLMOT Testing

May 1st, 2018 T+L, 2X.

1) Company website: 1.1 Title photo \rightarrow 2.x.
a.com. 1.1 1.1

1.2 Messaging: Customer Design & Integration.
Full stack Embedded Software System
Development for Greater Vision, AI,
and IoT. 1.3 ctione.org. Navigation

2) Parking \leftarrow Vision \leftarrow Photos (EX) \leftarrow Today.

2.1 Experiment-Enhanced Formula.

$$N_{\text{pulse}} = \frac{\text{dist}}{S_i \text{ Slope} * \text{Karl}} + \Delta N \quad \dots (1)$$

$K_{cal} = 88.26$ Calibration coefficient
 $\Delta N = 6.88 \times \text{MILSMT}$ and
 $\text{MILSMT} = 1000000 \text{ if } \text{MST} = 1/8 \text{ (Apr '30)}$

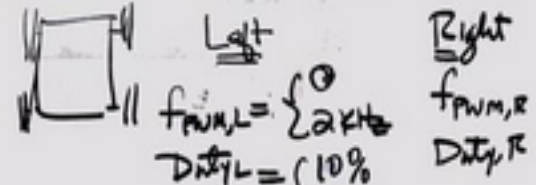
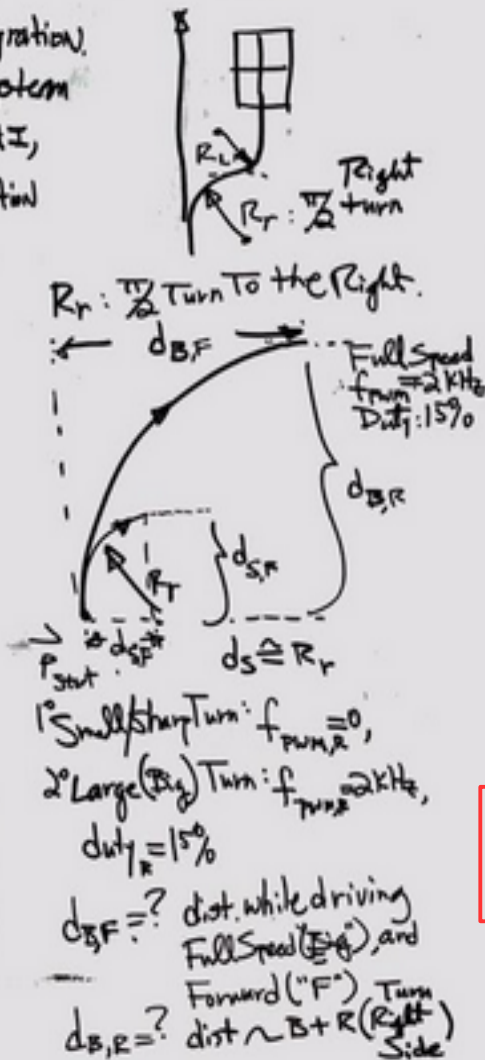
Table	Target Dist	$E_{\text{eff}}(N_p)$	Actual Dist	Error Dist (Target-Act.)
Fine Adjustment	5 mm	"		
	10 mm	"		
	20 mm	"		
	30 mm	"		
	40 mm	"		
	50 mm	"		
	250 mm	"		
	500 mm	"		
	750 mm	"		
	1000 mm	"		

10 pts =

where
 $S_{\text{Stop}} = R \cdot \alpha$
 $= R \cdot \frac{\pi}{200} \cdot \frac{1}{\text{MST}} \cdot \frac{1}{\text{RR}}$
 (5), (6) April 30, 1997

???

