OCAMSS

AN OPEN PLATFORM FOR STRUCTURAL SIZING OF COMPOSITE AIRCRAFT WING.

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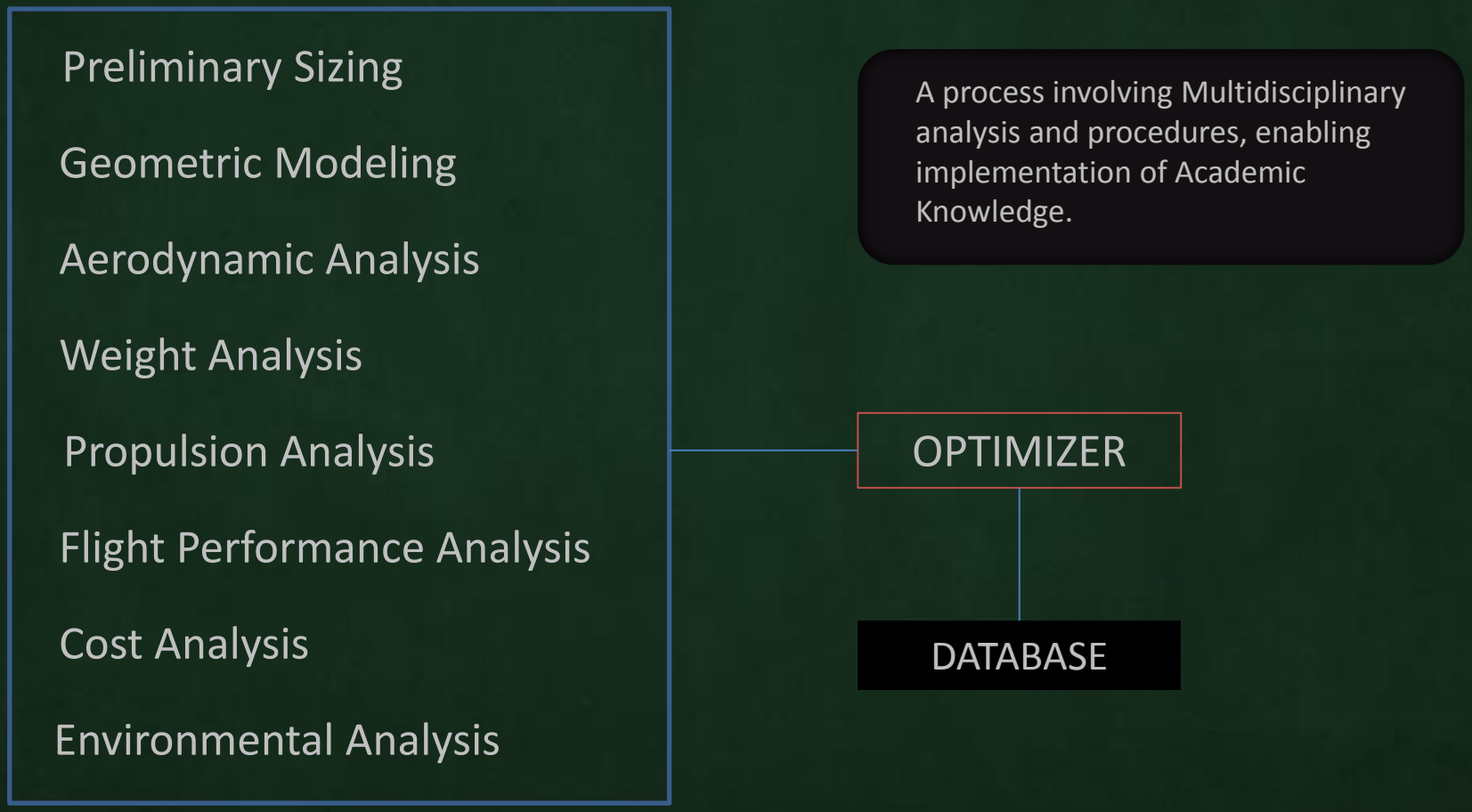
Content

- Aircraft Conceptual Design
- OCAMSS - Purpose
- OCAMSS - Design
- OCAMSS - Layout
- OCAMSS - Modules
- OCAMSS - Process Flow
- Future Plan and Improvements

Aircraft Conceptual Design



OCAMSS

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AN OPENSOURCE
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A MULTIDISCIPLINARY
PROCESS

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- A platform that can be **Extended** to serve as a Conceptual Design Suite.

