caxman

computer aided technologies for additive manufacturing

# Analysis-Based Design and Process Planning for AM

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The objectives of Computer Aided Technologies for Additive Manufacturing (CAxMan) are to establish Cloud based Toolboxes, Workflows and a One Stop Shop for CAx-technologies supporting the design simulation and process planning for Additive Manufacturing.

## GEOMETRICAL INPUT

The analysis-based design starts with a trivariate CAD description of the object to be analyzed. The generation of such CAD is also part of CAxMan.

## PROBLEM DESCRIPTION

Model equations, boundary and initial conditions, loads, material properties, etc.

## ISOGEOMETRIC THERMAL AND MECHANICAL ANALYSIS

Solves the equations directly on the CAD geometry, without mesh generation. Requires advanced algorithms to treat multiblock and trimmed CAD volumes, as well as high-performance solvers.

## IMATI PAVIA

The Pavia branch of IMATI is a center of excellence in mathematical and numerical analysis of partial differential equations (PDE), with long expertise on the development of discretization methods. In particular, IMATI-PV researchers have substantially contributed to the development and spreading of isogeometric analysis (IGA).

The team contributes to the Analysis-based Design activities with its expertise on IGA methods for PDEs, treatment and manipulation of tri-variate volumes and isogeometric code design. IMATI-PV researchers are the main developers of IGATools, a GPL-Licensed C++ library for IGA.

## SHAPE OPTIMIZATION

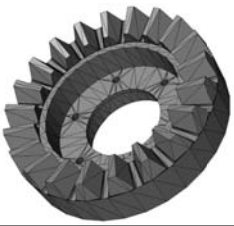
Seamless interaction between CAD and CAE software. The optimization can be performed with suitable algorithms or guided by engineering expertise.

## COMPUTE KEY PERFORMANCE INDICATORS

They rely on engineering expertise and will change from case to case. Examples include dissipated heat, pointwise stresses, maximum deformation, static and dynamic unbalance, vibrations, etc.

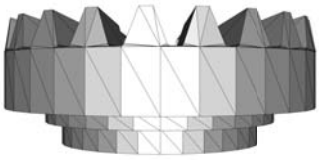
## TO PROCESS PLANNING

Once the designer is satisfied with the performance of the object, the final geometry is converted to STL and sent to the following phase.



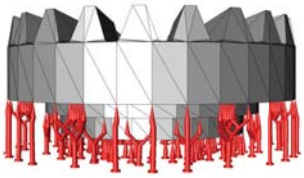
## INPUT

The Process Plan (PP) starts with a tessellated triangle mesh. The most widely adop-ted format is STL.



## ORIENTATION

A proper build orientation is selected. Many factors can be taken into account in the optimization, such as build time, surface quality and amount/positioning of supports.



## SUPPORTS

Supports structures are added to sustain overhangs while printing.

## SLICING

Both the part and the supports are cut by a stack of planes aligned with the build dir-ection, generating the slices.

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## IMATI GENOA

The research team, established in the early 80s, was one of the first CNR groups focusing on Computer Graphics. The group, currently 34 researchers, in active in geometry processing, similarity evaluation and semantics-based shape modelling.

In CAxMan, the team leads the process planning devel-opment, with its distinctive expertise in the creation, analysis and processing of 3D models using semantics-driven approaches. Particularly relevant is its experience in mesh repairing, shape analysis and managing STL models for 3D printing.

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