

Ecodesign and 3D topology optimization

Gustavo ASAI

Supervisors:

Pr. Frédéric LACHAUD

Pr. Joseph MORLIER



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Optimization problem formulation

Results

Bracket optimized for both load cases

Bracket optimized for vertical force

Bracket optimized for horizontal force

Quantitative comparison

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Quantitative comparison

$$\begin{aligned}
 \min_{\rho, \theta, \alpha} C(\rho, \theta, \alpha) &= \left(\sum_{i \in LC} c_i(\rho, \theta, \alpha)^n \right)^{\frac{1}{n}} \\
 &= \left(\sum_{i \in LC} \left(\sum_e \rho_e^p \mathbf{u}_{e,i}^T \mathbf{k}_0(\theta_e, \alpha_e) \mathbf{u}_{e,i} \right)^n \right)^{\frac{1}{n}} \\
 \text{s.t. } &\begin{cases} \frac{V(\rho)}{V_0} \leq f \\ \mathbf{KU} = \mathbf{F} \\ 0 < \rho_{min} \leq \rho \leq 1 \\ -\frac{\pi}{2} \leq \theta \leq \frac{\pi}{2} \\ -\frac{\pi}{2} \leq \alpha \leq \frac{\pi}{2} \end{cases}
 \end{aligned}$$

