Container development

Multi-objective optimization

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Objectives

1. Reduce the component cost
2. Maximize the container capacity

Constraints

1. Materials and thicknesses related to the production technology
2. Minimum capacity = 7.5 l
3. Maximum Stress < $\sigma_{\text{adm}}$
4. Production technology: Low pressure vs. High pressure Die Casting
Geometric variables

Set-up of a parametric CAD in order to maximize internal capacity, taking also into account the technological processes.
# Materials variables & production scenario

<table>
<thead>
<tr>
<th>Material</th>
<th>Type of Alloy</th>
</tr>
</thead>
<tbody>
<tr>
<td>A356</td>
<td>Aluminium Alloy</td>
</tr>
<tr>
<td>A360</td>
<td>Aluminium Alloy</td>
</tr>
<tr>
<td>AM60</td>
<td>Magnesium Alloy</td>
</tr>
<tr>
<td>AZ91</td>
<td>Magnesium Alloy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Production Volume [piece/year]</th>
<th>Number of low pressure machines</th>
<th>Number of high pressure machines</th>
</tr>
</thead>
<tbody>
<tr>
<td>23.000</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>46.000</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>69.000</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>
Design definition using DOE and MOGA algorithms

Input variables → ‘Random’ DOE

50 components design

MultiObjective Genetic Algorithm

250 designs of the component at the end of the optimization
Automatic mesh and analysis

Automatic mesh

Von Mises stress

Pressure loads
The 250 designs simulated by the DOE analysis may be represented in a single significant chart.
The result of optimization conducts to three possible alternatives, depending on customer needs:

1. Best capacity product
2. Maximum robustness to unpredictable pressure peaks
3. Lower cost product
Conclusions

1. It has been developed an innovative, completely automatic and multi-objective product optimization.

2. It has been obtained a substantial reduction of calculation times and of costs due to process and product optimization.

3. It has been pointed out the optimal configurations of the parameters for the component under study and the cheapest technology to produce it among three possible production scenarios.

4. The ModeFRONTIER workflow realized may be easily adapted to complex components.