

Overview of Position Sensors : From Electromechanical To Electronic To Fiber Optics

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Outline

1. What Are We Trying To Control?
 - Different Bridge Types-Different Degrees of Motion
 - How A Typical Actuation System Works
2. Types of Position Sensors and Application Examples
 - Case #1: Geared Limit Switch for Wind Turbine
 - Case #2: Selsyns for Bascule Bridge
 - Case #3: Optical and Fiber Optic Rotary Encoders for Lift Bridge (including discussion of resolvers)
3. Comparison of Position Sensor Technologies
 - Advantages
 - Disadvantages
4. Questions?

Micronor Overview

Serving Industry For Over 40 Years

Since 1968, Micronor has been supplying motion control products for industrial automation, military, aerospace and other harsh/hazardous environmental applications. Thousands of Micronor solutions have been controlling equipment from CNC machines to cranes, from ship diesel engines to nuclear power plants and aerospace systems.

Product Range

Products include rotary/linear encoders, resolvers, rotary limit switches, feedback transducers, cam timers, motorized potentiometers, manual pulse generators and handheld pendant stations.

Position Sensor and Feedback Transducer Specialists

Feedback Transducers are the integration of any type and combination of position sensor in an application-specific housing - including encoder, resolver, synchro, tach, potentiometer, rotary limit switch, etc.

First Commercialized Fiber Optic Rotary Encoder (Patented)

Micronor's ZapFREE™ encoders are the world's first commercialized, totally passive fiber optic rotary encoders. U.S. Patent 7,196,320



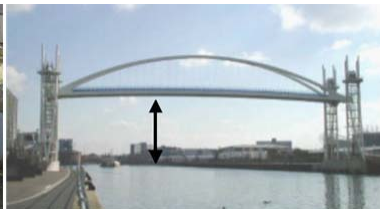
1. What Are We Trying To Control?



Leaf Bridge



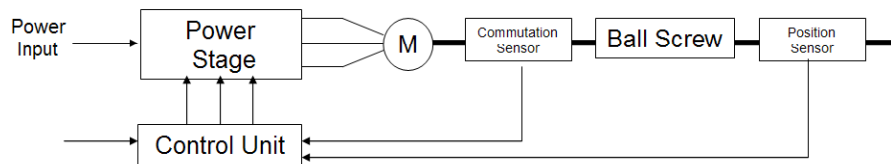
Rotating Bridge



Lift Bridge

Different Types of Bridges-Different Degrees of Motion

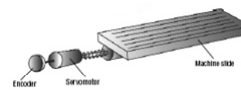
Typical Motor Drive/Actuator Circuit Diagram



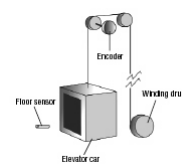
Rotary/linear sensors provide critical feedback to motor drive and actuation control systems:

