2014 HBM nCode Products User Group Meeting

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Damage Editing of Field Duty Cycles for Lab Fatigue without Direct Strain Gage Data

Additional, Long Technical Sounding Subtitle

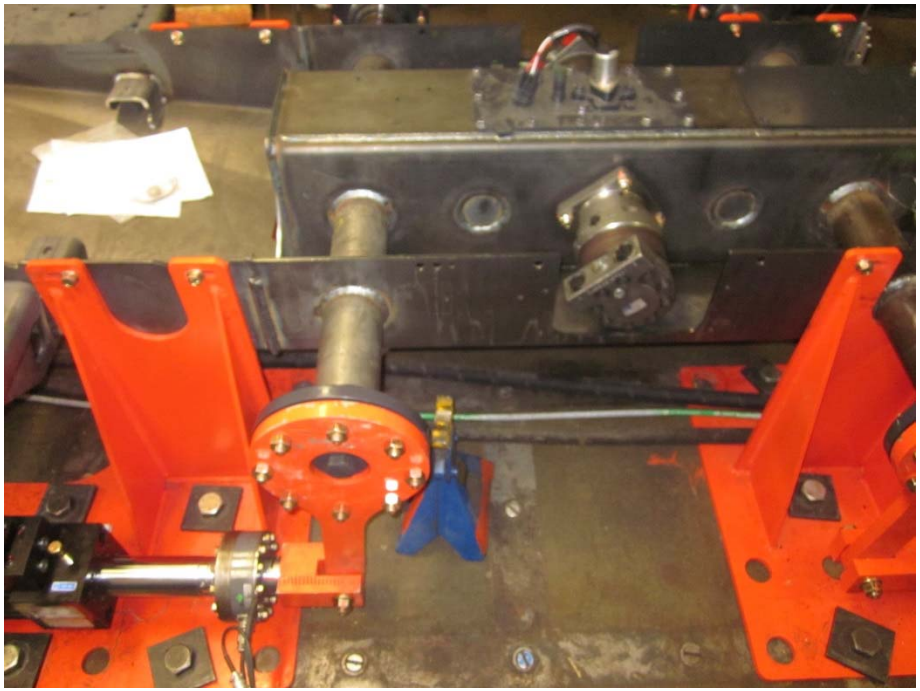
Intro to Bobcat Company – Test Engineering

- Bobcat Company is a worldwide leader in the manufacturing of compact equipment for global construction, rental, landscaping, agriculture, grounds maintenance, government, utility, industrial and mining markets.

- Test Engineer focused mainly in structures of loaders and excavators
  - Lab/Field Data collection
  - Fatigue/Durability testing

