

# 1 Brief Background

On 2014-05-04, we ran a set of tests to probe changes to control loop parameters (telescope\_el\_tests\_05May2014.sch). The tests were a subset of those run on 2014-04-30 (telescope\_el\_tests\_30Apr2014.sch). The schedule runs a series of el steps of various size and duration (the duration is defined as the time taken to step up or down). They are all performed with constant jerk. The following table shows the step sizes and durations. All possible permutations were run. For the larger steps and shorter times, a maximum acceleration was applied that made the actual time larger. Each scan is run 5 times.

|                    |     |     |      |      |      |      |
|--------------------|-----|-----|------|------|------|------|
| Step Size (arcmin) | 3.5 | 6.0 | 12.0 | 20.0 | 40.0 | 80.0 |
| Duration (seconds) | 0.5 | 1.0 | 2.0  | 4.0  | 8.0  |      |

We ran this schedule 4 times, with different values for the control loop:

|                   | Test 1 (normal) | Test 2 (10% reduction) | Test 3 (20% reduction) | Test 4 (30%) |
|-------------------|-----------------|------------------------|------------------------|--------------|
| El Lead Break     | 0.10            | 0.09                   | 0.08                   | 0.07         |
| El Crossover Freq | 0.450           | 0.405                  | .0360                  | 0.315        |
| El Lag Break      | 2.0             | 1.8                    | 1.6                    | 1.4          |

This leaves us with 4 sets of 5 for each scan. To get some useful information out of this, I stacked the scans, and then differenced them.

## 2 Method

Each set of 5 scans (run with the same control loop parameters) is temporally aligned. The method I use to do this leads to a maximum rms error of less than 10 arcmin in most scans. There are some that fail spectacularly, likely due to either glitches or other single events in one scan. I have not included any data from these scans.

### 2.1 Details of the Alignment

To correctly align the scans, I give each scan a temporal shift with respect to an arbitrarily chosen scan. To be specific, I minimize the sum

$$\sum_{i=1}^5 (\text{scan}_{match} - \text{scan}_i)^2 \quad (1)$$

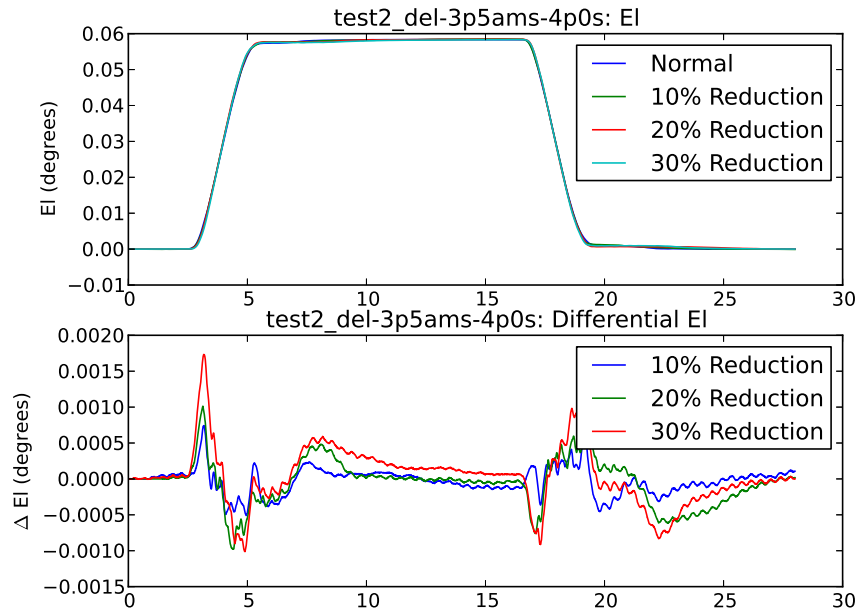
where  $\text{scan}_i$  has been shifted  $n$  points relative to  $\text{scan}_{match}$ . By minimizing this sum, I align 4 of the scans to the arbitrarily chosen “match scan”.

## 3 Results

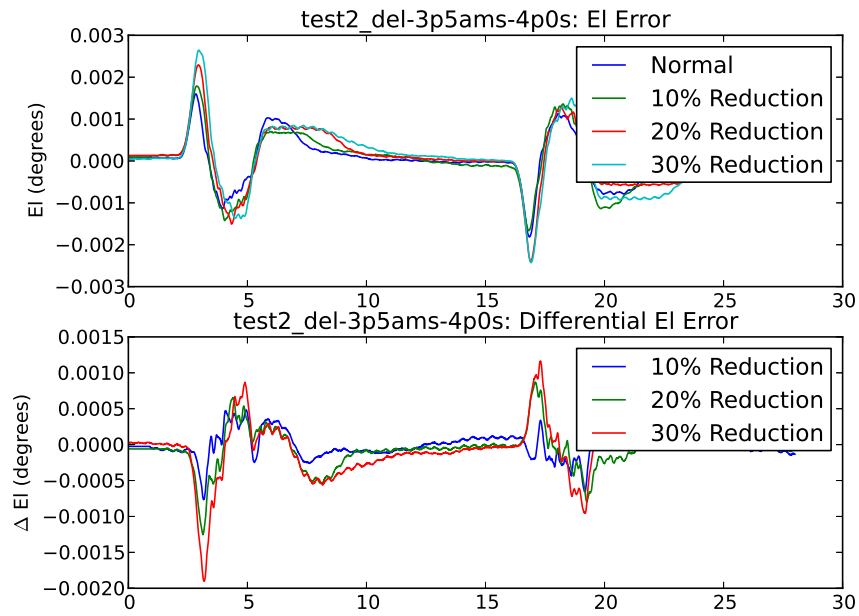
These tests seem to tell us that our current control loop parameters are better than the any of the changes we tried. In a few cases, the relaxed parameters give a lower overshoot, but the total settling time is longer.

We can also see that some steps cause oscillations on top of the overshoot (see test2\_del-6p0ams-8p0s on page 8). This only happens in the smaller steps, but there does not appear to be any further trend.