- Direction
- Speed
- Commutation
- Position

CNC Machine



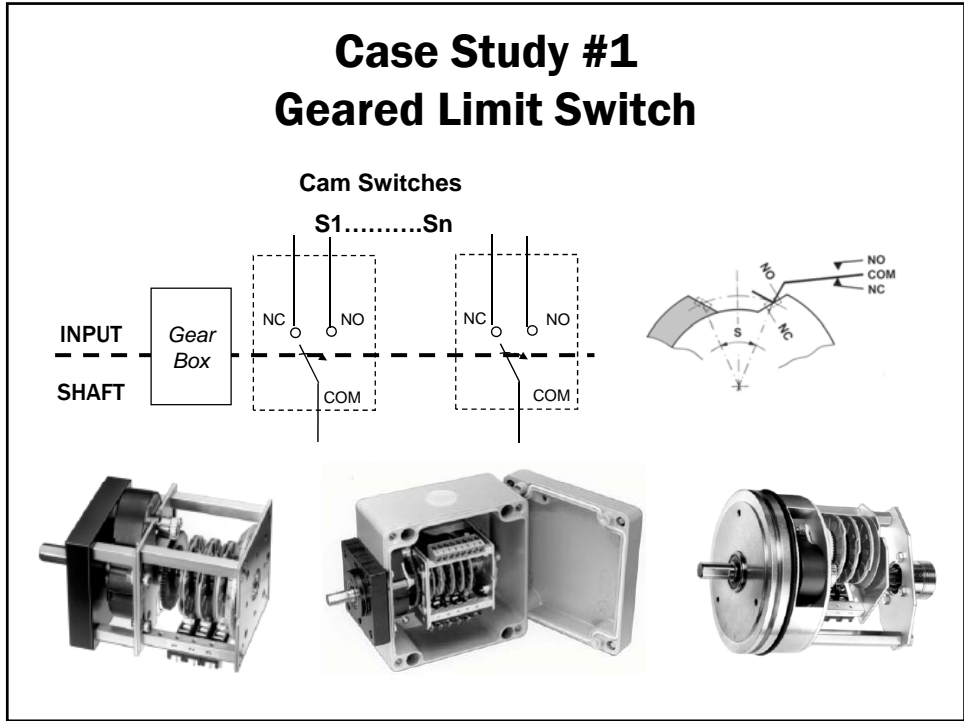
Elevator



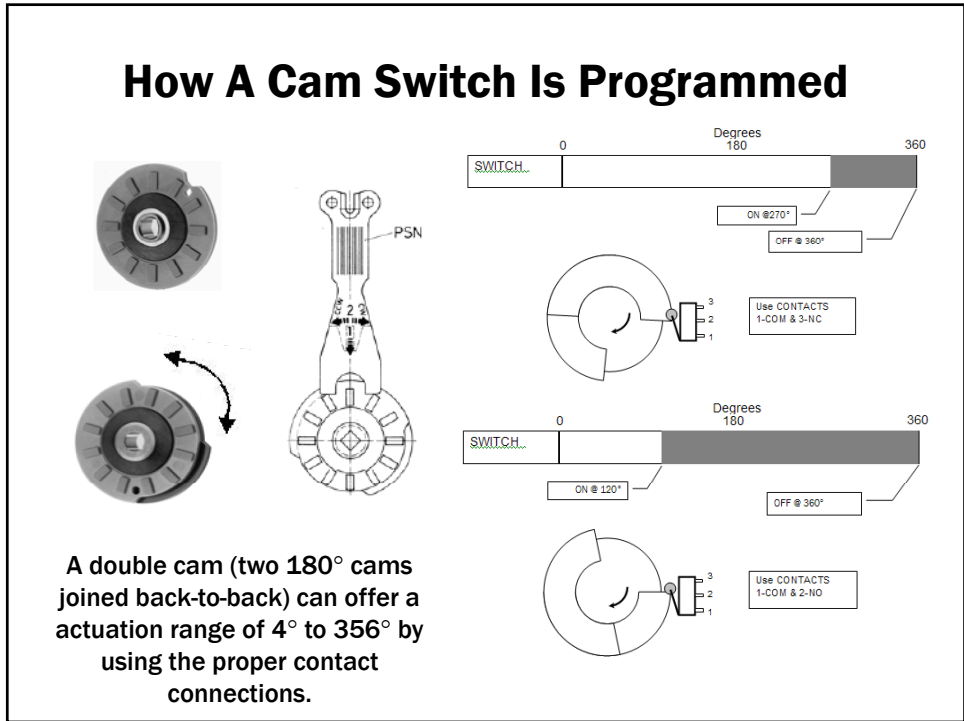
Types of Position Sensors

1. Rotary Limit Switch – Case #1
2. Selsyns – Case #2
3. Combination Feedback Units – Case #1 and #2
4. Resolvers – Case #3
5. Optical (or Magnetic) Rotary Encoders – Case #1 and #3
6. Fiber Optic Rotary Encoders – Case #3

