Fatigue Analysis Using Large Field Strain Gage Data with nCode GlyphWorks

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Joy Global – Surface Mining
Joy Global Inc. Surface Mining

Our goal at Joy Global is to be the leading global supplier of advanced equipment, systems and direct services for the global mining industry.

Our Surface Mining division is the world’s largest producer of electric mining shovels and a leading producer of rotary blasthole drills, walking draglines and wheel loaders. P&H products are used in mining copper, coal, iron ore, oil sands, gold, and other minerals and ores in all major mining regions in the world.

We also provide logistics and life cycle management service support through a global network of Joy Global service centers.
Background

- Previous P&H strain gage fatigue analysis
  - Strain gage techniques has been used for 20 years in P&H
  - Rosette is used to recover principal stress information
  - Field stage tests (20 min – 4 hours) with engineers onboard
  - Results could be misleading due to short test
  - Stress-based fatigue analysis following BS7608

- New long term field test
  - Long term (2 months – 1 year) test to cover possible variations (bank, operator, ground, blasting, weather, etc.)
  - 24/7 data acquisition without interference with production
  - 43 million points/channel/day

- Big data requires new procedure
  - Slow fatigue analysis solver
  - Multiple software packages for manual data process (verification, clean-up, reduction, etc.)
  - No result visualization
Requirements for New Procedure

- Automated procedure for big data
  - half year test vs. 1 day test
- Fast, accurate fatigue analysis
- Ability to handle variation of input parameters
  - Analysis methods
  - Joint classifications
  - Material parameters
  - Kf, Surface finishing, etc.
- Integration of basic data processing
- Easy to customize and expand
- Good technical support
- Legacy data
Fatigue Analysis using Big Strain Gage Data

- nCode GlyphWorks
- Automated life prediction
  - Multi-axial stress-based analysis
  - Multiple strain gages
  - 7 GB daily data
- Integrated function modules
  - Data review and abnormal signal detection
  - Data clean-up, filtering, and reduction
  - Strain gage rosette definitions and analysis parameters are pre-defined in XML file and Excel file
  - peak-valley and rain-flow counting
  - Critical Plane Approach algorithm
  - Strain analysis result plots, Rain-flow counting plot, damage histogram plot
- Advanced nCode programming
  - Metadata, super Glyphs, etc
Benefits

- Elimination of manual operation and operator errors
- Consistent work flow, therefore, consistent life results
  - Accurate life prediction, difference less than 2%
- Reducing time
  - Integrated automation procedure
  - Fast nCode fatigue solver
  - Over 1TB data has been analyzed
  - 15x faster
- Reducing cost (engineering time, software & hardware cost)
- Improving NPD by using strain gage data to optimize machine controls and to improve machine performance
- Quick response to field request
- Flexibility of analysis
- Easy to program
Thank you!

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