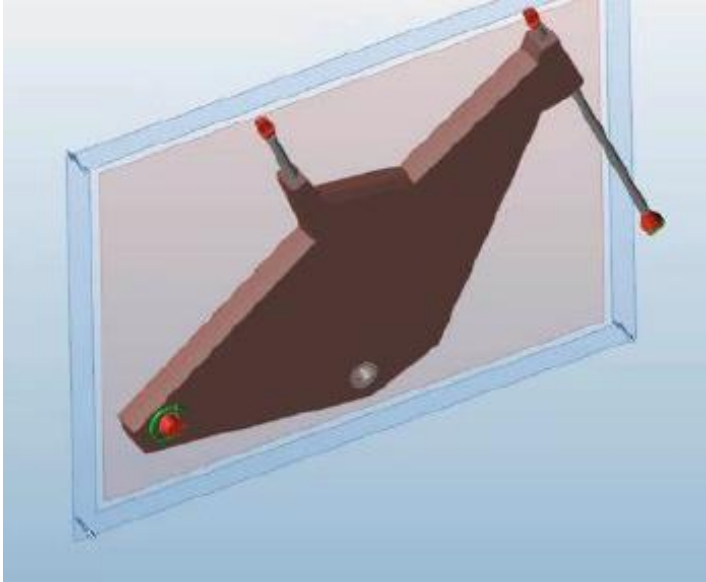


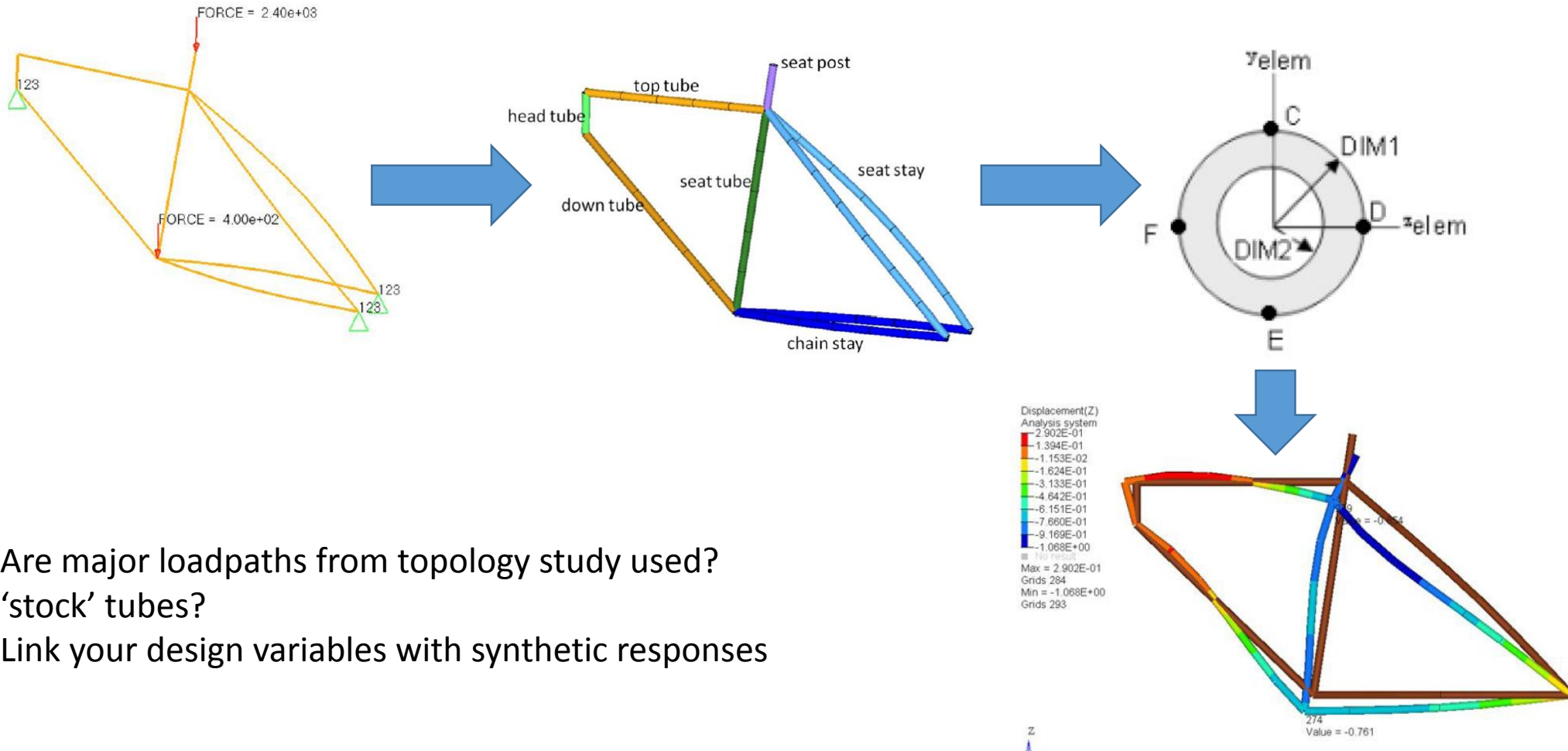
Size Optimisation

- Once major loadpaths have been established – what sized members do you need?



- Shell thickness
- Beam cross sectional properties
- Spring stiffness'
- Optimisation takes place on the element property – hence all elements using that property are changed.
- Variables can be real or discrete.

Size Optimisation

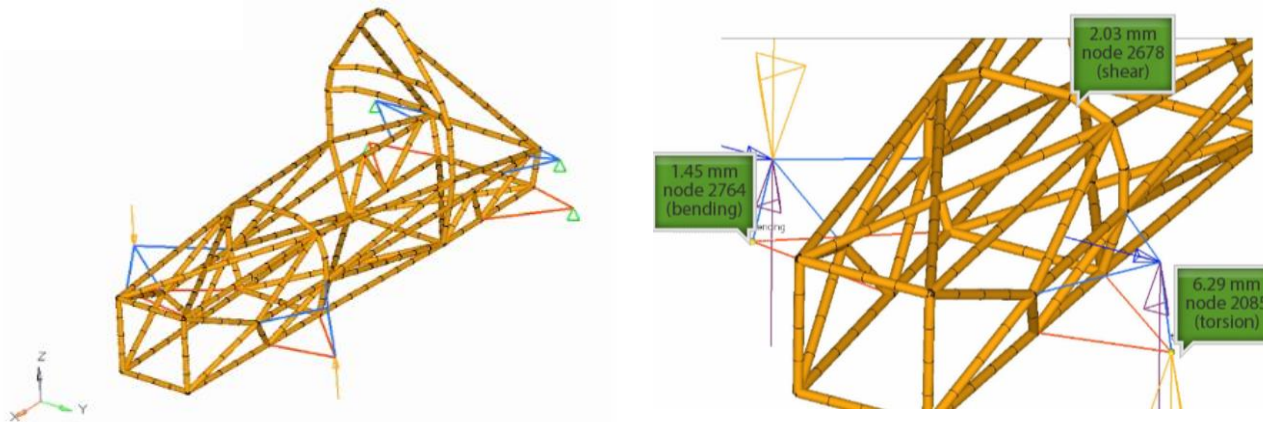


- Are major loadpaths from topology study used?
- 'stock' tubes?
- Link your design variables with synthetic responses

Size Optimisation – Formula SAE example



- All tubes are the same diameter
- Roll cage?



Linear Static Analysis – Base Design

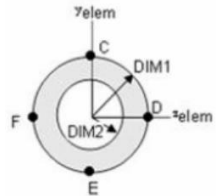
Outer radius: 12.5 mm
 Inner radius: 10.5 mm
 Total mass: 42.1 kg

Note, the values for inner and outer radius used for the base design have been just a guess.