OCAMSS

DESIGN

A PYTHON BASED PLATFORM
AN EXTENSIBLE PLATFORM
SIMPLE TOOLS

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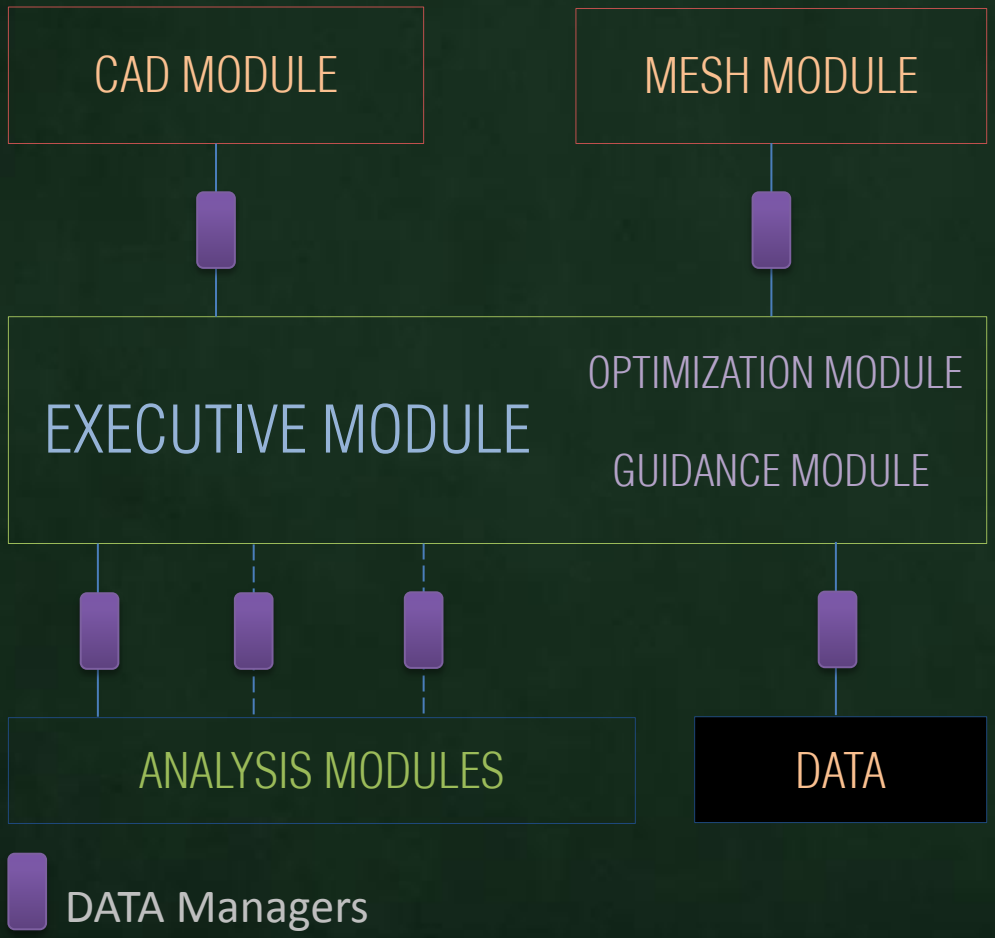
A Domain specific Documentation.

OCAMSS Layout



Python
PyQt
Numpy
SALOME
Pyevolve

CAD Module

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A parametric CAD Builder to design the Wing from given parameters with Database of parameters as Airfoil Data etc.

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SALOME MODULE : **geompy**

```
geompy.SubShapeAll
geompy.MakeEdge
geompy.MakeWire
geompy.MakeFace
geompy.MakeSketcher
geompy.MakeSewing
geompy.PointCoordinates
geompy.ChangeOrientation
```

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a

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A set of Algorithms for the computation of Meshes based on provided set of Hypotheses. API to create and modify them.

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Python API for creation, modification and quality control of Meshes.

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The Group Management Tools are of real importance for applying Forces, Boundary Conditions , Physical Properties etc.

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VISUALIZATION

Mesh Visualization Module* of SALOME provides a set of options for Mesh visualization.

MESH Module

SALOME MODULE : **`smesh`**

`StdMeshersDC` Python package provides interface to the standard SALOME Algorithms.

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MED supports eight element shapes: **point**, **line**, **triangle**, **quadrangle**, **tetrahedron**, **pyramid**, **hexahedron**, **polygon** and **polyhedron**.
Each element may have a different number of nodes, depending on whether linear or quadratic interpolation is used.

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Standard Elements and Algorithms supported and provided with SALOME are about sufficient concerning our Physical Models.

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Executive Module

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CONTROL AND MONITOR

Monitors and Controls the complete Structural sizing Procedure and provides the main interface to the platform.

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Communicates with other modules through a set of Data Manager Modules and provides tools to configure the Data Manager modules.

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DATA MANAGERS

Communicates with other modules through a set of Data Manager Modules and provides tools to configure the Data Manager modules.

- Responsible for generation of input and output files in required formats.
- All user input files in **`xml`** format, both Python and PyQt provides great tools to manage them.
- **MED** Data Model used for internal data exchange.
- **MED File** management is implemented using C API and **MED Memory** management is done with Python API

Executive Module

C

DEFINE FRAMEWORK

Provides interface to design the framework and define the calculation scheme for the procedure.

