

# - ALMIA CONSORTIUM – Space part -

## Combining topology optimization with additive manufacturing minimizes weight of part and buy to fly

### OBJECTIVES

- Redesign using topology optimization – Weight reduction – Cost reduction – Hardware demonstration

### A COLLABORATIVE PROJECT

#### ALMIA Project

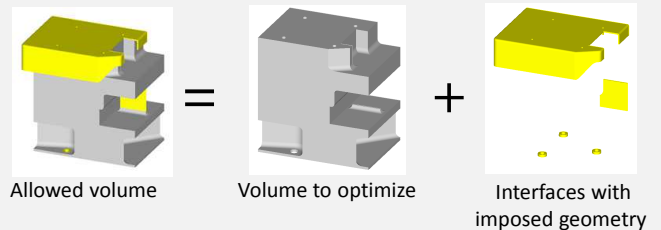
The ALMIA (Additive Layer Manufacturing for Industrial Application) project is a collaborative project with 4 companies and 1 university:

- 2 end users :  
- 1 design office (project leader) : 
- 1 Additive manufacturing supplier: 
- 1 University : 

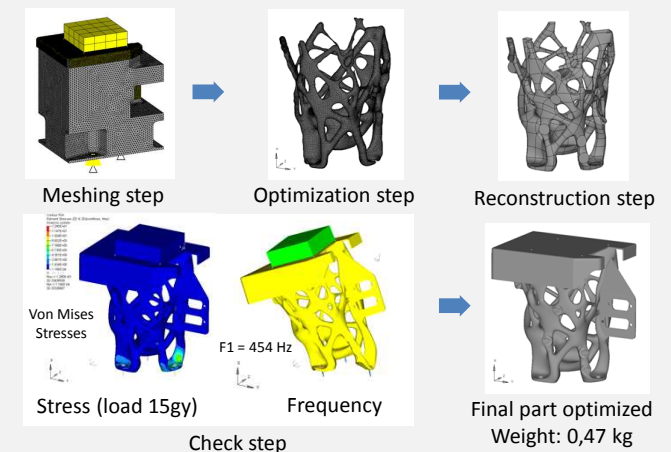
### TOPOLOGY OPTIMIZATION PROCESS

The topology optimization has been done with Altair® OptiStruct® by SOGECLAIR in close relationship with CNES design office.

#### Definition of the optimized volume



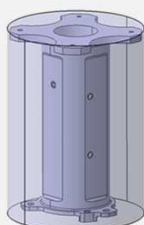
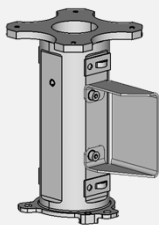
#### Main steps of the calculation process



### CURRENT DESIGN

#### Current design of the bracket

Today the part is fully machined from an aluminium block



Material : 2618 T851

Weight:

- Aluminium block: 3,4 kg
- Machined part: 0,56 kg

### INPUT DATA

#### Material : A357 (AS7G06)

| Properties    | Unit               | Value                 |
|---------------|--------------------|-----------------------|
| Young Modulus | (MPa)              | 58000                 |
| Poisson ratio |                    | 0.33                  |
| Density       | kg/mm <sup>3</sup> | 2.68 10 <sup>-6</sup> |
| Ftu           | (MPa)              | 287                   |
| Fty           | (MPa)              | 241                   |

Volume compliance: to prevent any interference with other parts

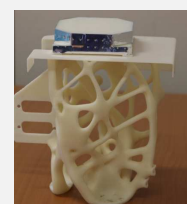
Weight: Minimize the weight

#### Static load conditions :

|                          | x   | y   | z   |
|--------------------------|-----|-----|-----|
| Applied acceleration (g) | 15  | 15  | 15  |
| Maximum stress 3σ (MPa)  | 146 | 146 | 146 |

| Dynamic load conditions : | Number of eigen modes  | 10  |
|---------------------------|------------------------|-----|
|                           | Maximum frequency (Hz) | 335 |

### OPTIMIZED DESIGN



First full scale prototype made with liquid resin at the CNES



### RESULTS & OUTLOOK

- Buy to fly reduced from 86 %
- Weight gain: 16% (although material mechanical properties was divided by 1,5 between 2618 and A357)
- Make the optimized part with A357 powder on a EOS M280 (at Fusia)
- Alodine surface treatment

Project funded by :

