Optimization of 3D infill structure produced by fused deposition modeling by using remeshing methods and optimization procedures

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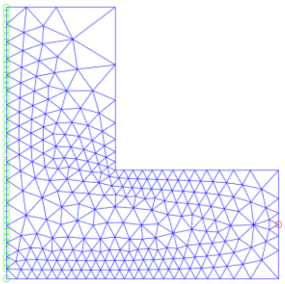
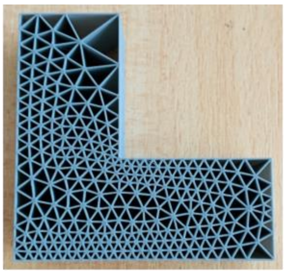
3D printing is an alternative manufacturing process that is particularly well adapted to unitary, low series or complex inner shape parts. This process is a solution for local and on demand production and is well adapted to personal and individual parts where no specific tool is necessary. Among the actual 3D printing processes, FDM process (Fused Deposition Modeling) is the most affordable and distributed. This process consists in deposing a fused material conditioned in filament onto a support in order to manufacture an object layer by layer. Recent work at the UR LASMIS Laboratory showed that on particular 2.5D parts (parts with constant section among the height) the continuous printing is possible that allows shortening the printing time and enhancing the mechanical behavior of the printed part. S. Madugula (phd student in the UR Lasmis, 2018-2022) developed a numerical tool to optimize the infil structure of 2,5D printed parts produced by the FDM process. When such a part is subjected to external loading,not all the infill regions will experience the same amount of stress. Therefore, using uniform infill throughout the part is not the most optimised solution in terms of material usage. S. madugula developed two methodologies based on an iterative process using 2D refinement technique and2D remeshing techniques coupled to Finite Element simulation (FE simulation) to control the internal structure of the part without changing the contour. These methodologies reinforce the infilll design of the 2D part in the area where the mechanical strength must be improved and to decrease the amount of material used to reduce the printing time.

The aim of this thesis is to continue this research work and extend the methodology to the 3D case. Optimization strategies will be implemented in order to define the position of nodes en reinforce the infill design.





Infill design of a L shape (thesis of S. K. Madugula)