Case Study #1 Geared Limit Switch



How A Cam Switch Is Programmed



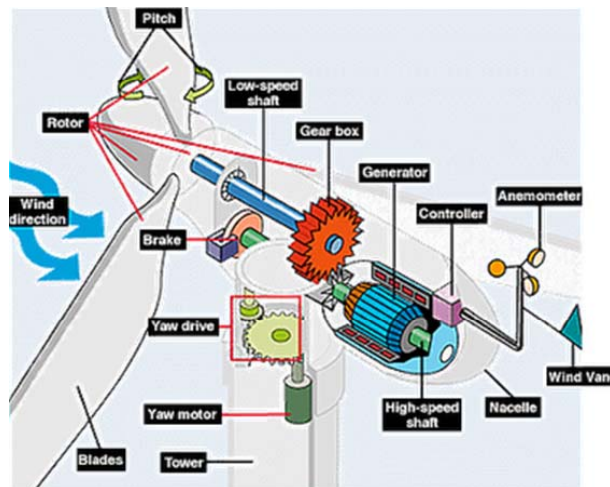
Why Use Rotary Limit Switches?

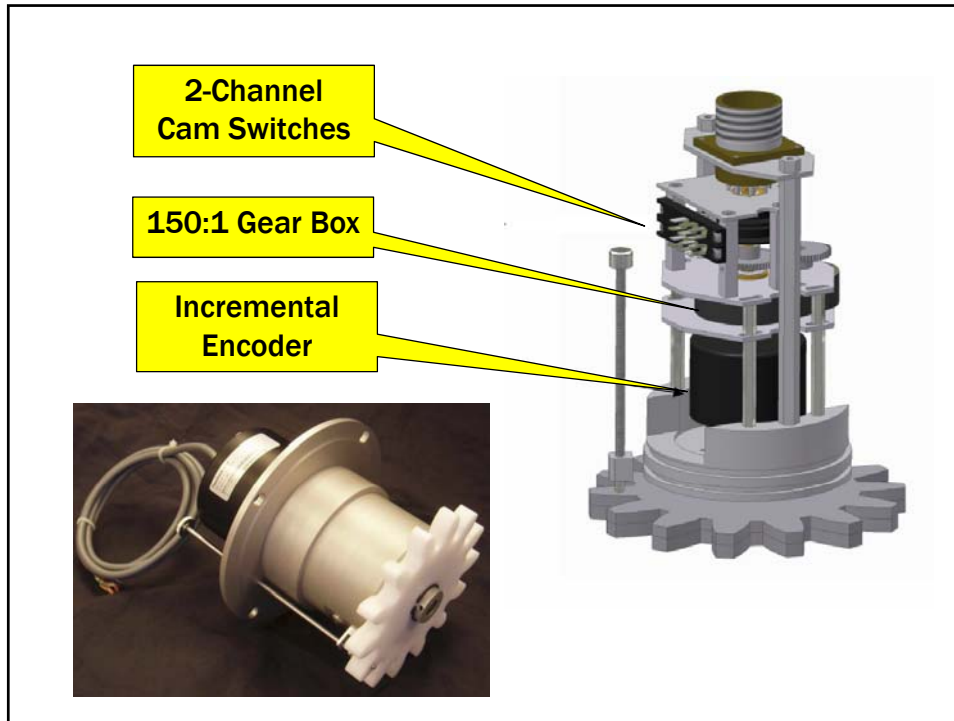
1. Most basic electromechanical control
2. Discrete Position Control or Failsafe Back-up
3. No power or control electronics required
4. No computer to program
5. No software to maintain
6. Unaffected by EMI or lightning
7. Simple, rugged and robust

Application: Yaw Sensor For Wind Turbine (New England)

