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\(^{nd}\) 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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