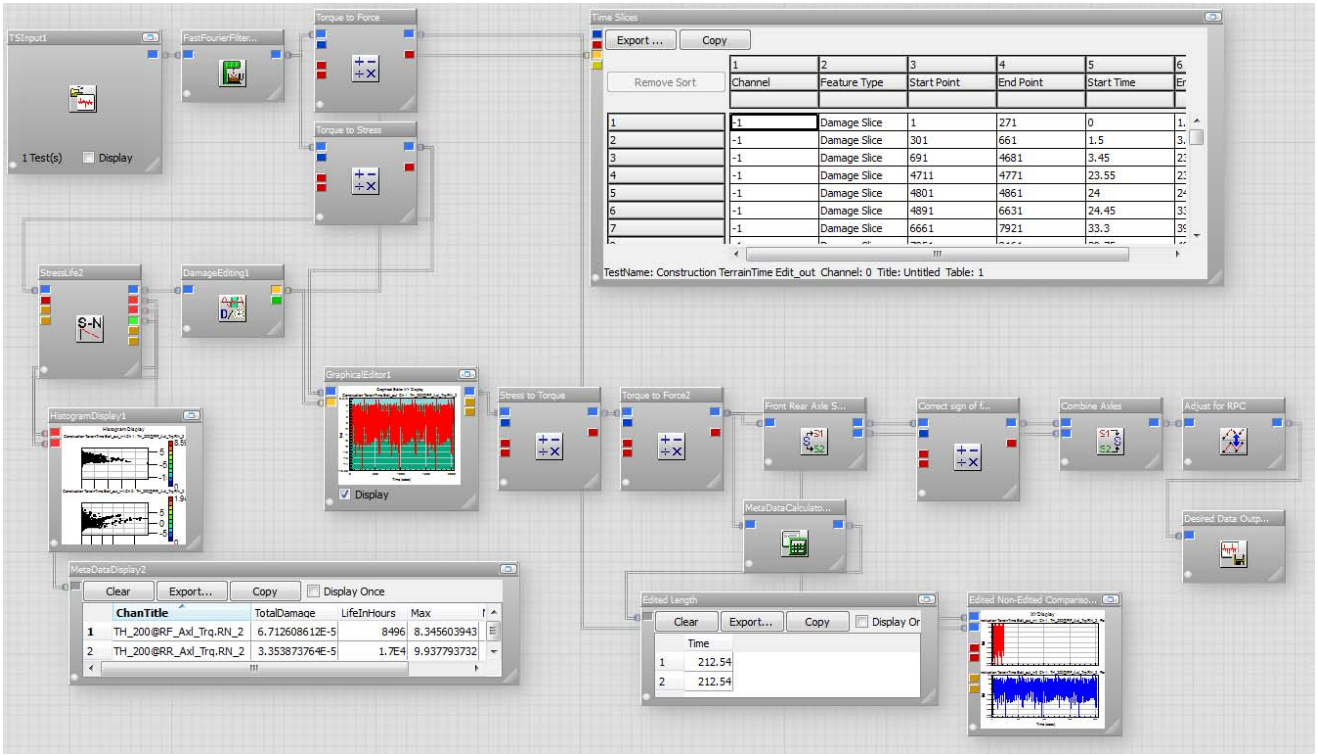
Challenge

- Needed to develop a lab durability test of a specific component of skid steer loader undercarriage.
  - Use collected field duty cycle data to create a time compressed lab test
  - There was not a viable position for direct strain gage data for the joint under test – bolted joint of hydraulic motor mount
    - Using data that was collected before the test was defined.
- Goal – Develop lab test based on drive motor torque as measured by strain gaged axles



