

Design Exercise Evaluation

Evaluation

Topology optimisation of a polymer robotic end effector

- Material & Process Selection
- Formulate a design & manufacture workflow for your chosen material and process?
- What information is required to setup the topology optimisation?
- What do you need to consider when redesigning the component for AM?

Material & Process Selection

- Cost
- Production Volume
 - Material Extrusion for prototyping stage (low volume production)
 - PBF is more suitable for higher volume production (either high numbers for copies of the same part or high number for a variety of products).
If the components are small, it allows for them to be stacked on top of each other to make full use of the build volume
- Part Size
 - Will it fit?
 - How many can we fit?
 - With material extrusion we could build multiple, but would we gain anything?
- Resolution
 - How accurate does it need to be?
- Surface roughness requirements?
 - What is acceptable?
- Mechanical properties
 - How strong does it need to be?
- Environmental properties
 - Exposure to chemicals
- Thermal properties
 - Which material is best suited?

Design & Manufacture Workflow

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- Formulate a design & manufacture workflow for your chosen material and process?

Example image of workflow

Topology Optimisation Setup

What information is required to setup the topology optimisation?

- Material
 - Are we using generic properties or AM properties?
 - Are we accounting for anisotropy? If not, how can we account for it (are we assuming minimum strength? physical testing?)
 - Where will the AM properties come from?
 - If PBF, are we accounting for potential porosity?
 - How confident are we that the part that we will print will meet the expected material properties? How can we ensure this?
- Design Space
 - Keep in/Keep out zones. Where must material go? Where must material not go?
 - Where is the rest of the assembly? Do the parts move?
 - Tooling access?
 - Post-processing requirements?
 - Extent of free space for design - How big? Bounding geometry?
 - Symmetry condition? (Reduce computational time)

Topology Optimisation Setup

What information is required to setup the topology optimisation?

- Meshing
 - Resolution?
 - Mesh sensitivity analysis? (Could help refine the design space)
- Constraints
 - Overhang rule?
 - How is the part fixed?
 - Minimum thickness?
 - Avoid voids?
 - Max stress/displacement?
- Loads Cases
 - Abuse loads? How can we account for the dynamic load?
 - Fatigue loads
 - Manufacturing loads (e.g. machining/drilling)
- Objectives
 - Minimise compliance
 - Minimise mass
 - F.O.S

Considerations for DfAM

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- What do you need to consider when redesigning the component for AM?
 - DfM Rules
 - Overhang
 - Orientation
 - Support
 - Re-validate design with FE
 - Access (tools/inspection)
 - What impact does this have on the rest of the system?
 - Design software (workflow/capability/limitations)
 - Build process simulation
- How can we increase the use of AM?
 - System level design
 - Consolidation of components (e.g. piping)
 - Further weight reduction



Example image of topology
result

Post-Processing Considerations

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- Support removal
- Powder removal
- Post-curing
- Surface finish
- Machining/drilling
- Inspection