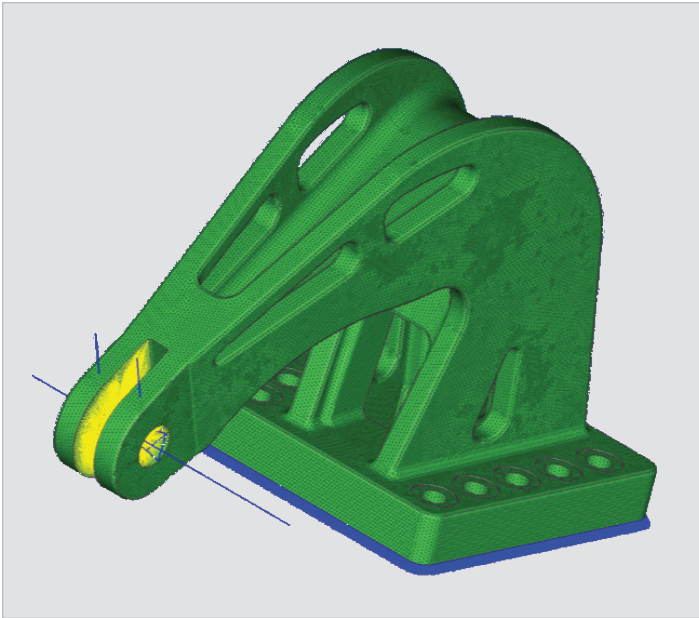


# Optimizing Strain Gauge Placement with LW Finder and HyperMesh



The following workflow demonstrates how to find the optimal locations to place strain gauges on a casted bracket in order to accurately measure loads.

This workflow is based upon a scenario where strain gauges are used to measure multiple real world load cases in a casted bracket. It is important that this load data is accurate since it may then be used for dimensioning parts or as an input to simulation models. The location of the strain gauges has a significant impact on the accuracy of the measurements. Poor gauge locations can lead to expensive repeats of tests, misleading results, and disrupted timelines.

The complete process is detailed below for using simulation models to find the optimal locations for placing strain gauges, and predicting the error that will result. This is achieved by first setting up the analysis in HyperMesh, solving the model in OptiStruct, determining the best gauge location with LW Finder, and finally visualizing the gauge locations and orientations in HyperMesh.

## Workflow Summary:

The first step is to set up the analysis in HyperMesh. Do this by applying forces to your solid model as separate load cases. Then create shells that cover the entire solid (Tools>Faces>Find Faces). Create a property with P-shells. Select a very small thickness so that it does not add to the stiffness of the model. Create a SET of elements which contains the shell elements on which it is possible to place strain gauges. Tell OptiStruct that it is going to output the strains (Analysis > Control Cards > GLOBAL\_OUTPUT\_REQUEST). Select the strain output from the element set that was just created. Run the analysis in OptiStruct.

After the analysis has been run in OptiStruct, use HyperView to extract the results that are needed by LW Finder:

- Strains in 3 directions (Tensor panel > choose the correct set > Strains resolved in elemental system, and tensor format to be component). Go into query panel and select element set, extract element ID and tensor plot results. Export and save as CSV file.
- Centroid coordinates. Import the input deck. Query panel, select element centroid for the candidate set. Export and save as CSV file.

Use any spreadsheet editor to combine the columns into a single spreadsheet for each load case with the correct format (see below).

The integration point column should only contain "0". See a demo file for example, such as "Result\_finished\_loadstep\_X". Save each load case as a space separated file or comma separated file.

Element ID	Integration Point	x-coord	y-coord	z-coord	E11	E22	E12
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Setup and run the optimization in LW Finder.

- Import the x, y and z load cases. Set the weight factor, load in service and unit load parameters.
- In the extra errors tab, click “Import combined strain files”, and add the +y and -y files.
- Click through “Configuration” and “Run optimization” tabs and follow instructions. Export the results.

It is possible to use HyperMesh to visualize the gauges and their orientation. This can be especially helpful for giving instructions to the workshop. First download the script called “visualize\_straingauges.tcl”. Open the file that was exported from LW Finder. Save the first sheet in the workbook as a comma-separated file, and put it in the same folder as the script. Run the script, it will display small arrows on the surface of the part.

## Links

**The files used in this workflow can be downloaded here:**

[www.lwengineeringsoftware.com/workflow-webinar/](http://www.lwengineeringsoftware.com/workflow-webinar/)

**Watch the full webinar:**

<http://web2.altairhyperworks.com/lw-engineering-hypermesh-optistruct>

## About Altair

Altair is focused on the development and broad application of simulation technology to synthesize and optimize designs, processes and decisions for improved business performance. With more than 2,000 employees, Altair is headquartered in Troy, Michigan, USA and operates 69 offices throughout 24 countries. Altair serves more than 5,000 customers across broad industry segments.

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