In the name of God

Univrsity of Tehran

Faculty of engineering

Electrical and computer faculty

**Linear control systems lab**

**CA #2**

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Group numb:5

Azar 1398

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Abstract

# Part 3

## 2-1. Filtering the data

Noise:

The receiving electronics will respond to input signal that is either logical “0” (less than 0.4 volt) or logical “1” (greater than 2.0 volts). The region between 0.8 and 2.0 volts is logically undefined and the transition through this region must be very rapid (less than 1 microsecond). As the leading edge of the waveform is distorted, the transition time increases. At some point the receiver becomes unstable and encoder counts must be gained or lost. The primary cause of the distortion is cable length or more specifically cable capacitance. Frequency response of the electronic scan also distort the signal.

phase error is a result of amplitude changes in the output with respect to the input.

Electrical Noise:

The problem of radiated electrical noise can generally be overcome with a few simple precautions. Signal cables should always be run in trays isolated from other AC carriers and kept from the vicinity of noise generators such as electric welders and large AC motors. In addition to radiated noise, encoder operation may be influenced by transients in the encoders power supply. line variations are a problem and line regulating is required for best results. Unregulated lines may introduce noise spikes into the encoder which can damage both the light source and encoder electronics.

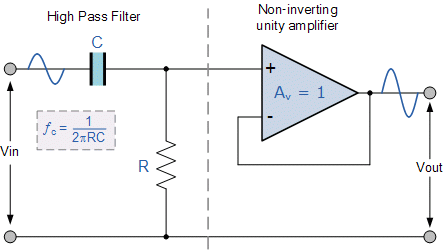
Encoder error consists of quantization error, instrument error, and cycle interpolation error.

Factors that create error:

1. Manufacturing and Material Tolerances 2. Silicon Cell Characteristics 3. Scale or Disc Alignment 4. Regulation of Power Supply 5. Electrical Noise 6. Temperature Variation 7. Mechanical Coupling 8. Mechanical Vibration

Filters:

When a light beam passes through a rotary polarizer and after through a fixed analyzer behind which a photo receiver is located a graph can be generated in the plane formed by the detected intensity of light versus the angular position of the polarizer. Defining the keyword “system noise” as a random fluctuation of system variables that degrades the quality of signals and data; then,   is accurate, only for imperceptible levels of system noise. So we need 1. The filter for a peak. And 2.  The filter for a valley.



**Active High Pass Filter**

An Active High Pass Filter can be created by combining a passive RC filter network with an operational amplifier to produce a high pass filter with amplification.

where should we use filters:

In many cases an encoder interface must filter the incoming encoder signals before further processing them. This may be required to reject low-level noise and brief, large-amplitude noise spikes commonly found in motor applications. in the case of mechanical-type encoders, to debounce A and B to avoid count errors due to mechanical contact bounce. Hardware-based interfaces often provide programmable filters for the encoder signals, which provide a wide range of filter settings and thus allow them to debounce contacts or suppress transients resulting from noise or slowly slewing signals, as needed. In bit-bang interfaces, A and B typically are connected to [GPIOs](https://en.wikipedia.org/wiki/GPIO) that are sampled (via polling or edge interrupts) and debounced by software.

Parameters of our filter:

the value of shaft position

the value of angular speed

the angular acceleration

Based on the allocation of the filter transfer function poles and a scaling factor.

Problems of using filters:

Kalman filter was pioneered by Rudolf Emil Kalman in 1960, originally designed and developed to solve the navigation problem in Apollo Project. Since then, numerous applications were developed with the implementation of Kalman filter, such as applications in the fields of navigation and computer vision's object tracking. Kalman filter consists of two separate processes, namely the prediction process and the measurement process, which work in a recursive manner. Filters are widely used for the modulation, typically attenuation, of amplitudes of different frequencies within neurophysiological signals. Filters, however, also induce changes in the phases of different frequencies whose amplitude is unmodulated. These phase shifts cause time lags in the filtered signals, leading to a disruption of the timing information between different frequencies within the same signal and between different signals.

# Part 4

## 2-1. Filtering the data

### 4-1. converting angle to its standard value

m = n -

Encoders consider angle negative as it increase

### 4-2. converting position to its standard value

|  |  |
| --- | --- |
| X(m) | n |
| -0.70 | -1.596\* |
| -0.375 | -8590 |
| 0 | 0 |
| 0.375 | 8587 |
| 0.70 | 1.578\* |



Graph I

This graph is the result of data fitting of the table above

# Part 5

# Ps1: process of program

We have two matlab files one of them called position fitting is the curve fitting tools and the other is called m which converts the number of pulses to its standard value with simulation gains.

# References

[1] By Lim Chot Hun, Ong Lee Yeng, Lim Tien Sze and Koo Voon Chet.Submitted: October 29th 2015Reviewed: February 3rd 2016Published: June 8th 2016.DOI: 10.5772/62352. [Online]. Available: <https://www.intechopen.com/books/real-time-systems/kalman-filtering-and-its-real-time-applications>

[2] [eNeuro](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5952323/). 2018 Mar-Apr; 5(2): ENEURO.0261-17.2018.Published online 2018 Apr 19. Prepublished online 2018 Apr 11. doi: [10.1523/ENEURO.0261-17.2018](https://dx.doi.org/10.1523%2FENEURO.0261-17.2018) .[Online]

Available: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5952323/>

[3] Incremental encoder. From Wikipedia, the free encyclopedia. [Online]

Available: <https://en.wikipedia.org/wiki/Incremental_encoder>

[4] Armando Bellini, Stefano Bifaretti, Stefano Costantini.” [A Digital Speed Filter for Motion Control Drives with a Low Resolution Position Encoder](file:///C:\Users\ASUS\Downloads\Documents\97869d395271a4daa92ba6fb7c010575ceb2.pdf) “PDF .UDK 621.313.07:621.371.54 IFAC IA 3.2.1;4.6

[5] Introduction to encoders. “[Encoders](file:///C:\Users\ASUS\Downloads\Documents\Encoders.pdf)” PDF.