Data Integrity

Engr325
Instrumentation
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This Lecture

• Data Integrity
  – Single vs. differential inputs.
  – Serial data transmission
    • Cabled – Ethernet, USB, Firewire, twisted pair, coax, etc.
    • Wireless – Bluetooth and other near-field protocols
  – Modulation – AM and FM.
  – Grounding.
  – Noise.
Single-ended Vs. Differential Inputs

A typical data acquisition board provides a choice of single-ended or differential analog input channels.

**Single-ended Inputs**

*Single-ended inputs* measure the voltage between the input signal and analog ground AGND. Because they require only one physical connection per input, a single-ended configuration can monitor twice as many channels than the two-connection differential configuration using the same connector and onboard multiplexer.

![Single-ended Inputs Diagram](image)

**Differential Inputs**

*Differential inputs* measure the voltage between two distinct input signals. A differential input better resists electromagnetic interference (EMI) than does a single-ended input. Most EMI noise induced in one lead is also induced in the other. The DAQ input measures only the difference between the two leads, and the EMI common to both is ignored. This effect is the major benefit of twisted pair wiring – the twisting ensures that both wires are subject to virtually identical external influence.

![Differential Inputs Diagram](image)
### Wired Communication Protocols

- Serial
  - Ethernet
  - USB
  - Firewire
  - Twisted pair
  - Coaxial cable
- Parallel

### Wireless Communication Protocols

- Wireless
  - Bluetooth
  - Cellular
  - Other near-field protocols
Modulation

- Amplitude modulation – AM
- Frequency modulation – FM
- Phase modulation – PM

Grounding

- Loops
Noise

• What up?