**PhD position:** **A new parametric geometric primitive for topology optimisation**

**Context:** **OCEAN-ALM project**

This PhD thesis aims at developing an original CAD tool based on a new mathematical representation of boundary surfaces in the context of the design/optimisation methodologies of parts that will be fabricated by means of additive layer manufacturing (ALM) technologies. Nowadays designers and engineers make an extensive use of topology optimisation tools since the early stages of the design process in order to have an idea of the optimum shape of the product for the considered application. It is a well-known fact that one of the main advantages of ALM technology is related to the ability of fabricating complex shapes. In this background, topology optimisation techniques received an increasing interest from the scientific community. To this purpose researchers put a considerable effort on the development of more and more efficient algorithms. Today in literature two main topology optimisation strategies can be found: the *solid isotropic material with penalisation* (SIMP) approach and the Level-Set method.
Nevertheless, both approaches suffer from several drawbacks:

1) manufacturing constraints related to the considered ALM technology are not integrated within such procedures
2) the result of the topology optimisation process is always a discrete object (a set of points which are collected into a STL file) which requires a long (and often complex) reconstruction phase in order to be integrated/modified within a CAD software.

The previous points are of paramount importance in the context of the design process. On the one hand, the compatibility with CAD commercial software is a crucial aspect since the optimised parts must be integrated within an assembly. On the other hand, the optimum shape needs several modifications in order to take into account the manufacturability constraints related to the ALM process.
To overcome the previous issues, in this thesis the candidate will develop a new topology optimisation technique based on the utilisation of new parametric geometric primitives directly integrated within a CAD software. The mathematical representation of boundary surfaces will make use of the Non-Uniform Rational B-Spline (NURBS) formalism and will be developed in the context of a variational geometry approach. The new mathematical representation will be totally compatible with standard CAD software and will allow the designer to easily manipulate the geometry of parts resulting from the topology optimisation process.

**Supervisors:** Jérôme PAILHES, Marco MONTEMURRO, Paul Le TEXIER, Vincent DELOS
**Contact:** M. MONTEMURRO, marco.montemurro@ensam.eu, P. Le TEXIER, paul.letexier@cea.fr, V. DELOS, v.delos@i2m.u-bordeaux1.fr