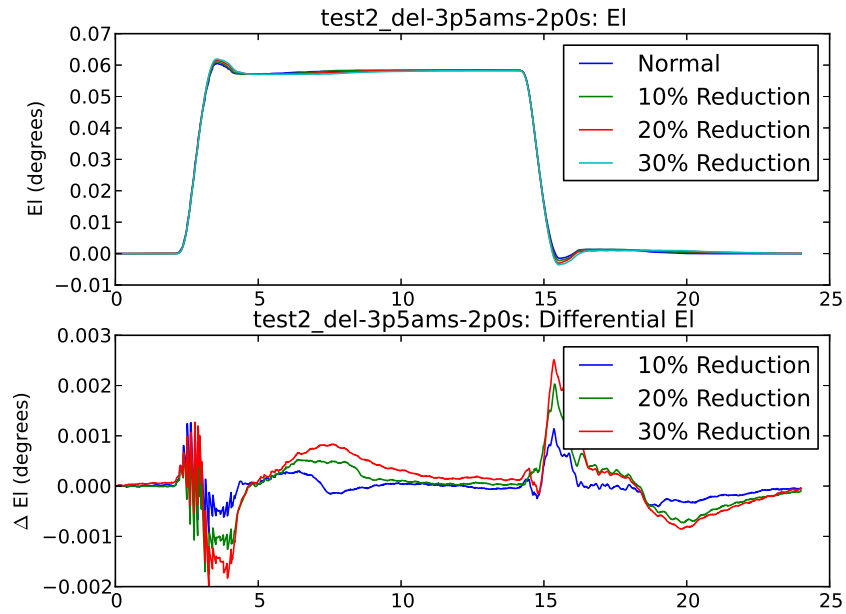
## Scan test2\_del-3p5ams-4p0s Position



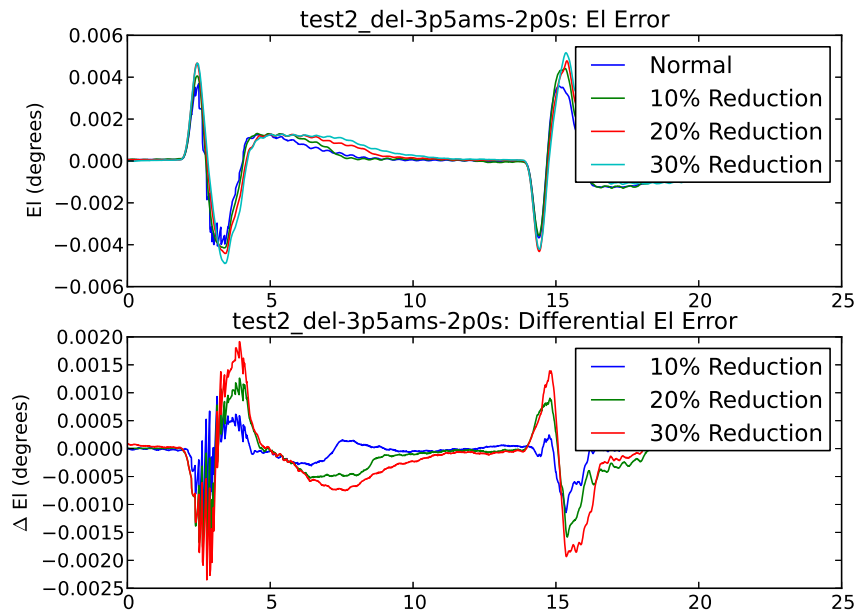
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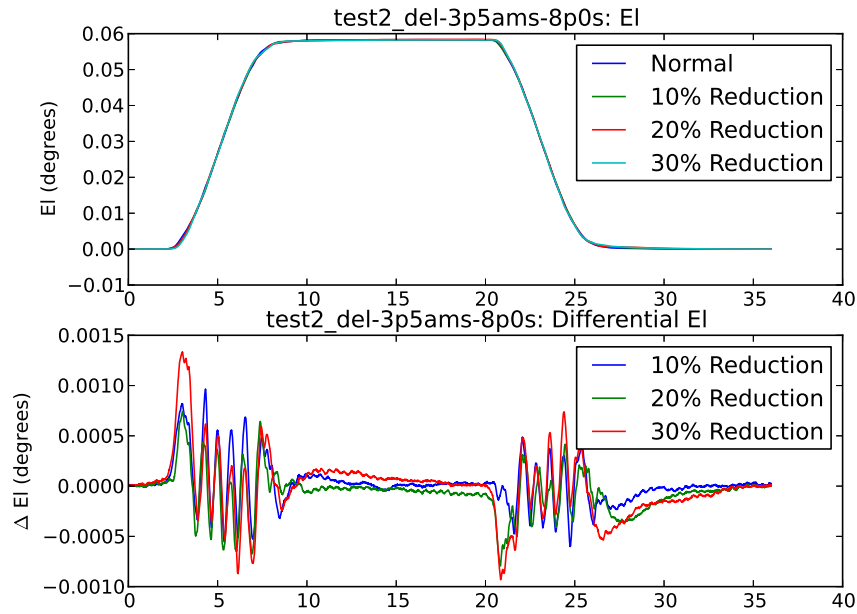
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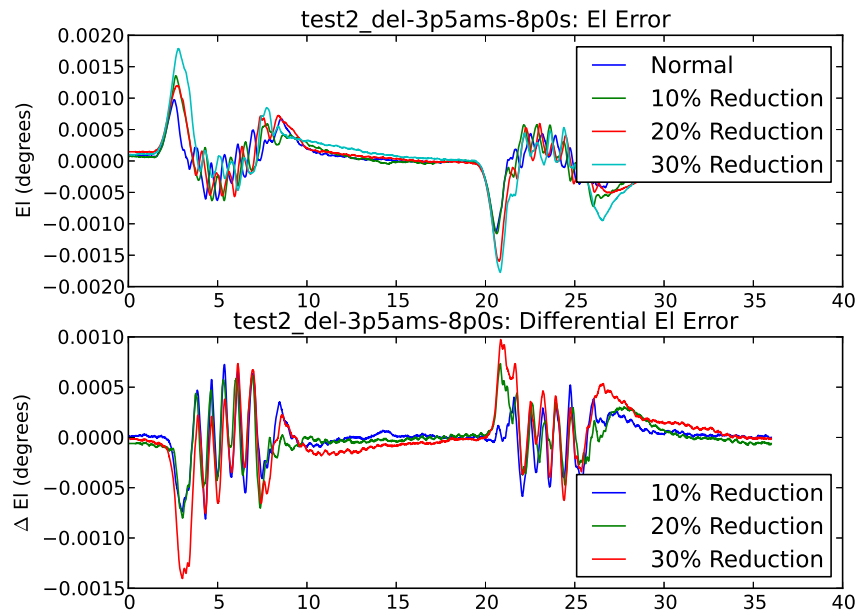
