Equalizer Adaptation

- Many adaptive filtering algorithms
  - LMS, RLS, steepest descent, interior point method, ...
  - Each with different convergence properties

- Link channel changes relatively slow
  - Key is to minimize overhead from adaptation

- Simple adaptation schemes generally preferred

Simplified CTLE Adaptation

Adaptive FIR Filters: LMS

Practical Issues with LMS in Links

- How do you know what the error is relative to?
  - I.e., what is your reference?

- How precisely do you know the error?
  - I.e., how many bits of information does each sample of the error give you?
Finding the Error

- Error is relative to the “data level” (dLev):
  - But, high resolution estimate of the error means high-resolution ADC...

Finding dLev: Dual Loop

- Stojanovic et al, JSSC 2005

Sign-Sign LMS

Eye Diagram Evolution

MMSE vs. ZFE

Dual Loop Convergence

- Both loops are converge within wide range 0.1 – 10x of relative speeds
- Hard to prove analytically
Practical Issues: Data Correlations

Spectrally Gated Adaptation
- Leibowitz et al, ISSCC 2007

Practical Issues: Dither/Resolution
- Can’t set tap values perfectly
  - Always have some residual quantization error
- Better include this error in link budget
  - Acts as quantization noise
  - Tap resolution must increase with # of taps
    - Noise accumulates