Optimization problem formulation

Results

Bracket optimized for both load cases

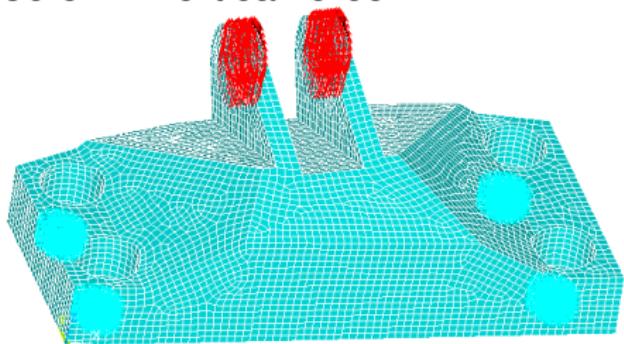
Bracket optimized for vertical force

Bracket optimized for horizontal force

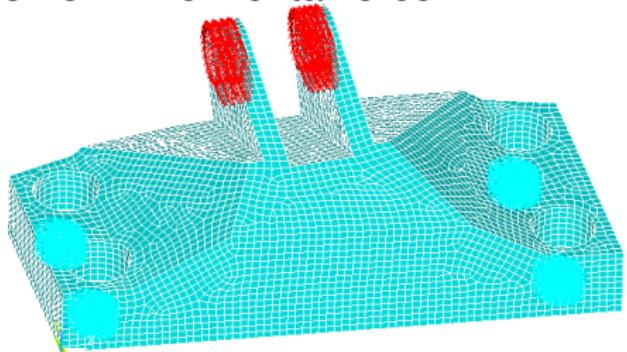
Quantitative comparison

Results

Load case 1:
36.5 kN vertical force

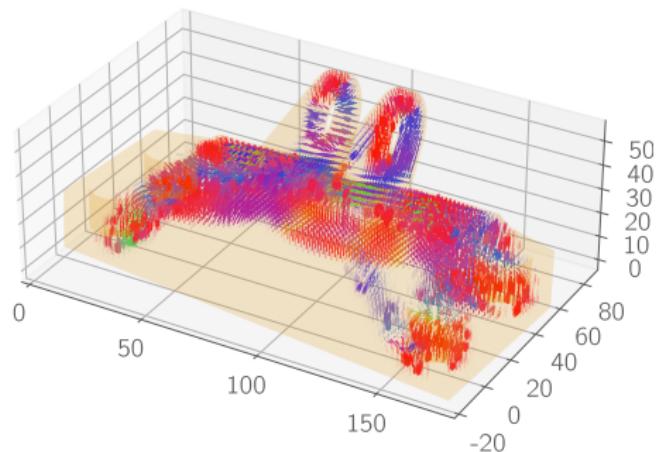


Load case 2:
37.8 kN horizontal force

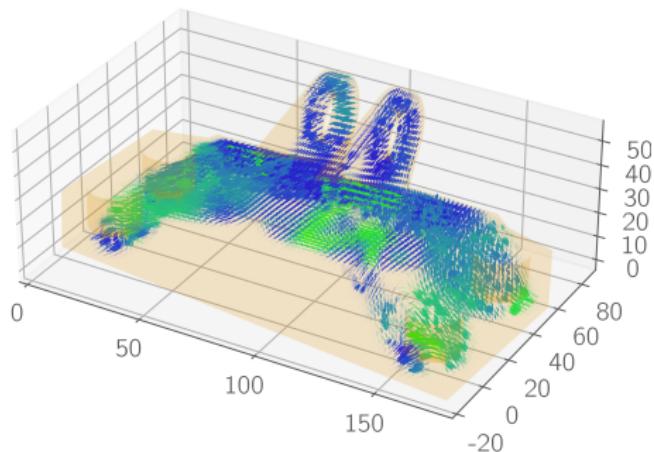


Bracket optimized for both load cases

ρ, θ, α

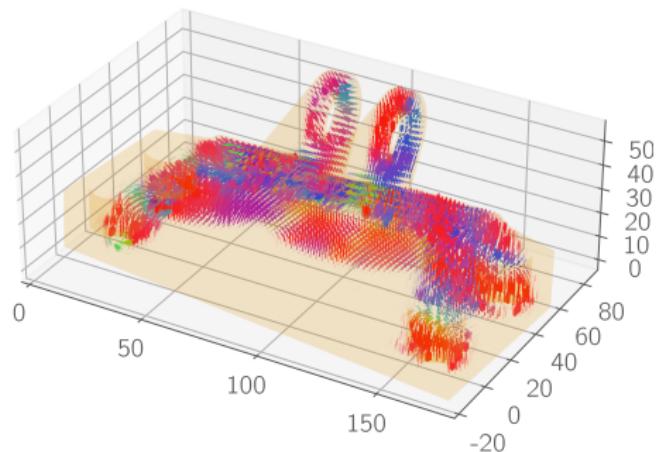


ρ, θ

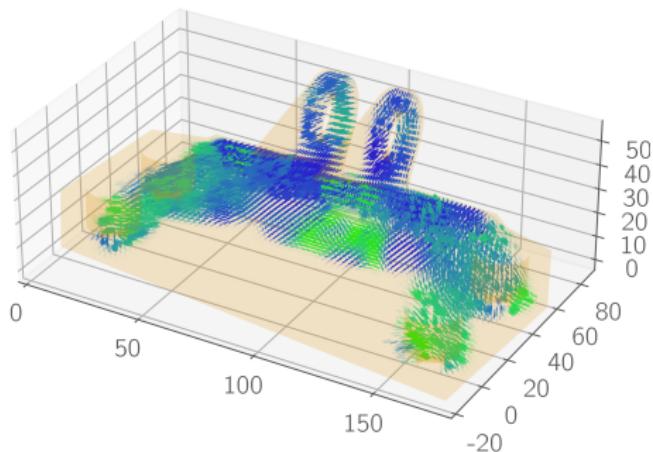


Bracket optimized for vertical force

ρ, θ, α

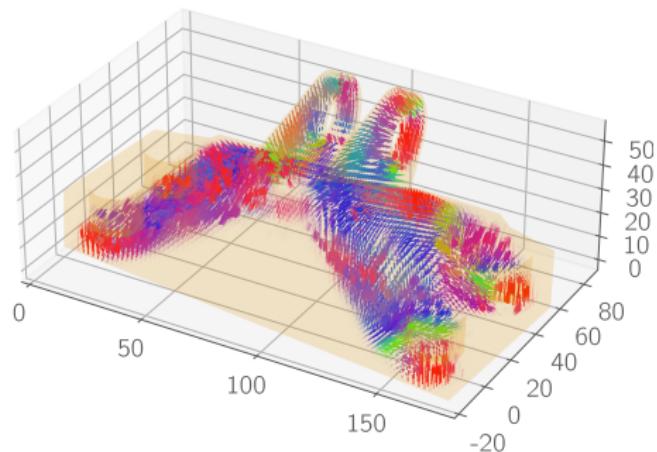


ρ, θ

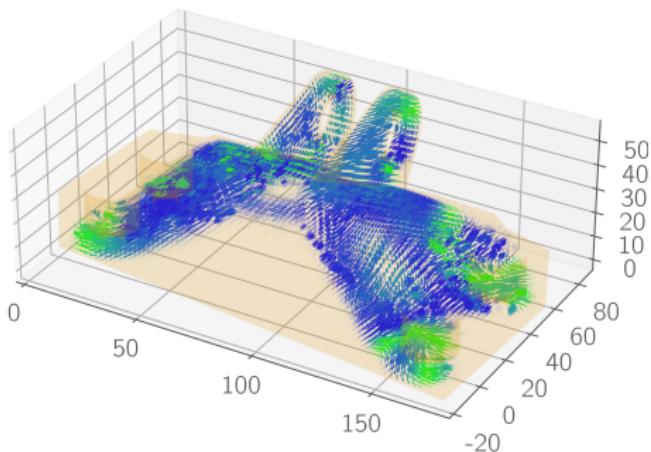


Bracket optimized for horizontal force

ρ, θ, α

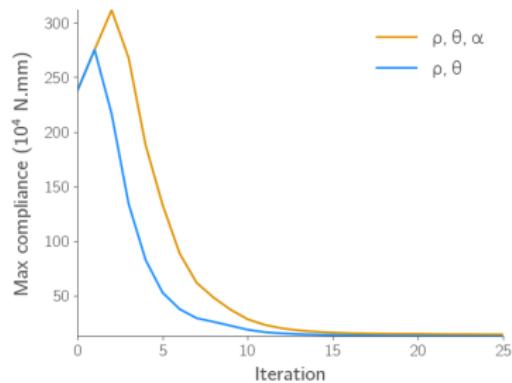


ρ, θ



Quantitative comparison

Final compliance (10^4 N.mm)



ρ, θ, α

LC	Vertical	Horizontal
Both	14.178	10.295
Vertical only	13.714	12.738
Horizontal only	108.016	2.933

ρ, θ

LC	Vertical	Horizontal
Both	12.584	8.793
Vertical only	12.500	11.521
Horizontal only	86.664	2.805