

OptiBike Robust Lightweight Composite Bicycle design and optimization

Fortissimo Experiment Facts:

- Industry Sector: **Manufacturing**
- Country: **Spain**
- Software Used: **Optimus, Code_Aster, MxNet**

ORGANISATIONS INVOLVED

IDEC (End User) is in an SME focused in composites and new materials engineering. Its main strength is the development and industrialization of Advanced Composite Structures by Resin Transfer Moulding technology.

NOESIS (HPC Expert) is an engineering partner from Belgium.

UNITO (HPC Expert) is an Italian university from Turin, that provided HPC expertise together with NOESIS in order to achieve better performance.

ARCTUR (HPC Provider), the Slovenian HPC centre, is the HPC Provider.



THE CHALLENGE

Composite structures, and especially those incorporating carbon fibres, are much more complex than isotropic metal alloys, as they require lengthy development, significant knowledge and fine tuning. Building prototypes to test various configurations may take years to reach an optimal structure, which is, of course, not affordable. Numerical simulations can significantly reduce the time and effort required, but modelling software tools and HPC infrastructures represent a large investment and solving optimization problems with hundreds of parameters require highly skilled engineers.



THE SOLUTION

The OptiBike experiment focuses on providing SMEs with a user-friendly service to optimize the configuration of the layers of a composite material part, returning, in a reasonable timeframe, the best performing orientation of the layers, that respects manufacturing constraints. In order to speed up the process, this service is deployed on a cloud-HPC infrastructure and it leverages machine learning algorithms to exploit and enhance the expert's knowledge about performance and manufacturability of the configuration. The OptiBike service, once it has defined the best-performing configuration, is able to analyse the robustness of the optimal design with respect to the uncertainty related to manufacturing tolerances. The approach is validated on a use case that involves the simulation of stresses and deformations on a composite bike frame.



BUSINESS IMPACT

The OptiBike solution leads to a reduction of 80% in the time to design and optimise a bicycle that can currently take up to 8 months. In addition, it reduces the number of the manufactured prototypes by 75%. Having this optimization workflow available, means that IDEC is capable of staying ahead of the competition despite its limited resources. This is particularly relevant in volatile sectors such as competition bike manufacture. The reduced development time, will also allow IDEC to react more quickly to modifications of the design coming from either the customer or an in-house department.