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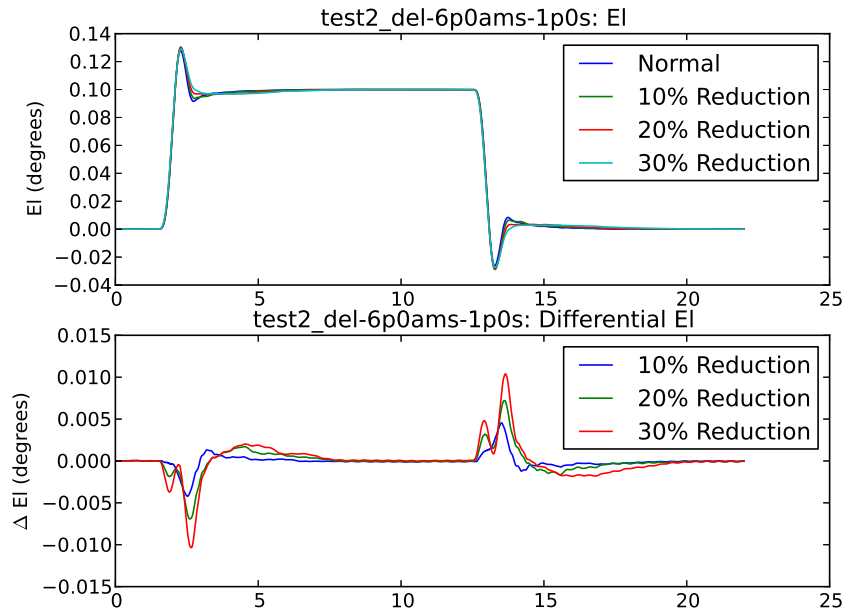
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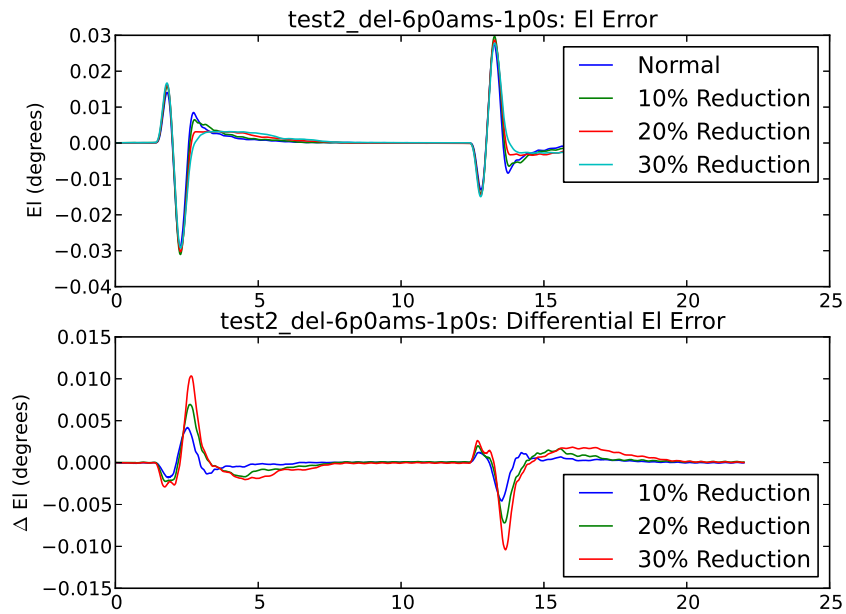
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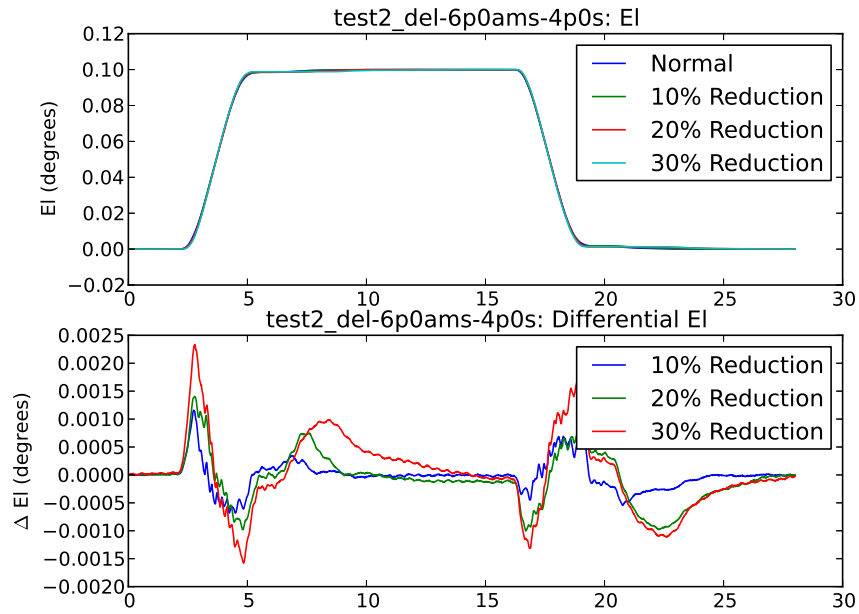
### Scan test2\_del-6p0ams-1p0s Position



