PERFORMANCE SCORE CALCULATIONS

RPSTF

March 7th, 2012

Performance Score Components

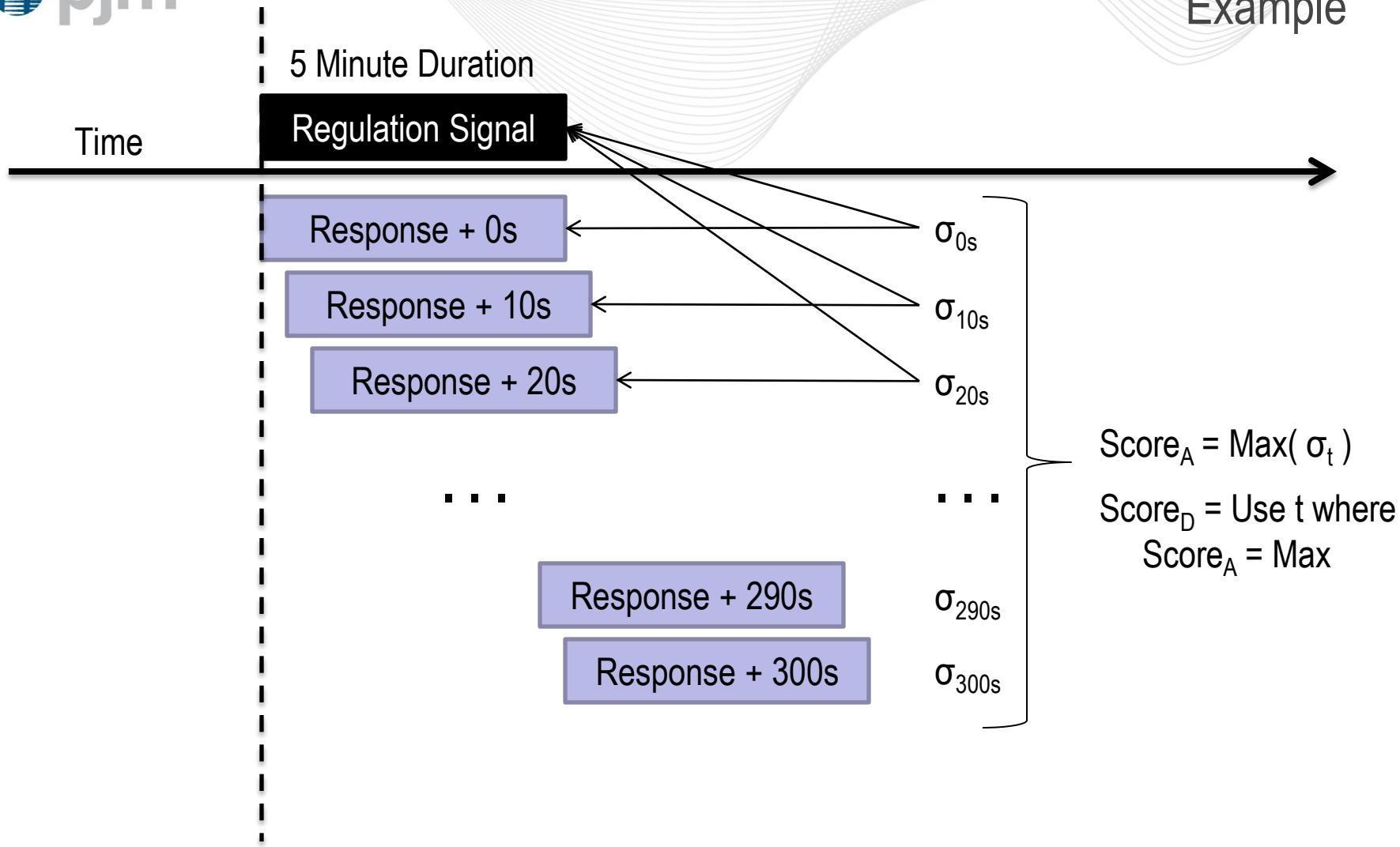
- Accuracy ($Score_A$)
  - Ability to control to closely respond to the regulation signal
- Time Delay ($Score_D$)
  - Tracks the delay in responding to the signal
- Precision ($Score_P$)
  - Measures the systemic error between the signal and the response

- Composite Score = A [$Score_A$] + B [$Score_D$] + C [$Score_P$]
  - A, B, C are scalars from [0..1], total to 1
  - Produces a weighted average of component scores

Current Method

- The Accuracy Score is the maximum of the statistical correlation between:
  - 5 minutes of the regulation signal, sampled at 10sec
  - 5 minute periods of the resource response, sampled at 10sec, shifting in 10sec increments over +5 minutes
- The Delay Scores is the time of shift where the maximum of the correlation occurs
  - One “free” 10 second interval for signal propagation
  - $Score_D$ = (5min – {[Time Delay] – 10s}) / 5 Min
- Scores are generated every 10 seconds across an hour
- Scores are averaged for the hour

