Wolf Star Technologies, LLC

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True-Load approach and capabilities

Typically measured loads often do not produce correlated results in FEA models. The reasons are many. The measuring device changes the structural characteristics of the system. There may be non-linearities up stream of the load transducer that are not represented in the FEA model. The load transducer may not be able to measure all of the DOF needed. Transducers can be very expensive in the range of tens of $ to thousands of dollars per transducer. Load transducers all need to carry NIS traceable calibration certificates. It can be very expensive to maintain the calibration certificates. Often the structure of the device (e.g. car chassis) needs to be cut away to insert the load transducer and then reinforced to make the device durable enough to measure the loads. This changes the structure and probably compromises the accuracy of the loads being measured. Furthermore, load transducers typically cannot capture all of the important loading DOF acting on a structure.

When working with measured strain data, engineers will typically compare one or two points in time of one or two channels to “hot-spots” on the FEA model. The engineer may modify modeling or loading techniques to get these ‘hot-spots’ to match up better. The strain signals are usually used for fatigue calculations with tools like fe-safe and nCode.

With True-Load, all of the measured strain channels will match better than 5% (typically 2%) and it will drive the FEA model to mimic the measured data. This allows for full FEA based fatigue to be performed with a high level of confidence.

Strain gauge placement is typically done using traditional knowledge and hot-spots from FEA models. The expected learning from strain measurement is usually a rear view mirror look. Does the strain measurement yield satisfactory fatigue calculations? Did the FEA model predict about the right peak strain? This data is almost never used to drive the next level iteration and lay the foundation for design improvement. With True-Load, the analyst learns about the entire loading regime and they can iterate and improve their design from the measured loads from True-Load. True-Load will literally give the analyst the tools to evaluate life of their components instead of stress or strain contour plots which are poor substitutes for life.

Multi-body Dynamics (MDB) and environmental simulation (e.g. water sloshing on a off-shore tower) are often performed to create loading to be used in an FEA model. The loads from these models are often handed off to another group of analysts for use in FEA simulation. There often is a great deal of mistrust in the accuracy of the loads because of assumptions in the MBD simulations (e.g. rigid bodies, frictionless, large displacements). The loads from these MBD simulations can produce erroneous results in the FEA model. The True-Load loading functions from measured strain can be used by the analyst in very natural fashion with no additional work. It’s not that the MBD is calculating the loads incorrectly. The loads MBD is calculating don't fit in nicely with the modeling techniques the FEA analysts are using. In addition, the quality of the MDB loading is only as good as the modeling of the environmental effects in the MBD software. Often times features like dirt and other natural features are very hard to approximate in MBD software.

The MBD and environmental analysis can be extremely time consuming. If at the end of that analysis, the data serves little value to the FEA analyst it can be seen as a waste of time. With True-Load, relatively simple strain measurement will drive the FEA analyst's model that will make it very useful for understanding the entire structure and performing fatigue analysis.

Typically companies do not manage the test and fea data together. In most companies the test data is managed by work order number and usually just kept in an OS file folder structure. The FEA models are typically managed by the analysts in their own OS file folder system. More companies are managing FEA data in PLM systems, but FEA usually follows CAD. The test data is the last data to be thought of in the data management environment.

With True-Load, the test data generates loading data stored in the .TFU file, the .QSE file and the .LDF file. This creates a "loose" connection between the test data and the FEA model, but it creates a strong mental link between test, analysis, and loading.

Time history generation from FEA can be very time consuming – especially if the strain needs to be calculated along a vector. With True-Load, these calculations are done a very natural UI. The benchmarks that have been performed at customers show that in 30 seconds a plot can be produced that would normally take 30 minutes or more without True-Load. These plots can be automatically dumped to a CSV which saves even more time to bring them into fe-safe.

The True-Load™ process and μETA Software

True-Load leverages the FEA model in μETA environment to place optimal strain gauges on the component. The analyst will have experimental test data collected at the indicated strain gauge locations. This strain data is then brought into True-Load/Post-Test running in the μETA environment to calculate loading from the measured strain data. Once the loading is calculated, the True-QSE tool can be used to create results on any node, element or an operating deflection shape. The loading functions can be brought into fe-safe to be used in a Scale and Combine fatigue analysis.