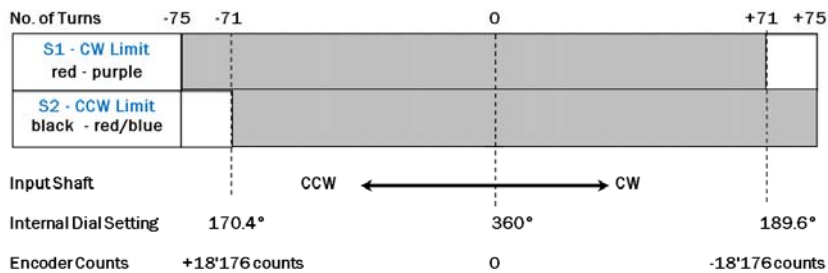


The wind turbine yaw mechanism is used to turn the wind turbine rotor against the wind.



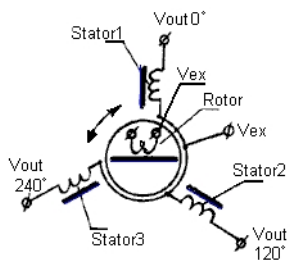


Requirement: Limit switches indicate when internal cables have become twisted 7 turns in either direction. Then control system will engage brake and motor will turn the turbine back to zero position. An incremental encoder output (256ppr) is counted to track absolute position.



NOTE: 1. Shaded area denotes contact closed.

Case Study #2: Selsyns and Combination Feedback Units

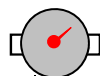


Schematic Diagram of Selsyn

(Similar to Electric Motor)

Angular Position Sensor (Selsyns Transmitter)

(Selsyns Transmitter)



Secondary Windings of Transmitter & Receiver Selsyns Are Tied Together

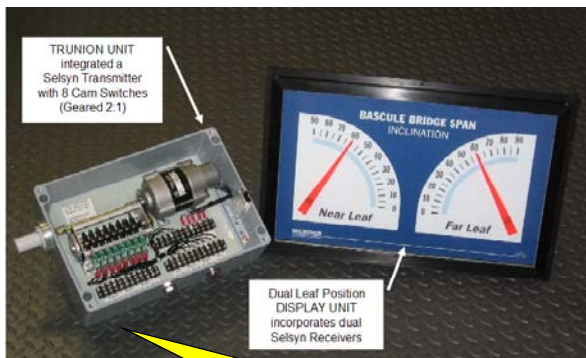
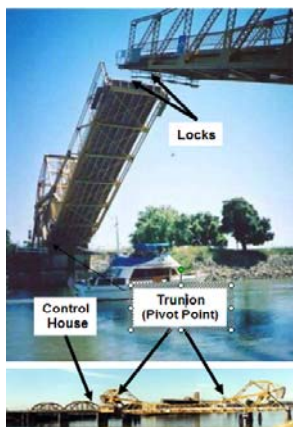
Display Indicator

(Selsyns Receiver Mechanically Coupled to Position Indicator on DISPLAY UNIT)



Primary Windings of Transmitter & Receiver Selsyns Are AC-Powered

Application: Bascule Bridge (Sacramento Delta, CA)



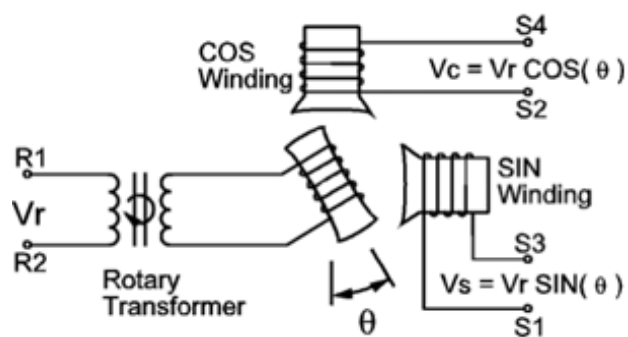
**Combinational Feedback Unit:
XMTR Selsyn +
8 Cam Switches (Geared 1:2)**

Case Study #3: Encoders versus Resolvers

Encoders and Resolvers are both popular types of rotary sensors. Many times the terms are used interchangeably but they are very different!