Example

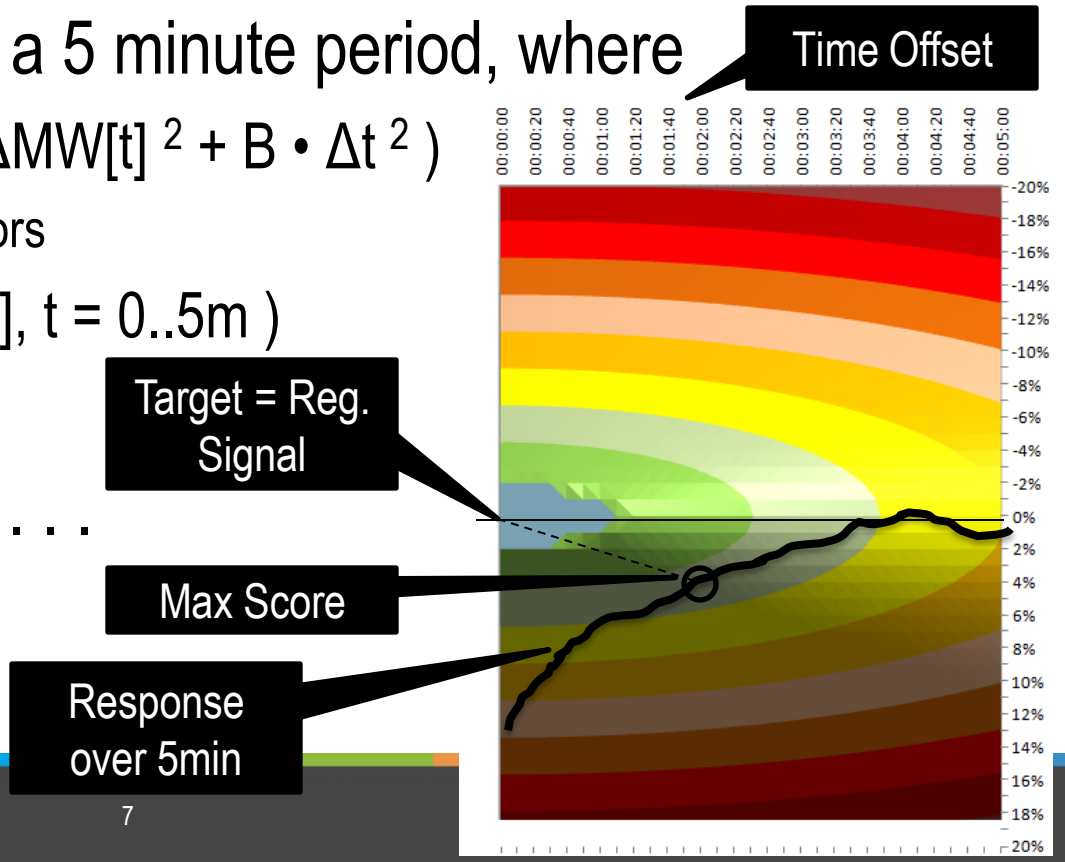


- "Area under the Curve" of error between the signal and the response
  - Error[t] = (Response[t] – Signal[t]) / AREG, sampled at 10s
  - $Score_P$ = 1 – Avg(Abs(Error[t])) , over 1h

Point Slope Method

- Correlation has a discontinuity at a zero slope
  - Correlation is the statistical dependence between two sets of data
  - A zero slope line has no variance, therefore no correlation
- Delay Score is also undefined
- A resource following a zero slope signal should also produce a zero slope response
  - Calculate slopes using linear regression
  - If the absolute error in slopes is less than threshold, then the resultant performance should be 1.0
- Still under development . . .

- At each sample, the regulation signal represents a target for the resource's control algorithms
- Calculate "distance" from the target to the resource response, using 10s samples over a 5 minute period, where
  - $Score[t] = 1 - Sqrt(A \bullet \Delta MW[t]^2 + B \bullet \Delta t^2)$
    - A & B are weighting factors
  - $Score_{A+D} = Max(Score[t], t = 0..5m)$
- Still under development . . .



Performance Score Caveats

- Periods where AREG = 0 result in no scores
  - Set response MW to null where AREG = 0 (unassigned)
  - Set signal to null where TREG = 0 (not following AGC)
- Last 5min of a regulating assignment would result in scoring signal vs. response outside of the assignment period
  - Apply rule above to remove samples / set to null
  - Calculate correlation with remaining non-null samples
- Samples with no score would not be included in the hourly average performance score

- Hourly performance scores are used in the clearing process to rank, and in settlements to compensate

- How soon after real-time must PJM calculate a score?
- When should the new hour's score be included in the rolling average?
  - SPREGO solves with an hour look-ahead, at the top of the hour
  - HE1 [00:00-01:00] would be scored after 01:00, after the case that is setting up the [02:00-03:00] period, so at minimum 3 hours