Discussions of topological optimization for additive manufacturing of a cavity

Hui Min Gassot

CNRS/In2p3/Ipn Orsay

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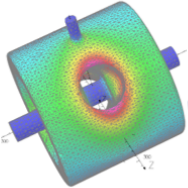
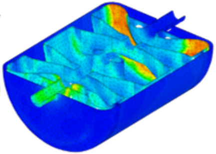
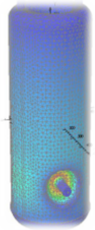
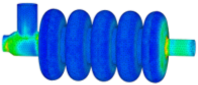
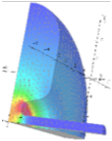
I Simulations tools for topological optimization

1. Motivations: use of simulation tool for topological optimization
   - Tests on differents simulations tools
   - Minimize the weight of a cavity

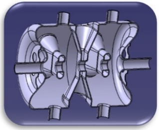
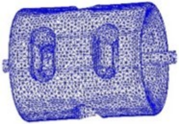
II: Topological optimization for additive manufacturing

2. Topology smoothing: make a STL file of a cavity for additive manufactuning
   - Extraction of smooth surface lisse

Activities on supercondecting cavities

two gaps Spoke, four gaps Spoke,Quarter wave, 5 cells cavity,single cell

workflow cao-mechanic

Part I

Pratices on optimisation topologique

Tests on differents simulations tools

- Topological optimization solution as function of volume contraint with maximal stiffness
- Optistruct/Altair, Comsol, Cast3M

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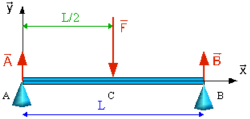
flexion of a bending beam

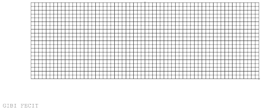
Design variable: pseudo-density per elements

$E(x) = E_0\mu^p(x)$
$\rho(x) = \mu\rho_0(x)$
$0 < \epsilon_{seuil} \leq \mu(x) \leq 1 \; p \geq 1)$



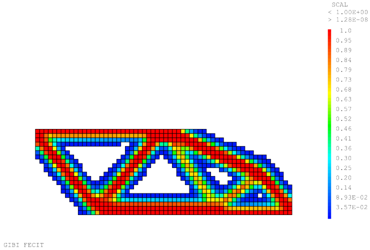
Bending beam under strength centered

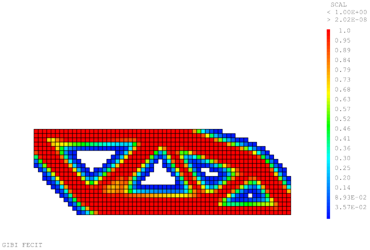
With a masse inferior
to the initial mass, the topological optimization find the maximal stiffness for the material distribution in the initial volume



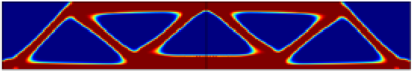
intiel mesh

Comparative studies between commercial and non commercial code





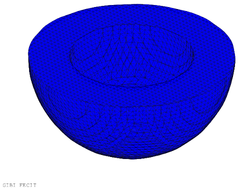
$V = 40\%$ $V = 60\%$



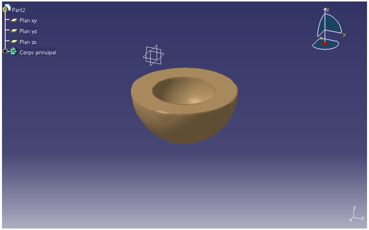
Comsol

2. Topology smoothing: make a STL file of a cavity for additive manufactuning
    - Extraction of smooth surface lisse

Realization of smooth surface in 3D

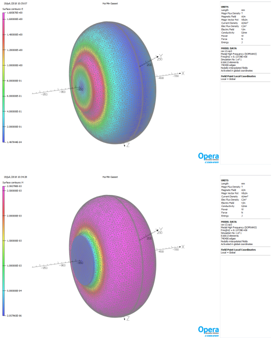


optimized geometry

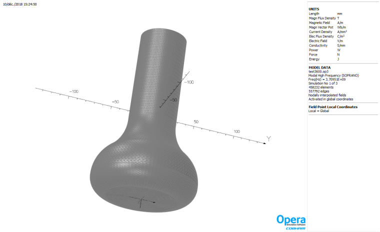


geometric representation of the STEP file created from optimized geometry

Some tests in perspective



monocell 804 MHz β 1 cavity

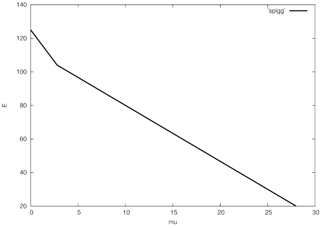


3.6GHz β 1 cavity

Porous material's properties

$$E(x) = E_0 \mu^p(x)$$
$$\rho(x) = \mu \rho_0(x)$$

E



μ

for a porous material
the Young's modulus
is function of porosity,
some model could be studied
in parallel
of characterizations

Advantage, possibilities and limites

Times of iteration correct
Non linear mechanic
...
Development on demand
...