

EECS 192: Mechatronics Design Lab

Discussion 5: Velocity Sensing

GSI: Andrew Barkan

February 17, 2021 (Week 5)

- Velocity Sensing
- Pulse Counting
- Encoder Demo

Review of Optical Encoder Basics

Line Sensors

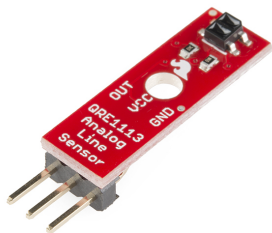
- ▶ Use combination of LED and photosensitive diode to detect change in reflectivity
- ▶ Sends out analog signal based on reflectivity of surface

Encoders

- ▶ Mount encoders somewhere on the car
- ▶ Radially encoded with changes in reflectivity

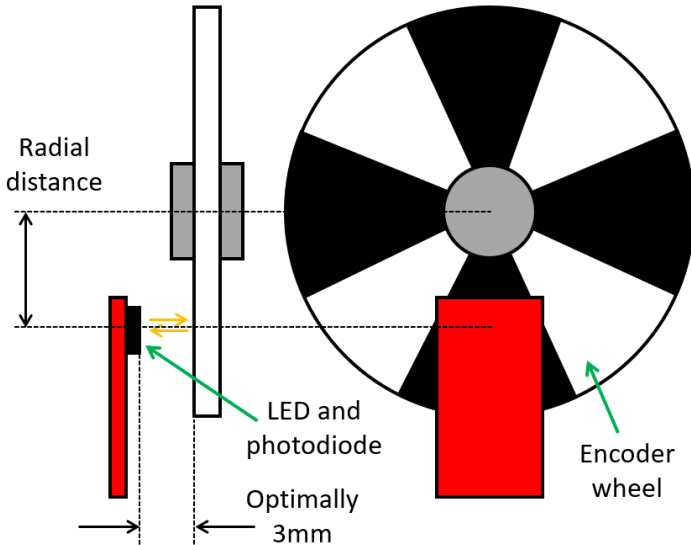
Considerations

- ▶ Mechanical stability?
- ▶ Resolution?
- ▶ Time to build?



Line sensor from
Sparkfun

Design Considerations



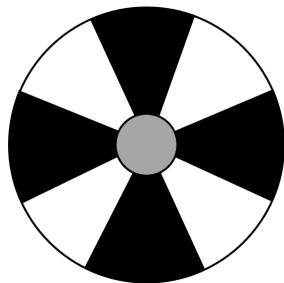
Prototype Your Encoder Wheel

Reflectivity of surfaces

- ▶ Printing? Taping? Laminating?
- ▶ The reflectivity will determine signal distinction

Number of transitions

- ▶ Depends on expected rev/s
- ▶ How many can fit?
- ▶ How many can you reliably distinguish?

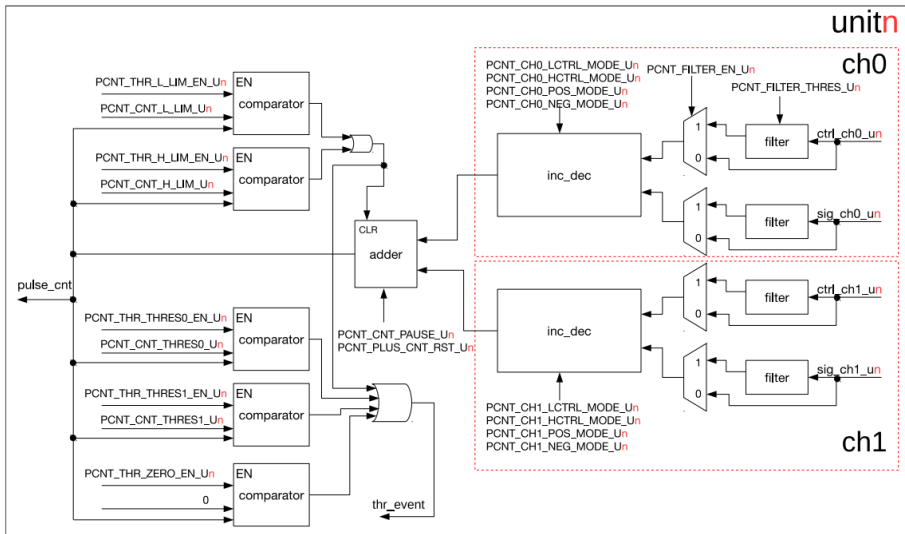


A Few Gentle Tips

- ▶ Search for the most mechanically robust spot on your vehicle!
- ▶ Drive shaft shifts forward/backward
- ▶ Wheels move up/down due to suspension
- ▶ Pay attention to assembly/disassembly
 - ▶ Take pics before disassembly!
 - ▶ Keep track of fasteners
- ▶ 4WD : Differential prevents one wheel from spinning the rest of linkage
- ▶ When testing velocity control, apply friction



Pulse Counting: One Option for Velocity Sensing



Pulse Counting: One Option for Velocity Sensing

```
static void pcnt_example_init(int unit)
{
    pcnt_config_t pcnt_config = {
        // Set PCNT input signal and control GPIOs
        .pulse_gpio_num = PCNT_INPUT_SIG_IO,
        .ctrl_gpio_num = PCNT_PIN_NOT_USED,
        .channel = PCNT_CHANNEL_0,
        .unit = unit,

        // What to do on the pos/neg edge of input?
        .pos_mode = PCNT_COUNT_INC,
        .neg_mode = PCNT_COUNT_INC,

        // What to do when control input is low or high?
        .lctrl_mode = PCNT_MODE_KEEP,
        .hctrl_mode = PCNT_MODE_KEEP,

        // Set the max and min limit values to watch
        .counter_h_lim = PCNT_H_LIM_VAL,
        .counter_l_lim = PCNT_L_LIM_VAL,
    };
};
```

Pulse Counting: One Option for Velocity Sensing

```
/* Initialize PCNT unit */
pcnt_unit_config(&pcnt_config);

/* Configure and enable the input filter */
pcnt_set_filter_value(unit, 100);
pcnt_filter_enable(unit);

/* Initialize PCNT's counter */
pcnt_counter_pause(unit);
pcnt_counter_clear(unit);
pcnt_counter_resume(unit);
}

void get_count()
{
    pcnt_get_counter_value(pcnt_unit, &count);
}
```


Encoder Demo