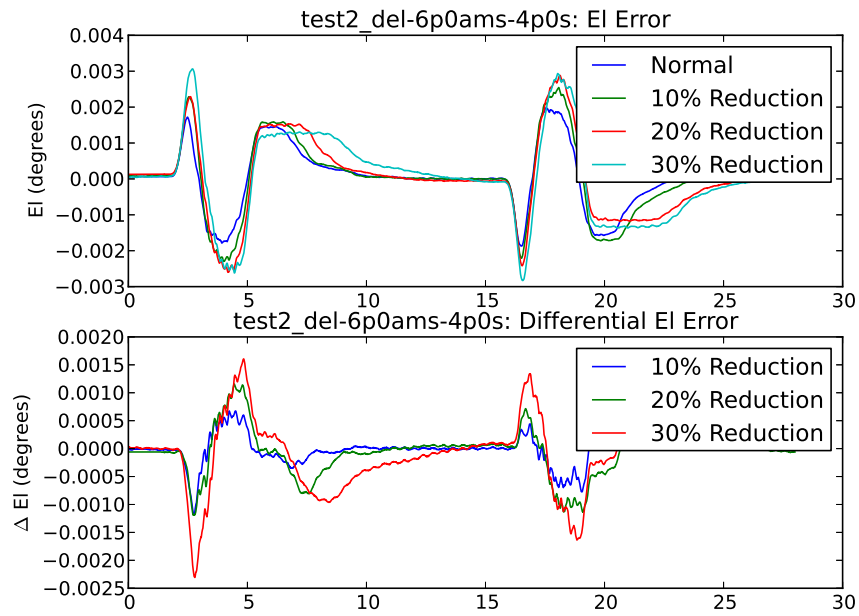
### Scan test2\_del-6p0ams-1p0s Error



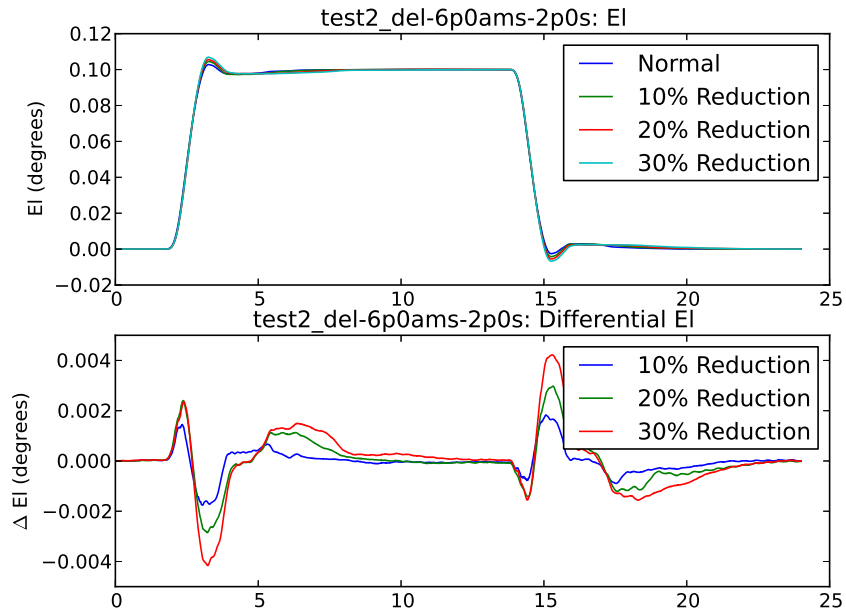
### Scan test2\_del-6p0ams-4p0s Position



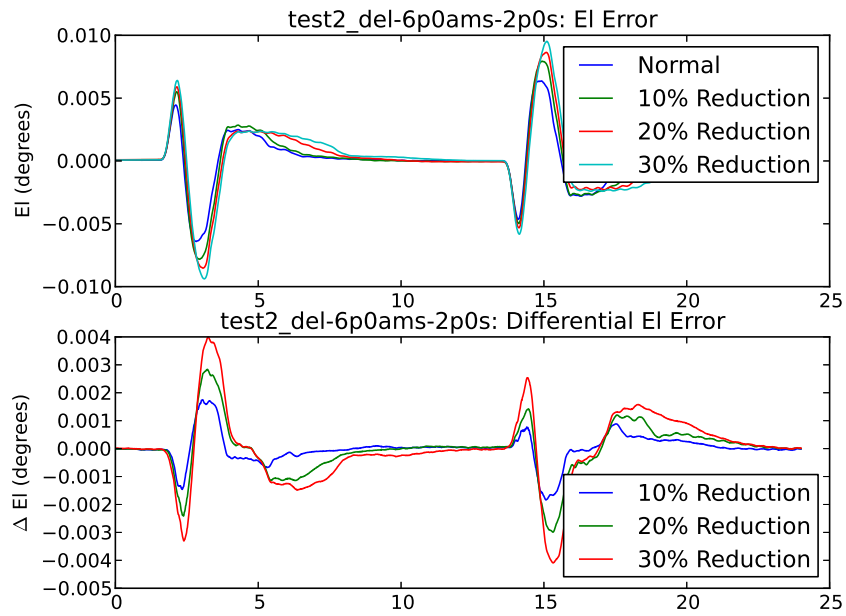
### Scan test2\_del-6p0ams-4p0s Error



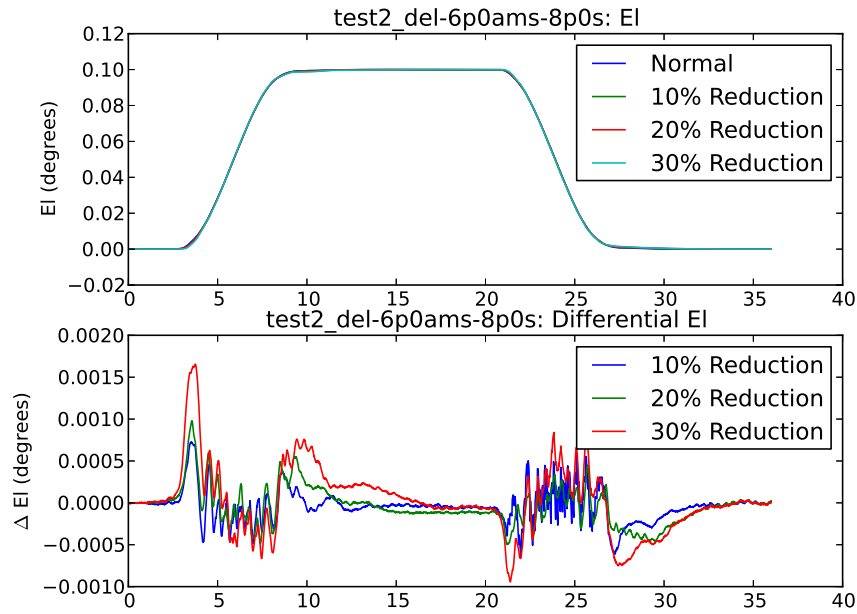
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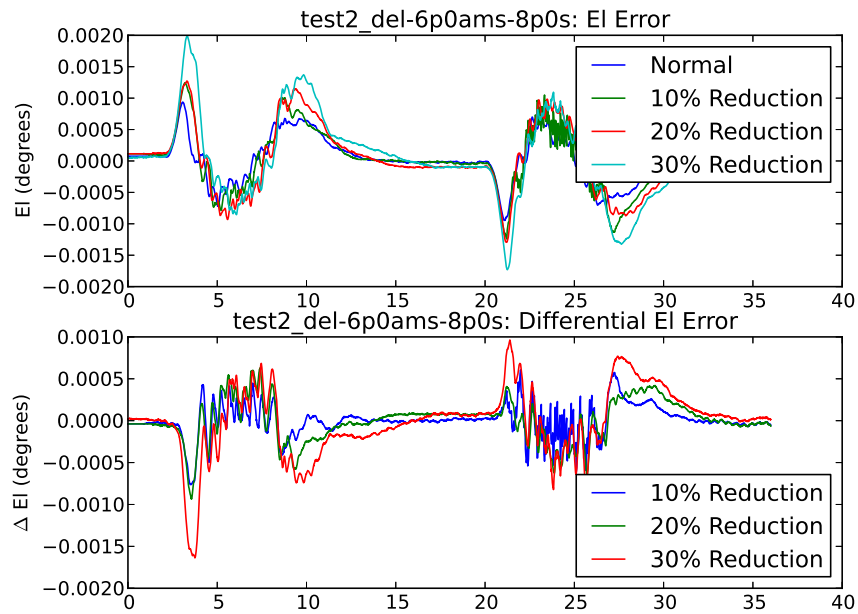
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### Scan test2\_del-6p0ams-8p0s Position