22 Parking Turn (Right)



Combinations:

$$1^{\circ} f_{\text{max}}(0) \cdot f_{\text{min}}(2\pi) \cdot \text{Duty}(10\%)$$

$$2 \cdot f_{\text{front}}(2k) \cdot f_{\text{rear}}(2k) \cdot \begin{matrix} \text{Duty}_L(10\%) \\ \text{Duty}_L(15\%) \\ \text{Duty}_L(20\%) \end{matrix}$$

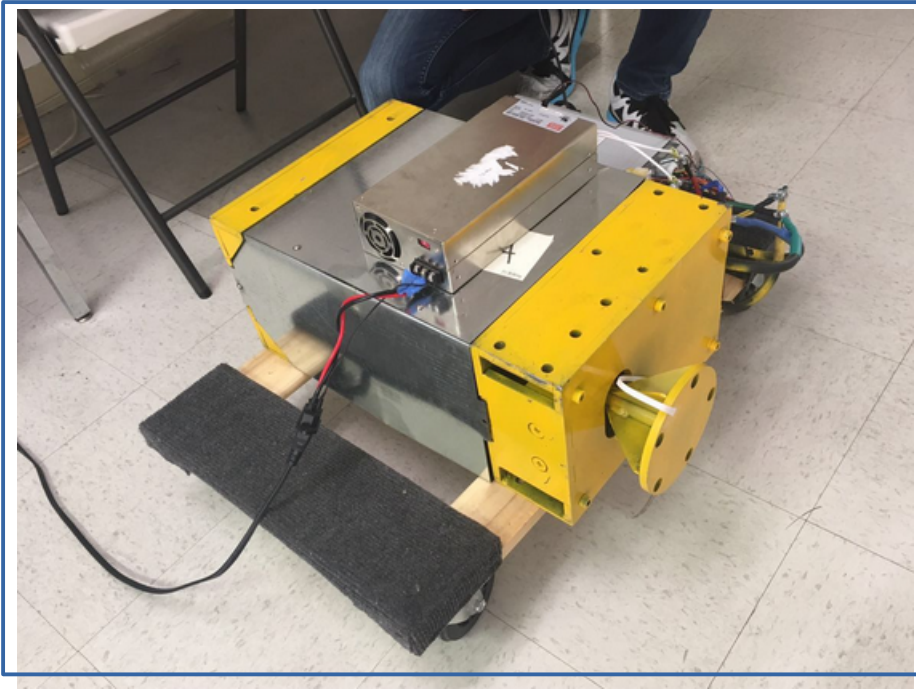
$$3^{\circ} \begin{cases} f_{PWR,R}(0) \cdot Duty_R(10) \cdot \{f_{PWR,L}, Duty_L\} \\ f_{PWR,R}(10) \cdot Duty_R(15) \cdot \{f_{PWR,L}, Duty_L\} \\ f_{PWR,R}(20) \cdot Duty_R(20) \cdot \{f_{PWR,L}, Duty_L\} \\ f_{PWR,R}(2K) \cdot Duty_R(10) \cdot \{f_{PWR,L}, Duty_L\} \\ \quad \cdot Duty_R(15) \cdot \dots \\ \quad \cdot Duty_R(20) \cdot \dots \end{cases}$$

Hence :

$$\{f_{PWR}\} \times \{f_{LDR}\} \times \{f_{PWR}\} \times \{f_{LDR}\} = 36 \text{ events}$$

Test 1. from (b) spts. find N_R d_{SF} d_{SR}
 23 Messaging B/W
 LPCMOD & TX25VR (TX25VR Blocking Sequential)

Motor Control



May 2 Turning Tests

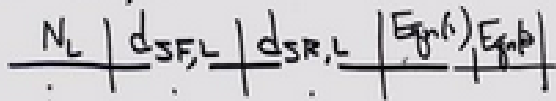
May 2 2018 HL, Z.X.

1) Company website: 1.1 Title photo \rightarrow 2.x
a.com. 111

1.2 Messaging: Customer Design & Integration.
Full Stack Embedded Software System
Development for Computer Vision, AI,
and IoT. 1.3 c1one.org Navigation

2) Z.X, HL, Andy.

