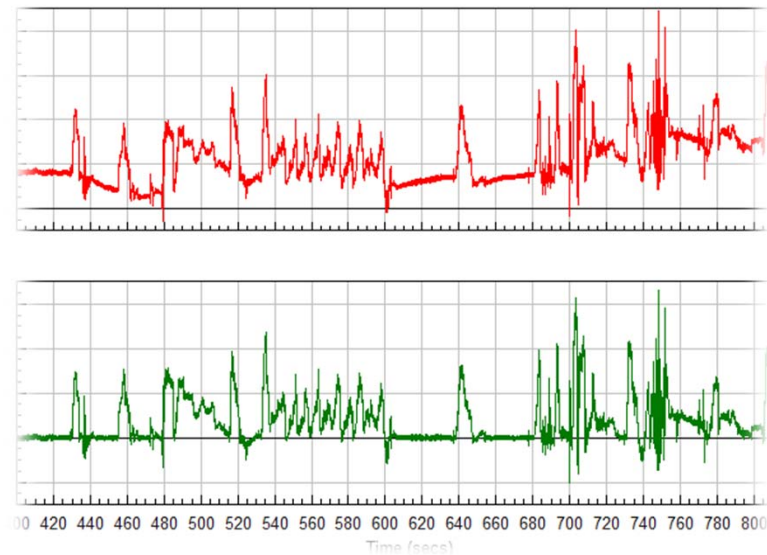




# Piecewise Trend Removal Using GlyphWorks

**Automated method for trend removal from signals with non-zero mean**



## Ford Motor Company: Customer Correlation

### Primary Function

- Oversee the design and correlation of durability procedures and targets

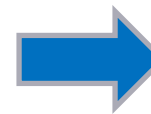
### Method

- Study customer vehicle usage - Surveys and data collection
- **Clean Data** – Remove non-real trends and anomalies to ensure quality.
- Analyze – Determine fatigue damage for target customer usage
- Design Test Procedure - Replicate customer damage profile and strike a balance between under and over design

### Public Roads



### Proving Grounds



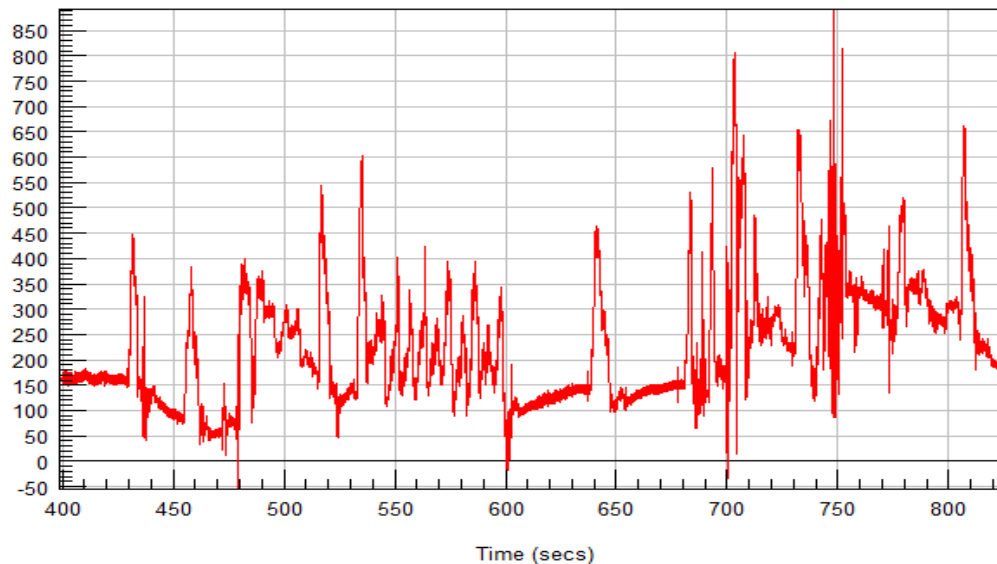
## Challenge/Project Scope

### Project Goal

- Remove non-real trends from signals with non-zero mean
- Apply this method to *\*hundreds\** of signals, consistently and quickly

### Available Methods

- Running mean removal – Does not fit trend
- Butterworth High Pass Filter – Does not fit trend and too fuzzy
- Linear/Polynomial trend removal – Does not fit trend
- Manually highlight sections/manipulate – Too time consuming/inconsistent