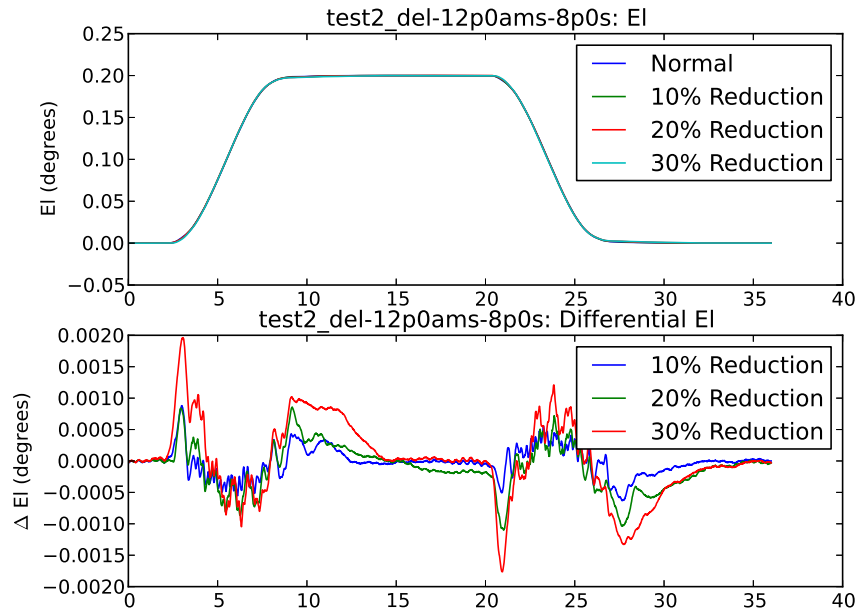


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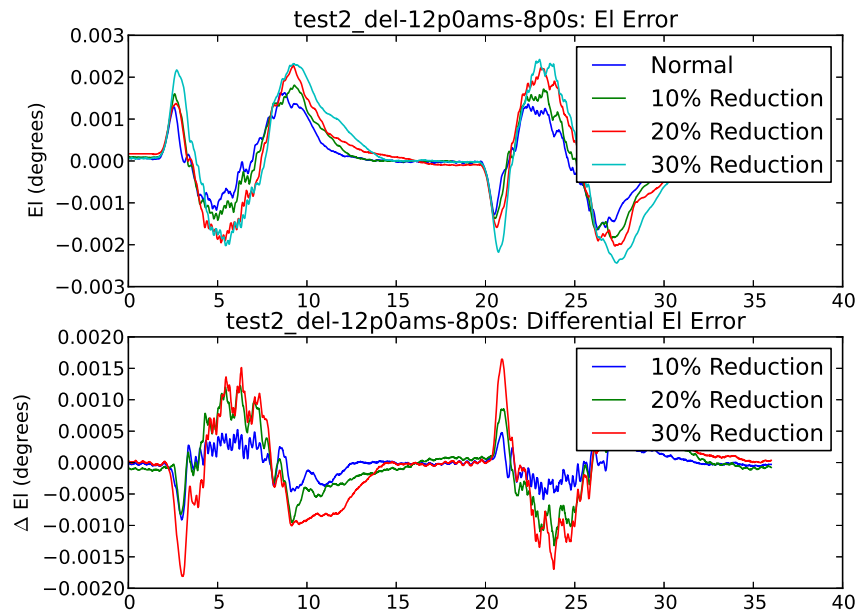




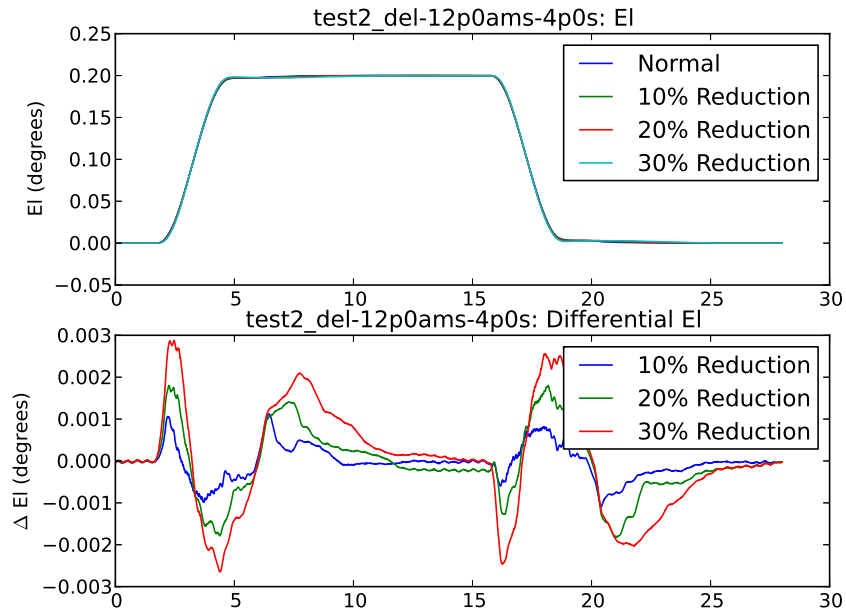
## Scan test2\_del-12p0ams-8p0s Position