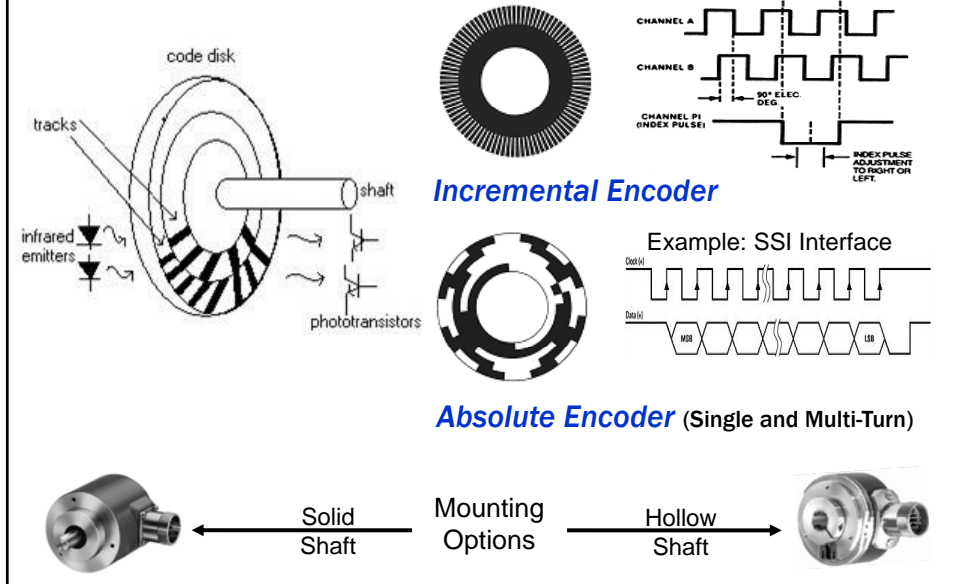
- Encoders are digital in nature, Resolvers are analog
- Encoders contain electronics while Resolvers require an external R/D interface. Exception is fiber optic encoder which is passive).
- Encoders can internally be optical or magnetic, but the output options are the same (incremental, SSI, analog, Fieldbus, etc.)
- Potentiometers are another type of rotary sensor, but not considered here due to reliability concerns.