Load Step	Max. Displacement (mm)	Node
Bending	1.45	2764
Shear	2.03	2678
Torsion	6.29	2085

Size Optimisation - example

Design variable / parameter



		Lower bound (mm)	Upper bound (mm)	Initial value (mm)
DIM1	r_o	5	15	12.5
DIM2	r_i	1	14	10.5

OBJECTIVE - Min mass

Optimization constraints

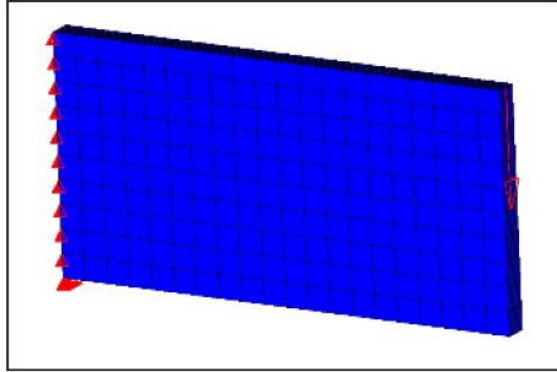
Load Step	Max. Displacement (mm)	Node
Bending	1.5 base 1.45	2764
Shear	2.0 base 2.03	2678
Torsion	6.5 base 6.29	2085

Loadstep	Base Design	Size Opti. Design	Node
Bending	1.45 mm	1.5 mm	2764
Shear	2.03 mm	1.83 mm	2678
Torsion	6.29 mm	6.09 mm	2085
Mass	42.12 kg	34.97 kg	

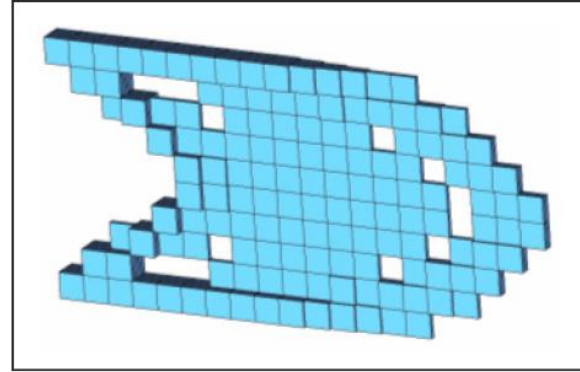
- All tubes are the same diameter
- 4 iterations
- Real values used
- Discrete values = 39kg

Free Size/Topometry Optimisation

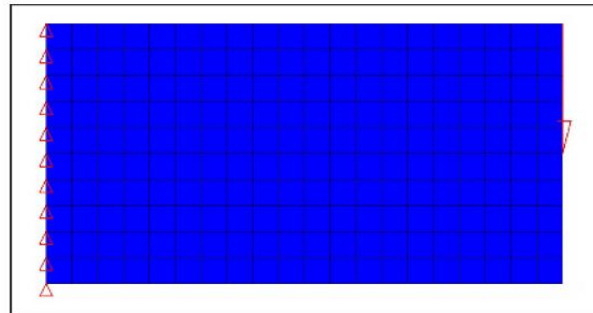
- Limited to shell thickness – thickness altered by element rather than property



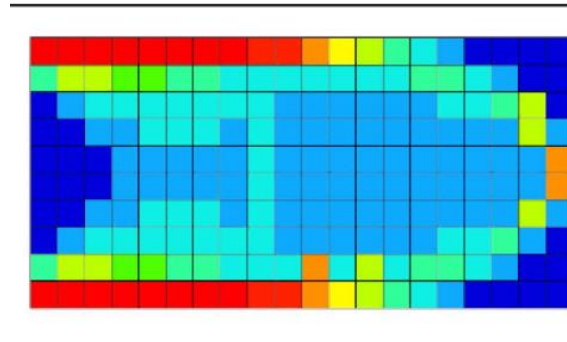
Cantilever Plate – 3D Model



3D Topology Result



Cantilever Plate



Free-Size Result

Notes adapted from/Further reading

- Practical Aspects of Structural Optimisation, Altair University, 2014