Sorting and Visualizing Machine Usage Data With Glyphworks

Enhancing the Capabilities of Glyphworks using Python
Intro to John Deere

- **John Deere**
  - Founded in 1837 by John Deere - a man with an idea
  - “Committed to those linked to the land”
  - Business has evolved to meet the needs of a growing population and changing technology
  - Currently a global manufacturer of engines, agricultural, construction, forestry, and turf care equipment,
  - Financial and customer services provider
  - $37.8 Billion net sales and revenue in 2013

- **John Deere ADV Facility**
  - John Deere Internal Service Provider
  - Instrumentation design
  - Data collection
  - Data analysis
  - Structural testing
Project Background & Challenges

- Machine Duty Cycle Data Collection Challenges
  - Large volume of data
  - Instrumentation failures in the field can be hard to troubleshoot
  - Data transmission can be problematic
  - Diverse product portfolio necessitates a variety of analyses
  - Etc.

- How Can I Use Glyphworks to Mitigate Challenges?
  - Automated data screening
  - Presenting data in video form
Automated Data Screening With Glyphworks

- Reasons to pre-screen data
  - Ensure data exists
  - Make sure data is useful
  - Sort data for proper grouping

- Initial Process
  - Data is processed manually using any compatible viewer software
  - Notes taken regarding file parameters
  - Files manually loaded into Glyphworks for further processing
  - Tedious and time-consuming
  - Not easily scalable
Automated Data Screening With Glyphworks

- A simple, but powerful flow
- Python provides test-to-test flexibility
Automated Data Screening With Glyphworks

- Calculate overall test length and date
- Obtain GPS time and date at start of run
- Input time zone offset from GMT
- Use Python’s datetime module to compute proper local time and date
Automated Data Screening With Glyphworks

- Output new parameters as test level metadata
- Use a Metadata Manipulation glyph to combine with original data
Automated Data Screening With Glyphworks

- This segment varies from test to test
- Example passenger car test:
  - Engine speed must remain above 800 RPM >= 50% of the file length
  - Vehicle must be moving >= 50% of the file length
- Query the data to determine percentage time above the threshold for each channel
- Compare percentages to design specification and establish metadata

```
########Set flag logic
    if (vehspeedpct>=50) and (engspeedpct>=50):
        flag='true'
    else:
        flag='false'

########Output processing flag
    outputmeta.SetItem(-1,"TestInfo","ContinueProcessing","string",flag)
```
Automated Data Screening With Glyphworks

- Output new parameter as test level metadata
- Use a Metadata Manipulation glyph to combine with original data
Automated Data Screening With Glyphworks

- Evaluate processing flag with a test splitter
- If flag is true, save s3t file with run data
- If flag is false, do not save
Automated Data Screening With Glyphworks

- Use a metadata display to collate information to build schedule files
- Output a multicolored table to the final Python script
  - File naming information
  - Sorting metadata
  - Processing flag
Automated Data Screening With Glyphworks

- Import table of sort criteria
- Sort the data based on specified criteria
- Write a schedule file with all required data files
- For car example:
  - First trip: To preschool (discard based on acceptance criteria)
  - Second trip: To work
  - Third trip: Home from work
  - Fourth trip: To store
  - Fifth trip: Home from store
  - One schedule is generated from trips 2-5
- Less than 170 lines of code to significantly reduce time and tedium
Generate Data Videos With Glyphworks

- Visualizing machine operation in a small area can be a challenge!
Generate Data Videos With Glyphworks

- Use Glyphworks to create individual frames
- Assemble the frames into a movie externally
Generate Data Videos With Glyphworks

- Establish how much data each movie frame represents
- Establish length of “breadcrumb trail”
- Create values with a MetaData Generator glyph
- Add values to the time series with a MetaData Manipulation glyph
Generate Data Videos With Glyphworks

- Reduce processing time by reducing channel count
- Send through only the channels required for the display
Generate Data Videos With Glyphworks

- A looping superglyph takes care of creating individual frames
- Use Python to calculate the number of frames
- The script generates a list of frame numbers to iterate on
Generate Data Videos With Glyphworks

- Script exports a multi-column table to the loop control
- Using “Multi-Column” loop control sets the proper loop execution
Generate Data Videos With Glyphworks

- Python script imports time series data and loop number
- Using trail length, frame duration, and loop number, the script calculates the points to extract for the current frame
- Extract date and time information and assign to metadata
- Pass extracted time series and new metadata variables to the output pipe
- Example:
  - Frame duration of 1 second
  - Trail length of 60 seconds
  - Loop 500
  - Result: Extract data from 440 seconds to 500 seconds
  - Result: Time vehicle speed taken from the 500 second data point
Generate Data Videos With Glyphworks

- Data is passed from script to studio display
- Calculate feature lines, if desired
- Display frame is exported as an image file
- The loop number is appended to the file name to keep the frames in order
- Superglyph returns to process the next loop
  - Previous example: Next data to be extracted will be from 441 to 501 seconds
Generate Data Videos With Glyphworks

- Multiple software packages available to assemble the movie file from the individual frames
- Details will be a function of the software used
- Need to know final frame rate, first file, and codec to use
Generate Data Videos With Glyphworks
Summary

- Showed two techniques for improving duty cycle data processing
- The scripting glyph is a critical tool
  - Neither process would be possible without it
- Matlab coding is already familiar to many
- Python is an easy language to learn and use
- “Think outside the glyph!”
Thank you!

Mike Brand  
John Deere ADV Facility  
Tel. +1 309-748-8692  
brandmichaela@johndeere.com