2.1 $f_{PWM,R}(b)$ 4.5 Tests



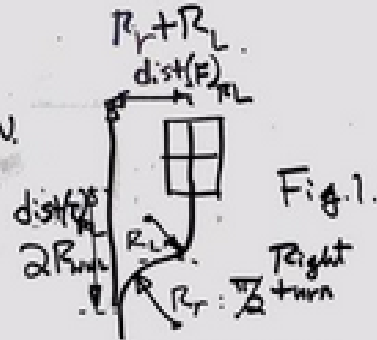
2.2 Formulas

R_{WHL} : For Wheel Base,
Ideally, $ds_{F,L} \geq R_{WHL} \dots (1)$

$$d_{\text{SFL}} \simeq R_{\text{WHU}} \dots (2)$$

Confirmed w/ Experiments for
 $f_{\text{res}}(2k)$, $\text{Duty}(w_i)$ 15%, 30%
 All the Same Result.

2.3. Turns: RT + L.T. (Right Turn + Left Turn)
Centerline as Reference for Displacement.



$R_r: \frac{\pi}{2}$ Turn To the Right.

Full Speed
from 2 kHz
Duty: 15%

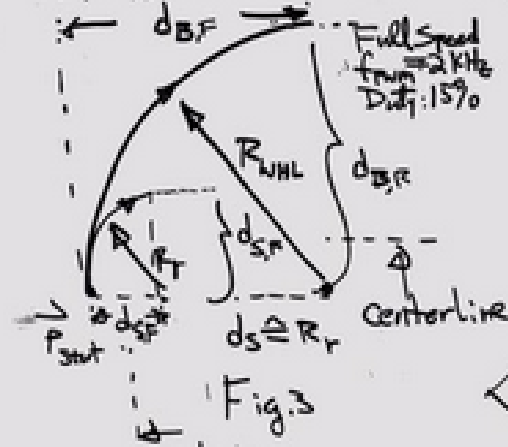
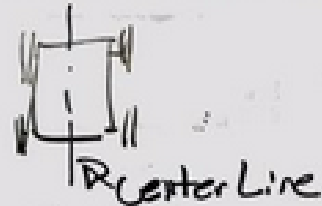
[illegible]

Fig 2.

$$\textcircled{1} \begin{array}{|c|c|c|c|c|} \hline N_L & \text{DSFL} & \text{DSRL} & E_f(1) & E_f(2) \\ \hline \end{array}$$

(2) $N_R \mid \mathcal{D}_{SF,R} \mid \mathcal{D}_{SL,R}, E_f^{(1)}, E_f^{(2)}$

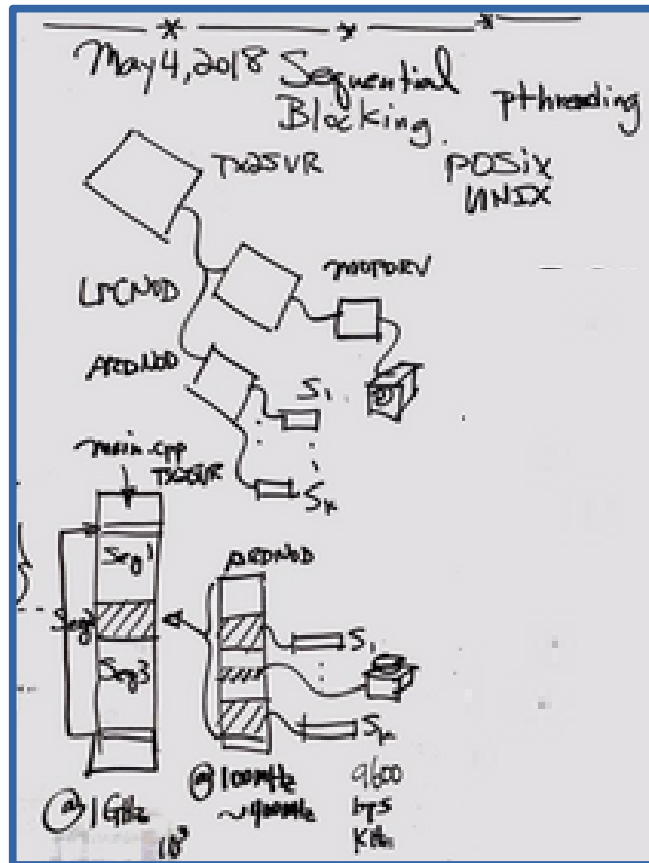
③ $N_L + N_R$ Dist_{RL}(Exp) (Theoretical) Dist_{RL}(F) ↓