### Fundamental Problems

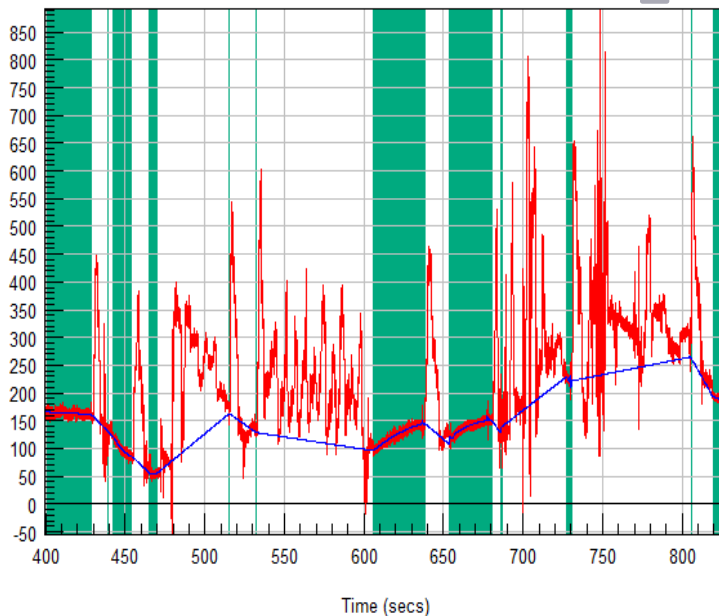
- Non-zero mean
- Trend is not a function

## Challenge/Project Scope

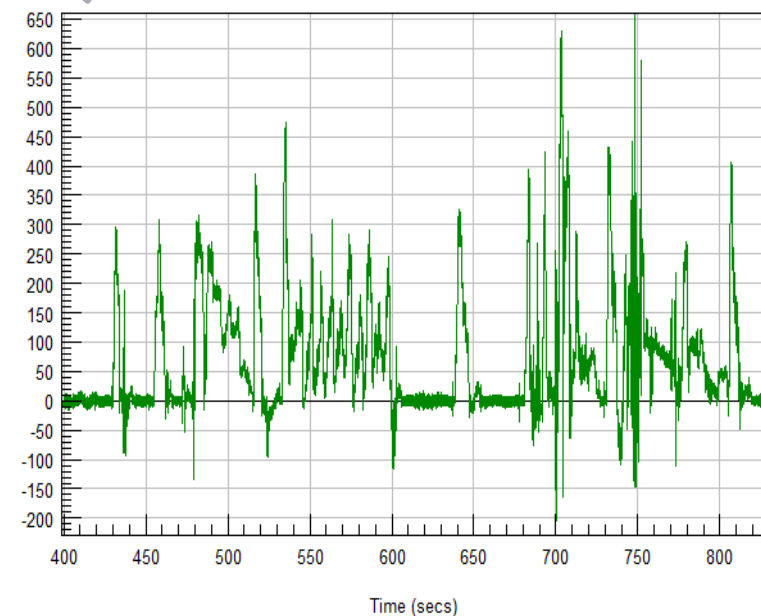
### Automated Approach

- Determine Conditions – When should the part be in an unloaded state? (i.e. Low speed, neutral, no throttle, no braking, no hard turning)
- Mark Sections – Use external signals (i.e. throttle, brake, clutch, gear)
- Individual Curve Fitting – 2<sup>nd</sup> order polynomial or linear
- Subtract Composite Line – Construct one line to represent complete trend

### Raw Signal



### Adjusted Signal



## Using GlyphWorks for Piecewise Trend Removal

### Main Glyphs Used in Process

- Time Series Calculator
  - Create feature lists and opposite feature lists
- Looping Super Glyph
  - Curve Fitting Glyph outputs polynomial coefficients into table
- Multicolumn Manipulation Glyph(s)
  - Used to manipulate table of values and create time series

### Value added using GlyphWorks

- Rapid Development – Premade functions, modular, drag ‘n drop
- Interactive Results – Immediate visualisation, not just numbers
- Processing Speed – 10x faster than manual, saves project time
- Consistency – Possibly most valuable improvement
- Long Term Asset – Enable future projects, lessons learned built-in



**Thank you!**

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