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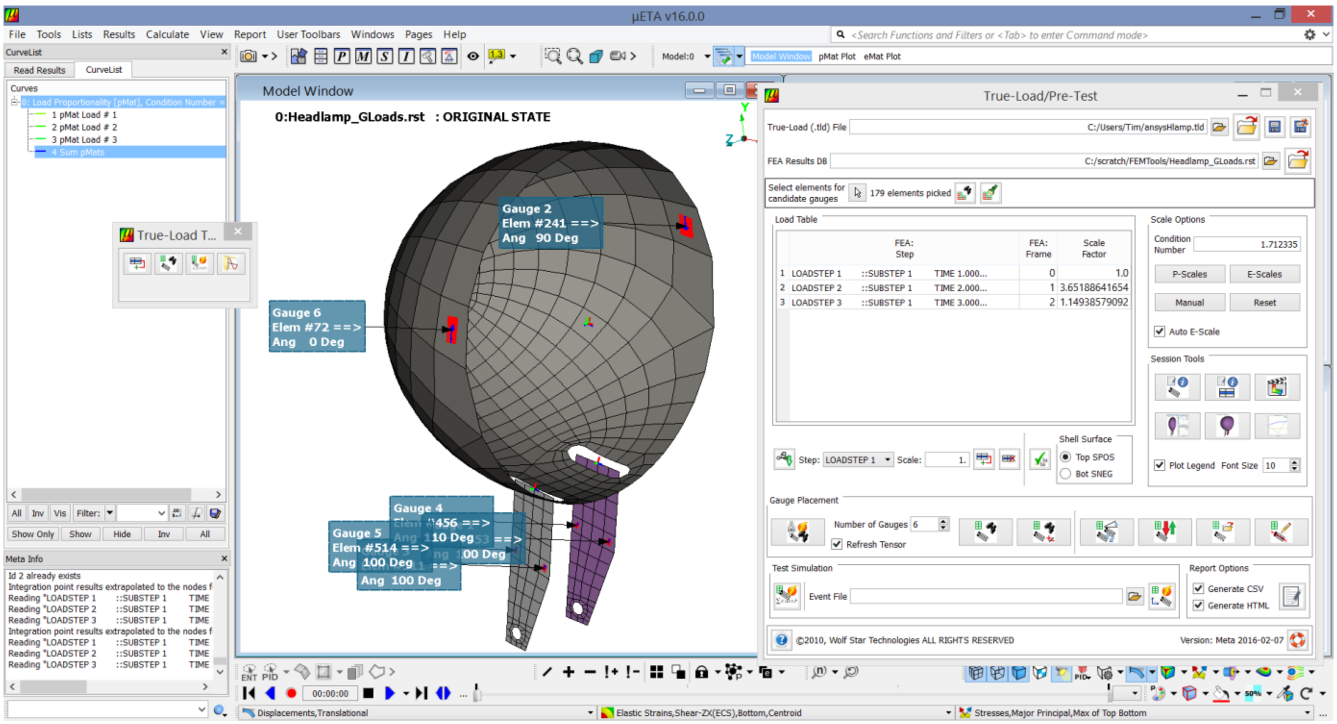

The True-Load™ Value Proposition

Know your loads! Turn components into multi-DOF loading transducers by leveraging an FEA model and uniaxial strain gauges.

Rapidly iterate on design using measured loading and highly efficient results reconstruction.

Drive FEA based fatigue analysis using strain correlated loads.

Eliminate entire design / build / test iteration cycles through improved knowledge of loading.

True-Load™ provides the capability to:

- Locate optimal strain gauge placement
- Understand complex loading on structures
- Provide strain correlated loading for use in FEA, Fatigue and laboratory testing
- No modification of hardware required
- Uses uniaxial strain gauges
- Leverages existing FEA models for gauge placement and load determination
- Customers experience eliminating entire design/build/test iteration cycles because of improved knowledge of loading

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