3. Messaging B/w Andy (Theoretical)
SAFRAS $\text{dist}_n(F)$
and TEASNo.

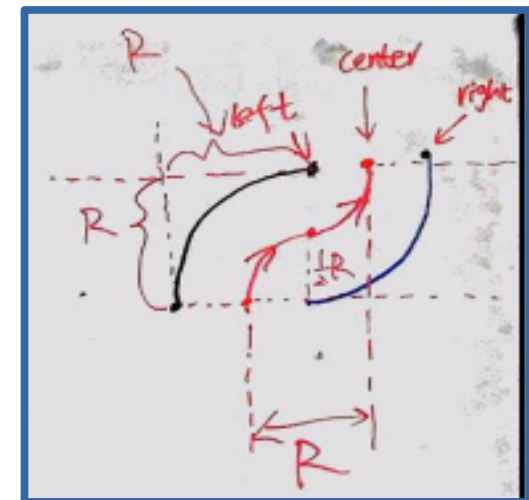
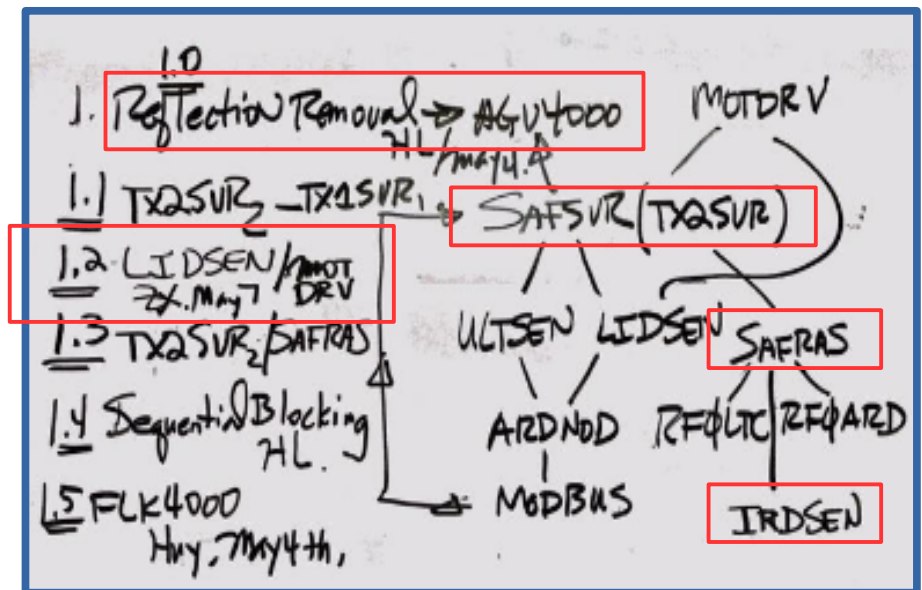


23 Messaging B/W Phase:
LPCMD & TX2SVR (TX2SVR Blocking Sequential)

May 4 Sequential Blocking, FLK4000



Solve sequential blocking: 1. interrupt; 2. pthreading



Conclusion: the tightest turn distance is R

May 7 Turning Arbitrary Angle

May 2 2018 HL, Z.X.

- 1) Company Website: 1.1 Title photo \rightarrow Z.X. PPT.
 1.2 Messaging: Customer Design & Integration.
 Full Stack Embedded Software System
 Development for Computer Vision, AI,
 and IoT. 1.3 ctione.org. Navigation

May 7, 2018. HL, Z.X.