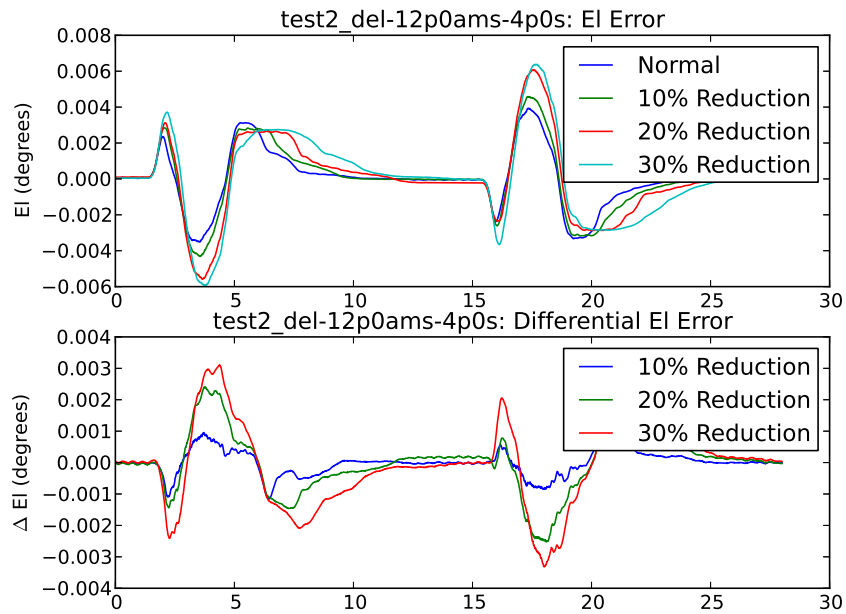
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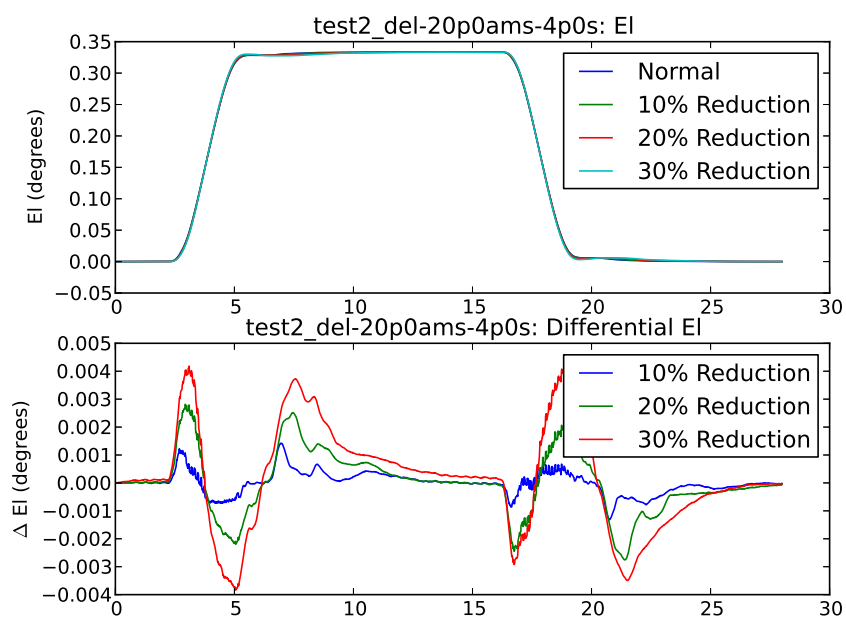
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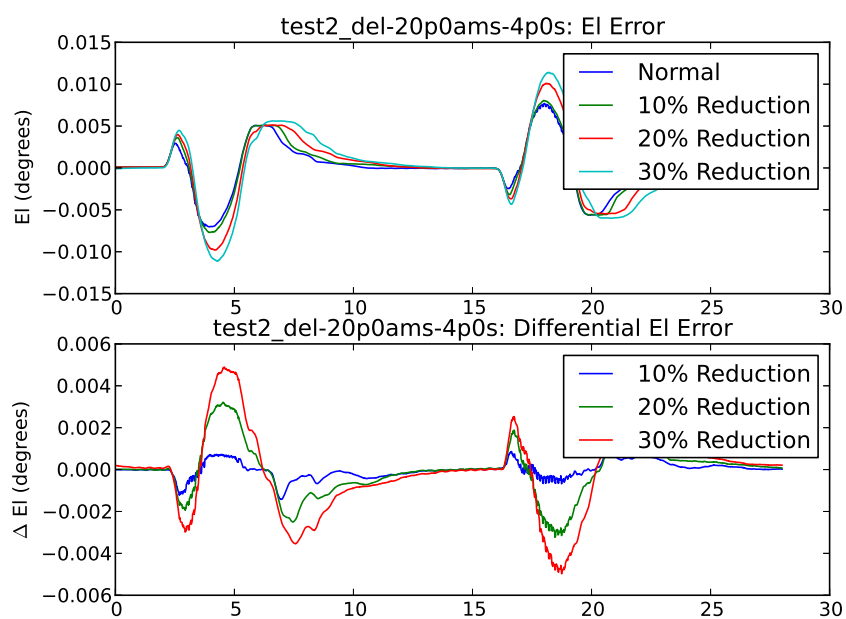
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