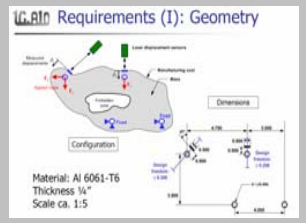
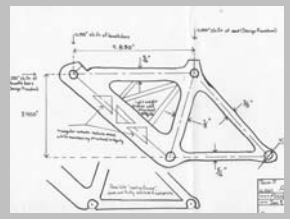
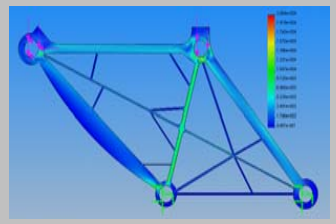
Design Evolution

Phase 1



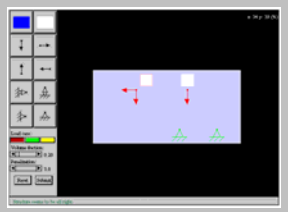


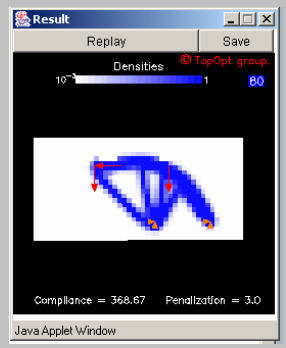


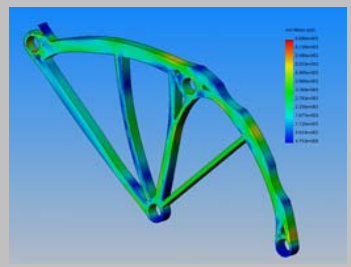
Problem Statement → Sketch → CAD Model → CAE → Rapid Prototyping Validation ↓

Phase 2

Design Optimization (Trimming!) → CAD Model V2 → CAE V2 → Rapid Prototyping V2 Validation V2







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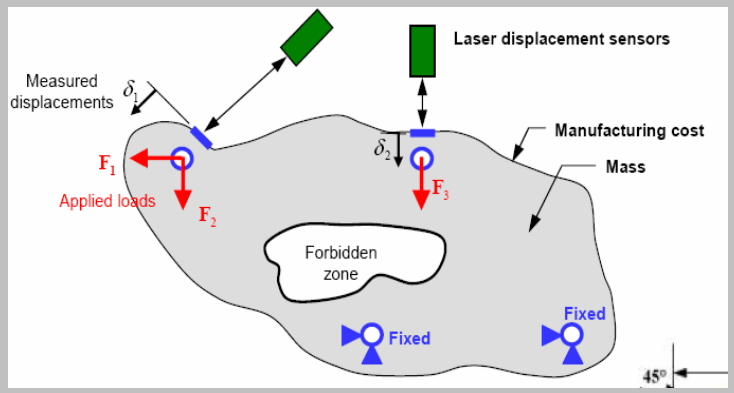
Comparison of Metrics

	Displacement 1	Displacement 2	Mass	Natural Freq	Cost
Requirement	0.071 mm	0.011 mm	0.160 lbs	505.7Hertz	7.8 $ / Part
CAE 1	0.303 mm	0.0455 mm	0.160 lbs	460 Hertz	$14.83
Experimental 1	0.7473 mm	0.08625 mm	0.166 lbs	477.45 Hertz	$14.83
CAE 2	0.1568 mm	0.010998 mm	0.160 lbs	432 Hertz	$10.19
Experimental 2	0.390 mm	0.043575 mm	0.165 lbs	426.2 Hertz	$10.19

Table 1: CAE and Experimental Data

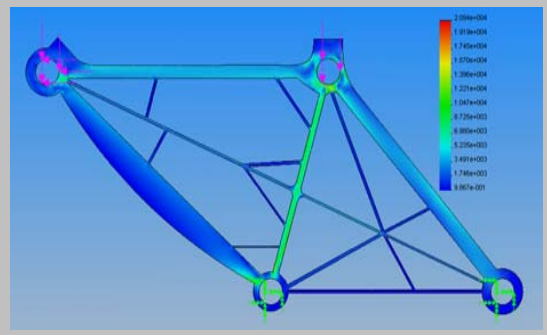


Load Case

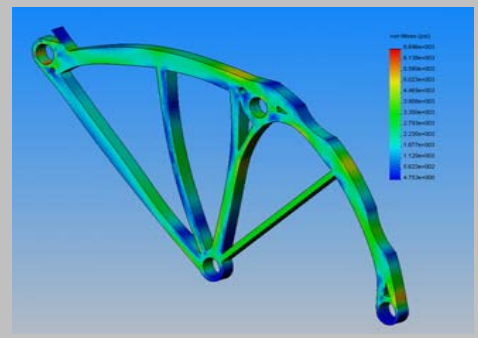
F1 = 100lbs

F2 = 100lbs

F3 = 50lbs



Version 1 CAE



Version 1 CAE

Version 1 CAE

Version 1 CAE

FIVE

Attribute	Constrain	Optimize	Accept
Cost			■
Performance		■	
Mass	■		

Table 2: Priorities

Final Specifications in Comparison to Requirements

Manufacturing Cost	$10.19	$7.80
Performance	0.390mm, 0.0435mm	0.071mm, 0.011mm
Mass	0.165 lbs	0.160 lbs
Surface Quality	5	5

Design rational

•Focused on requirement delta2 to achieve stiff and rigid power train region to give rider a sense of good acceleration

• Met mass requirement as weight is an important factor in racing bike

• Cost was largely ignored, as it is an acceptable criteria and optimizing for the other factors naturally improved cost efficiency

Final Conclusions

- Design analysis arrived at performance and weight results with in a reasonable window for the 2nd product
  - δ1 was 221% of the target, while δ2 was 99.9% of the target deflection
  - Mass was at 100% of the target
- Testing did not align with the CAE to full satisfaction
  - δ1 was 248.7% of the prediction, while δ2 was 396.2% of Cosmos Works' predictions
- While the iterations were successively achieving better results, the final model has nearly approached the limitations of the materials being utilized
  - Only by blending materials and adding new parts to the assembly, can the performance to mass ratio be improved
  - Any advancements of this kind will require a new manufacturing process, which is currently available.
- While further iterations of the design and prototyping process could improve the designs performance, these iterations would not be cost effective