



Structural Design Using Altair Hyperworks / Inspire

The goal of this project is to use Altair Hyperworks / Inspire to perform topology optimization on a structure that you select. Topology optimization is a process that requires many decisions and choices. At all stages of this project, the most important task is to identify the choices that you are making and to justify them with engineering reasoning. To complete this project, submit a written report that has the following components:

- **Preliminary proposal:** *By 18 March*, submit a proposal for the structure that you wish to optimize. You should explain what is the structure and why you expect that topology optimization is likely to produce interesting results. The proposal should be less than one page, and must contain a sketch of the three-dimensional design space, the three load cases and any geometric constraints. Provide details on what are the design requirements for your system. Read the complete project assignment carefully before submitting your proposal. Do not use existing design challenges that may be found online. **This component is not worth any marks toward the grade for this project.**
- **Project proposal and description (25%):** Based on the preliminary proposal that you submitted, and incorporating any feedback, describe the topology optimization problem that you intend to solve. This must include a description of the part to be optimized, a specification of the objective function, a drawing of the design region and how it connects to non-designable components, a set of load cases, and geometric and other constraints that must be satisfied. You must provide at least three distinct load cases. This requirement will be important in selecting the structure that you wish to optimize. Your diagrams of the design region must identify clearly all load cases and geometric constraints. Discuss non-geometric constraints, such as minimum member size or maximum stress, that you will need to apply.
- **Problem setup (20%):** Describe how you set up this problem for solution using Hypermesh or Inspire. Take screen shots of the process as needed.
- **Analysis and topology optimization result (15%):** Present the raw results of the topology optimization. You should do several runs with varying parameters, present the results and choose, based on your engineering knowledge, the most promising option. Justify your choice.
- **Post-processing (25%):** Take the topology optimization result and transform it into a form that can be rendered in CAD and fabricated using standard techniques. Demonstrate that

the result, after post-processing, satisfies the constraints. This will require finite element simulation. Discuss alternate methods for post-processing that might improve the results.

- **Conclusions (15%):** Discuss the process of topology optimization as applied to your structure and what you have learned from this project.

This project is worth 20% of your final grade for AER 1410. The weights for each component of the project are indicated in the descriptions.