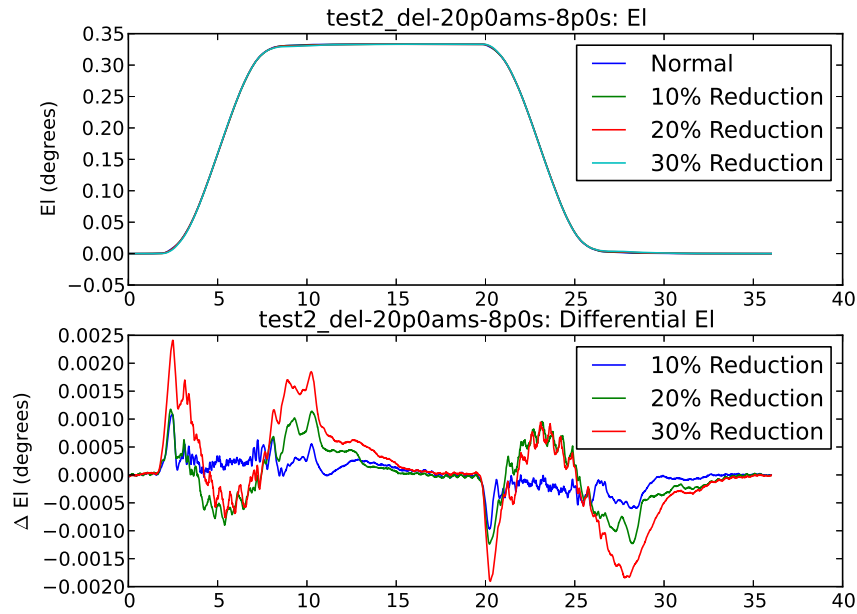
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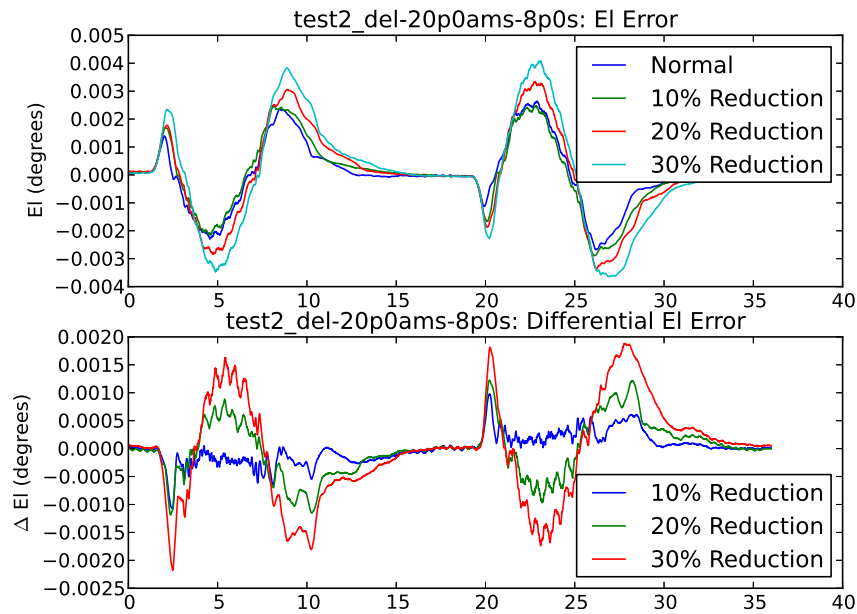
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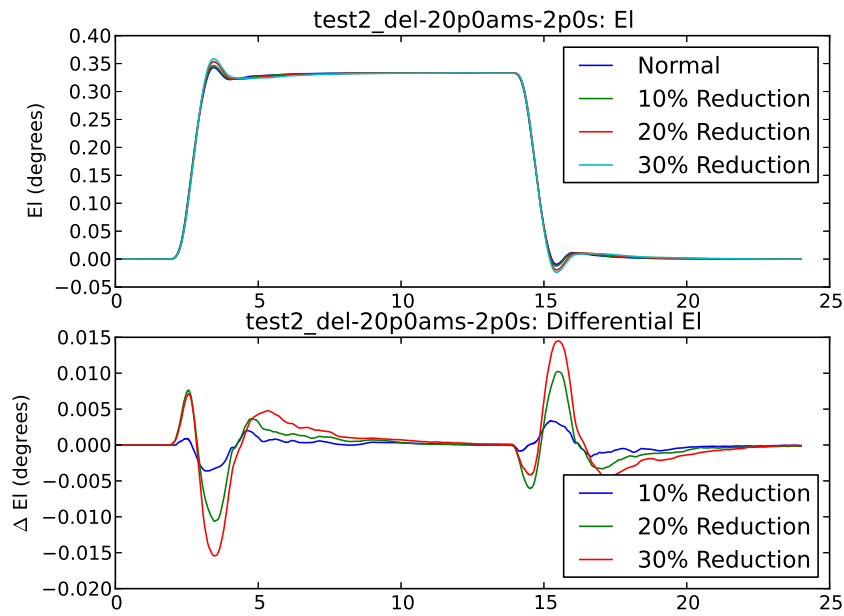
### Scan test2\_del-20p0ams-8p0s Position