How A Resolver Works

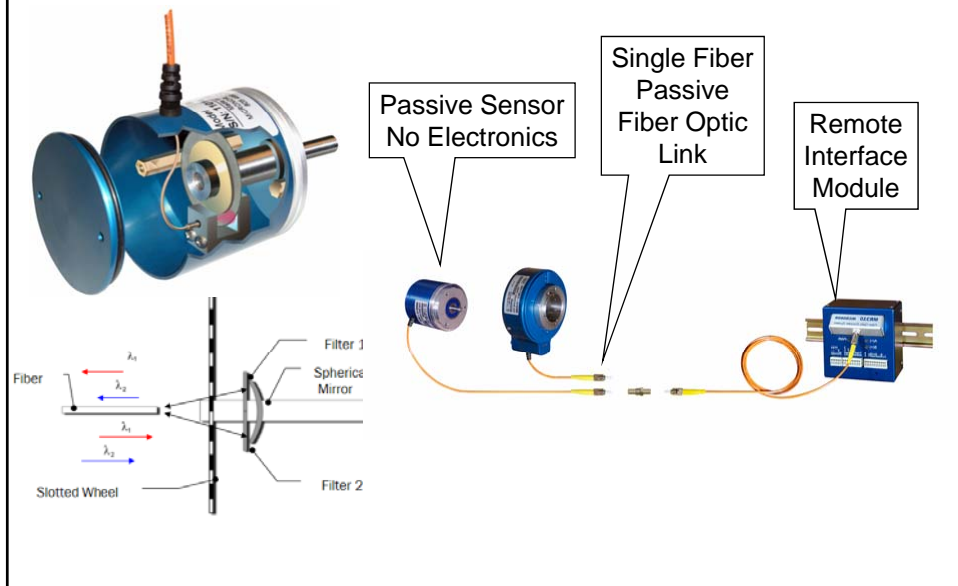


Three variations of Brushless Resolvers
- Shafted, Frameless and Geared

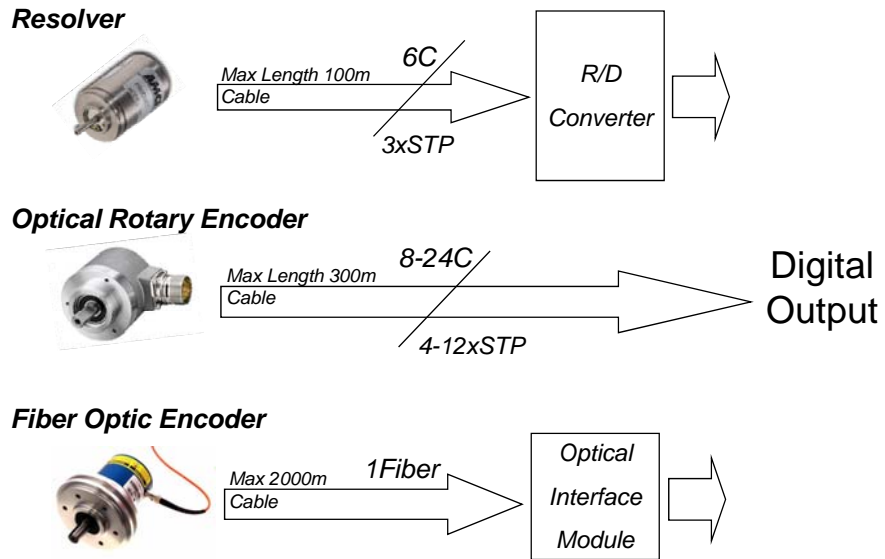
How An Optical Encoder Works



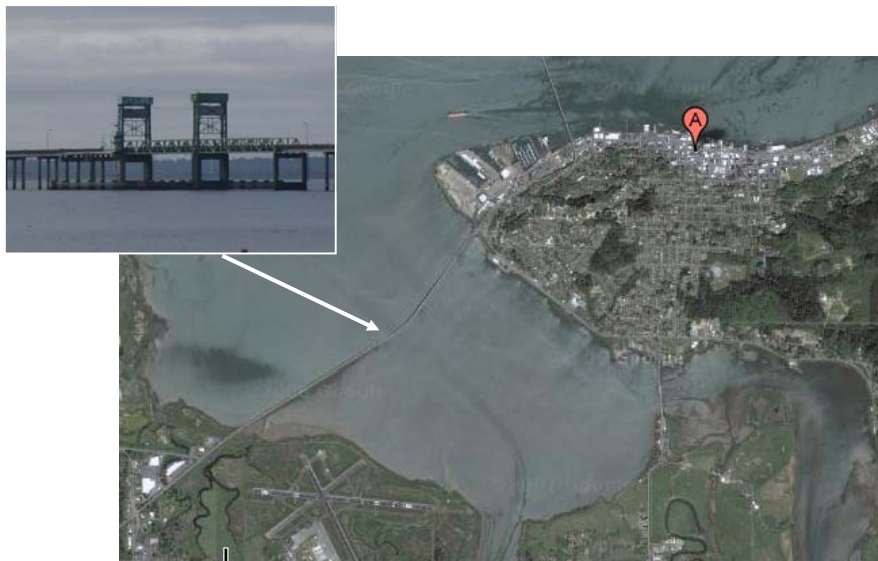
How A Fiber Optic Encoder Works

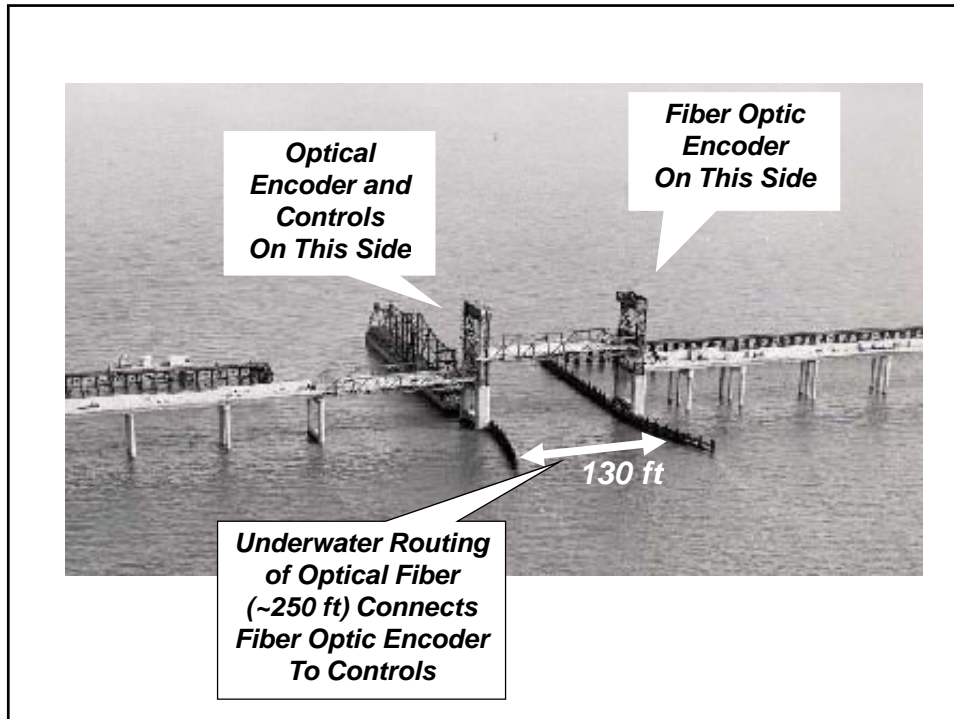


Cabling Requirements



Application: Lift Bridge (Astoria, OR)





3. Comparison Chart of Sensor Technologies

Advantages and Disadvantages of each type:

- Technological Maturity
- Supplier Base
- Temperature Range
- External Interface Requirements
- Discrete or Continuous Position Sensor?
- EMI Sensitivity
- Remote Sensor Power Requirements?
- Cabling Requirements + Number of Conductions
- Maximum Distances
- Cost

Type	Geared Limit Switch	Selsyns (Synchros)	Resolver	Optical Rotary Encoder	Fiber Optic Rotary Encoder
Classification	Electromechanical	Electrical	Electrical (requires remote R/D interface)	Optoelectronic	All Optical
Years In Use	100+ years	50+ years	50+ years	10+ years	5 years
Multiple Suppliers?	Few	One	Few	Many	Few
Active or Passive Sensor?	Passive	Active	Semi-Active	Active	Passive
Temperature Range	-40/+85°C	-0/+55°C	-55/+125°C (+150°C)	-20/+70°C (+100°C)	-60/+150°C
External Interface Required?	No	Yes. Requires Selsyn RCVR.	Yes	No	Yes
Discrete or Continuous Position?	Discrete	Continuous	Continuous	Continuous	Continuous
Sensitive to EMI?	No	No	Yes	Yes	No
Remote Sensor Power Required?	No	Yes	No	Yes	No
No of Conductors Required?	2-3C per switch	5C	6 wires (STP preferred)	8-12C for incremental encoders, SSI and other field bus interfaces. (STP preferred)	1 fiber
Maximum Distance	100m	100m	100m	300-500m (depending on type of output drivers and EMI environment)	2000m
Cost	Medium	High	Medium	Low-Medium for Incremental Encoders. Medium-High Cost for Absolute Encoders.	High

got questions?