1. Reflection Removal Release 1, R1

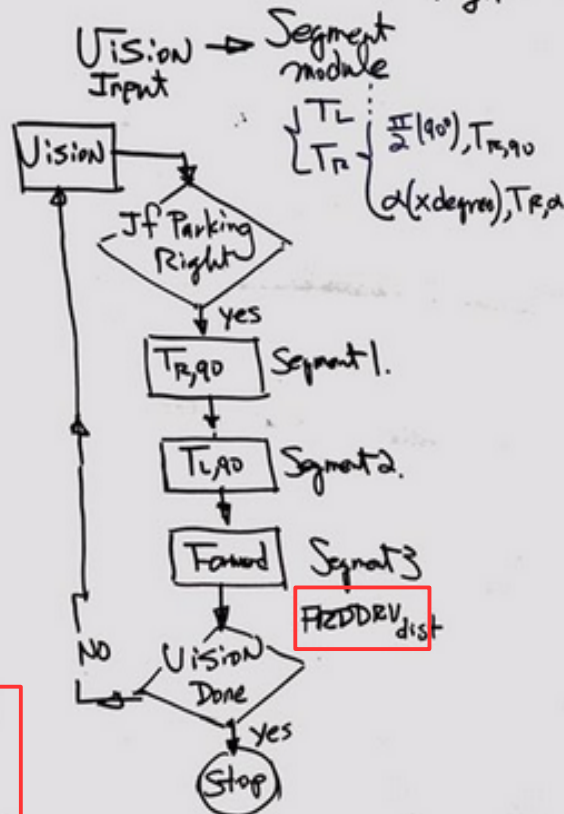
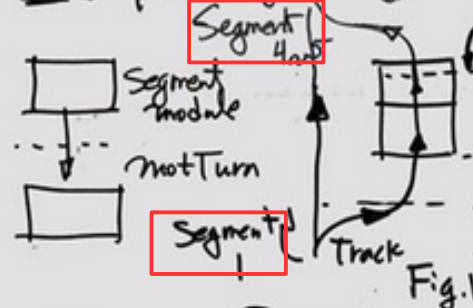
- 1.1 Separate Module. videoTrack/Reflection
 May 8. HL, Z.X. - inRange-final.cpp.
 DUTXASUR. 1.2 NoiseRemoval. Clean
 up the Video Result.
 VidPat.cpp. Contours. May 8, HL.
 Integration.

2. Parking: Motion Control \rightarrow module.

- 2.1 Turn
 - Left Turn T_L
 - Right Turn T_R $\left\{ \begin{array}{l} \frac{\pi}{2}(90^\circ) \text{ Turn}, T_{R,90} \rightarrow N_{R,90} \\ \alpha(x \text{ degree}), T_{R,\alpha} \rightarrow N_{R,\alpha} \end{array} \right.$

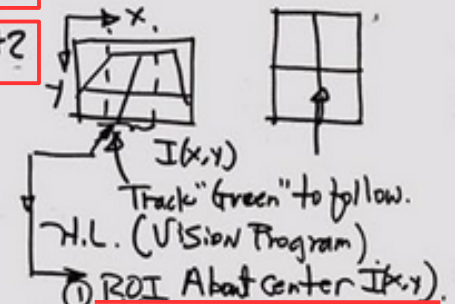
```
int motTurn(uint8 : WHL { Left wheel 1 (input)
                          Right wheel 2 (input)
                          Both. 3
                          input
int f_pwmL, f_pwmR (f_pwm);
int dutyL, dutyR; int angle; expFlag:1
int N_pwmL, N_pwmR, int expFlag) Computed Already
```

2.2 Composition of Driving/Parking



3. Parking Exit

- 3.1 Vision Program to Track The "Green" we want.



- ① ROI About center $I(x,y)$
- ② Angle $\alpha \in [-\alpha_d, +\alpha_d]$

$$|\alpha_d| \text{ or } |\alpha| \leq \Delta_{\text{Bound}}(15^\circ)$$

- 3.2 X Second Parking/Stay ~ 5 seconds.

Exit from Parking Resume to the Loop (Normal Track) in Fig. Segment 4 + 5.

Question: Resume Reference point? from "Stop" or from Vision?

April 27 18 SAF