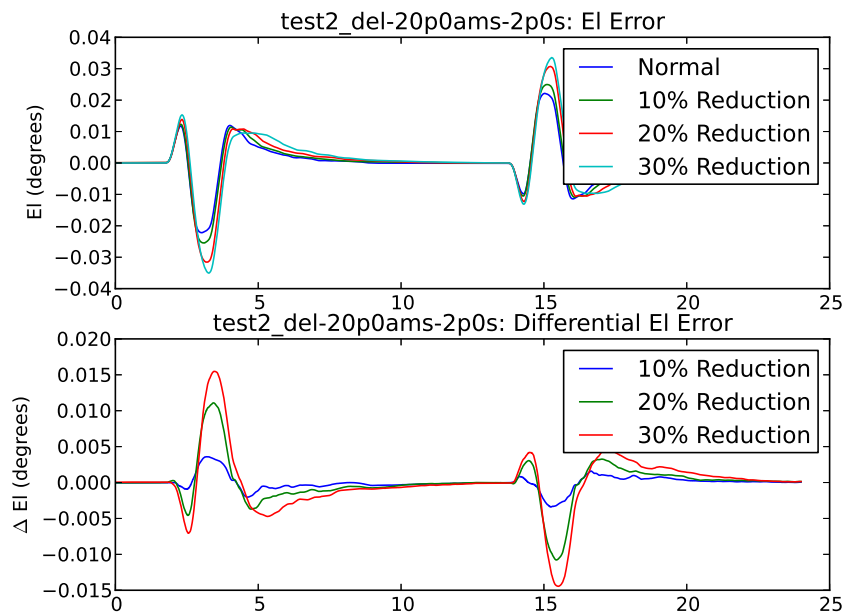
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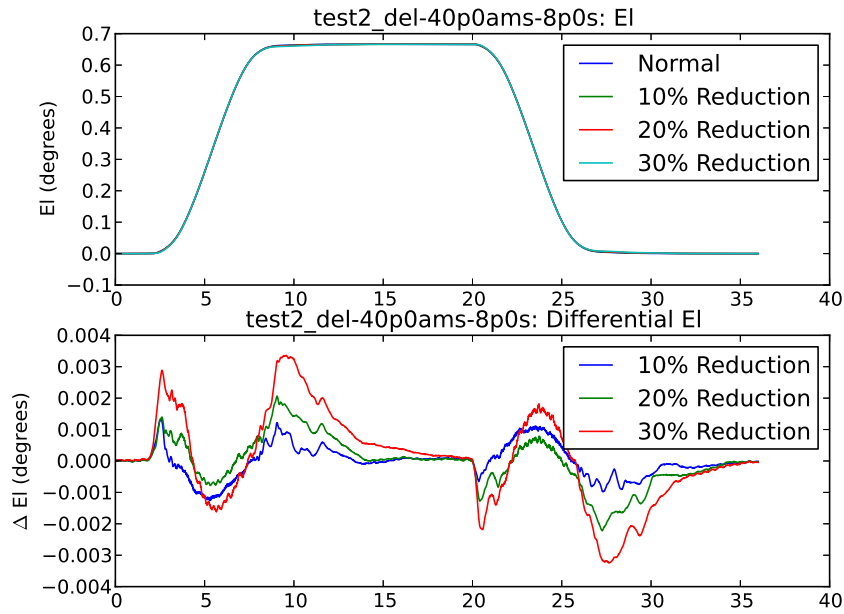
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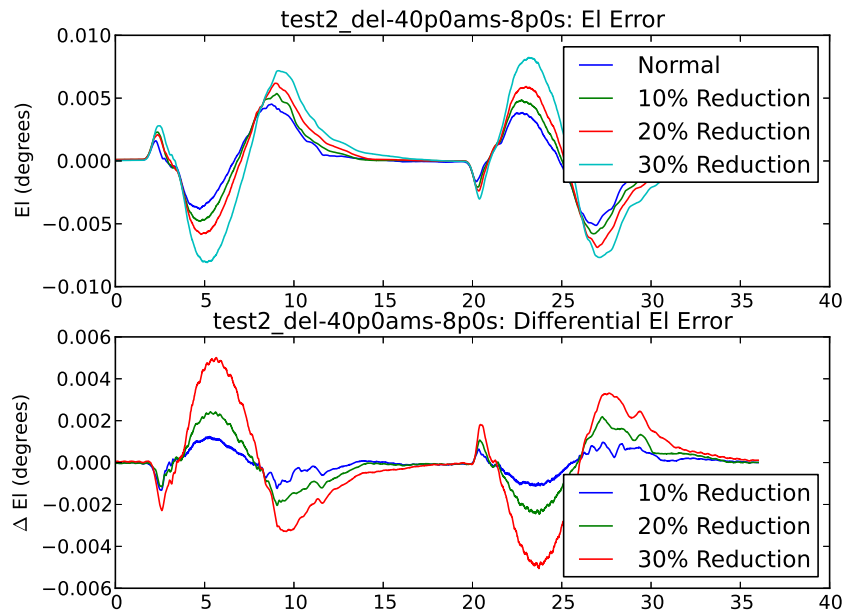
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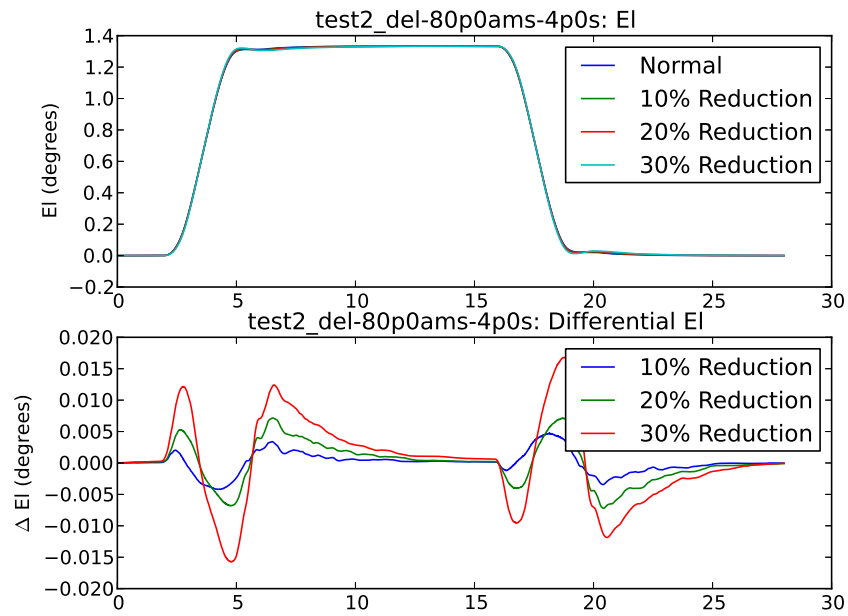
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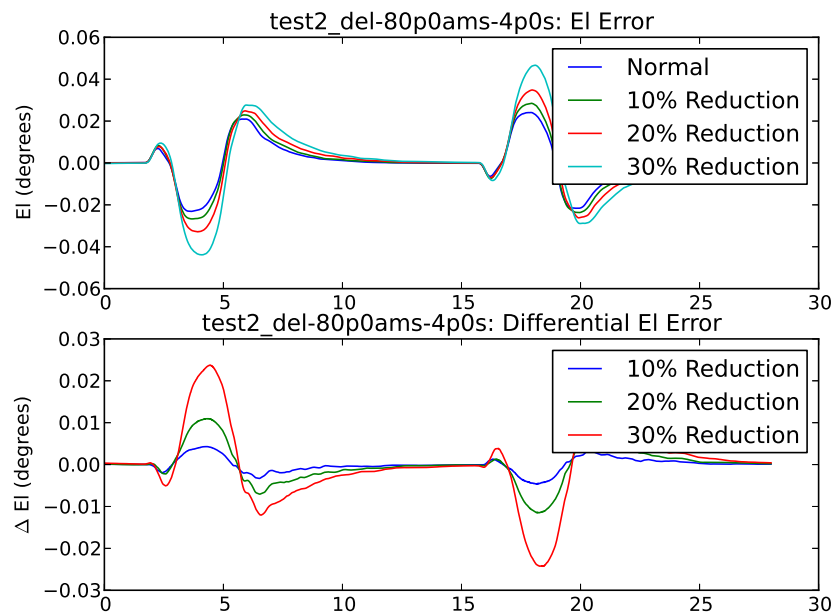
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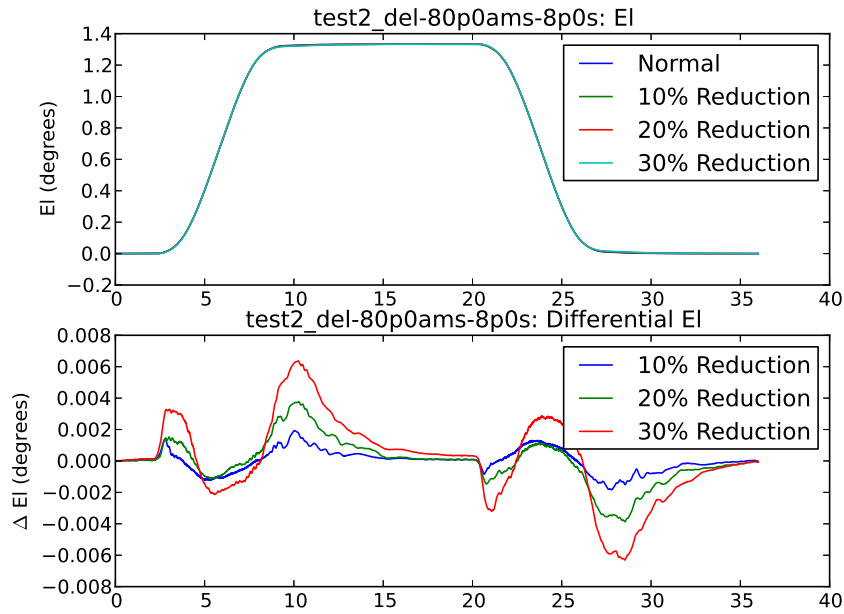
### Scan test2\_del-80p0ams-4p0s Position



### Scan test2\_del-80p0ams-4p0s Error



### Scan test2\_del-80p0ams-8p0s Position



### Scan test2\_del-80p0ams-8p0s Error