Using nCode Glyphworks for Data Analysis and Damage Editing

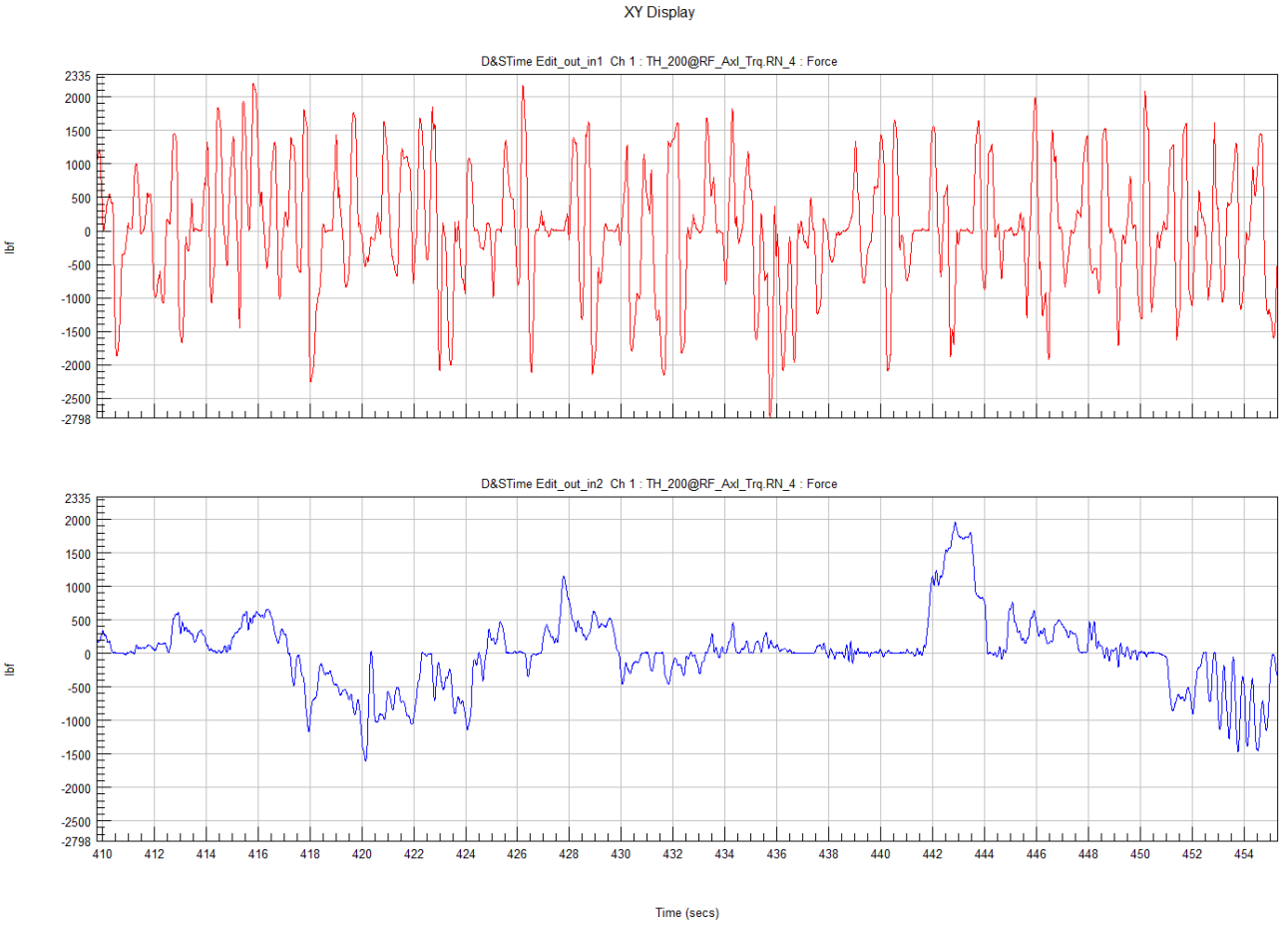
- How is nCode integrated as a solution?
  - The Damage Editing glyph to remove all non-damaging events to greatly reduce the required test time.
- What is the added value of using nCode?
  - Greatly decreases the amount of time required to calculate damage realized by component
  - Quickly adjust parameters and re-analyze to see effects



Effects of Damage Editing/Time Compression

- Remove time slices that do not induce damage into component
  - Maintain a specified % of damage of the original data
  - Keeps multiple channels in phase

- Edited Data



- Original Data

Damage Editing without Strain Gages

- Damage editing glyph requires damage time series input from stress life or strain life glyph
  - Have axle torques from field duty cycles, but not a good strain gage to work from
  - Torque is linearly related to stress – use a scalar factor to reduce the torque time series magnitudes to magnitudes typically seen from strain gage data
    - Target values/scalar factor must be well thought through to ensure the damage is not under or over predicted
  - Choose reasonable material from library for location of expected failure
    - Weld Class/Parent Material
  - Once the data is damage edited, it is converted back to torque (using the same scalar factor), then to force based on the test rig design

Using nCode Glyphworks for Data Analysis and Damage Editing

- Test Rig Realities
  - Test rig was only capable of reproducing frequency spectrum up to about 10Hz
  - Test timeline created opportunity to scrutinize old methods and deploy new tools
    - Super looping glyph
      - Determine effects of low pass filter frequency on damage retention
      - Optimize Damage Editing glyph settings to maintain damage retention and create test length that fit in the project schedule
    - The settings were evaluated on all field duty cycles the test rig was going to subject the specimen to.
    - Final settings were used to create .rpc3 files to play back in the test rig.
  - Loads being played back in test rig are actual field loads, making calculation of test acceleration factor straight forward.
    - Preferable to block cycle testing
- Outcome
  - nCode Glyphworks made it possible to quickly analyze data and create an optimized test rig drive file, ensuring that the product was validated on schedule.

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Thank you!

Scott Berndt
Test Engineering, Bobcat Company
scott.berndt@doosan.com