Executive Module

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DEFINE FRAMEWORK

Provides interface to design the framework and define the calculation scheme for the procedure.

- Define Design specifications.
- Import Preliminary analysis Data.
- Define Load-cases and constraints.
- Define calculation scheme using xml file and execute scheme using SALOME **YACS** module Python API.
- Define Solver Config./ Command file in xml format.
- *Interface to modular Solver Design.

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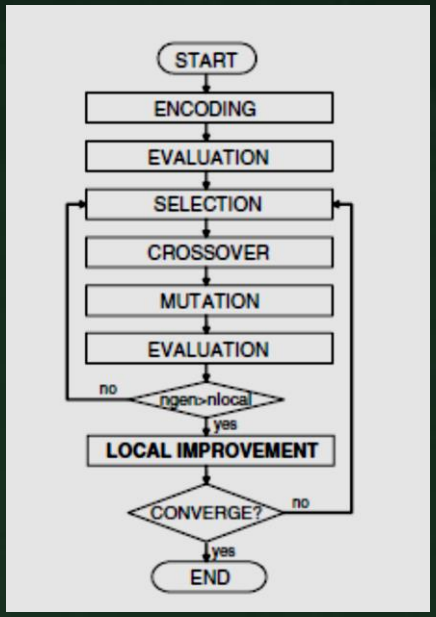
SUB-MODULES

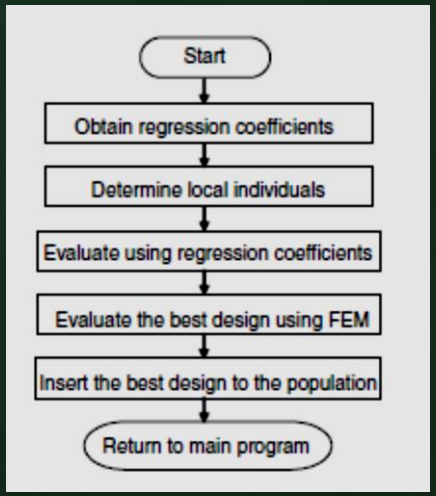
It has two sub modules, the Optimization module and the Guidance module.

Executive Module

OPTIMIZATION MODULE

- Carries out the sizing procedure depending upon the constraints and given base design.
- Incorporates an Improved Genetic Algorithm[1] where local improvement is inserted into Standard GA.
- Finite element calculations in local search are replaced by regression analysis.
- 'Local' defines individuals in two ways :
  - i. Individuals which are different from the best individual by **only one variable**.
  - ii. Individuals in which all the values of the variables are the same as those of the best individual, but in which two are interchanged.
- **Pyevolve** Genetic Algorithm framework can be modified to perform the optimization.





[1] C. C. Lin and Y. J. Lee, "Stacking sequence optimization of laminated composite structures using genetic algorithm with local improvements.," *Composite Structures,* no. 63, pp. 339-345, 2004.

Executive Module

GUIDANCE MODULE

- Guides the user during the complete procedure and reports necessary feedbacks or errors as required during the procedure.
- Monitors data at every step and provides the user with information to move forward in the process.
- Depends upon the Documentation of modules, Design specifications, constraints , data from previous analysis and statistical data to provide the feedback.
- Introduction of special Guidance objects using Python Dictionary Type into the framework for reference and comparison.

Process Flow

01

PRE-REQUISITES

As per the requirement of the framework set up the platform with pre-requisite scripts, modules, relevant guidance objects etc. from the Main Interface.

- Creation or Modification of Data Manager Modules .
- Solver Modification and Integration requirements.
- Refinement of CAD Builder or MESH Module.
- Availability of Constants and Statistical Data

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02

DESIGN SPECIFICATIONS

Define the Design Specifications and import the Preliminary Analysis Data (xml).

Process Flow

03

CAD BUILDER

Choose a Base Design to modify or create a completely new Design using the CAD Builder Module and the various Data and constants provided.

Airfoil Data

1.0000000	0.0000000
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……	……
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Airfoil Geometric Equation

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MESHING

Import the CAD Model, mesh the model using the appropriate algorithms based on proper hypotheses that can support the Physical model of your Framework.

- Spar and Rib Caps : Rod Elements.
- Spar and Rib Webs : Panel Elements.
- Engine Mount : Bar Element (Extensional, Bending and Torsional Stiffness)
- Wing Covers : Polygon membrane Elements.

Process Flow

05

ANALYSIS

Define the constraints, load-cases and the calculation scheme. Create the Config./ command file for the Solvers. Start and monitor the analysis.

xml config./command file (representative)–

```
<material  id="1" name="MAT01" >
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<p_ratio type="double">0.3</p_ratio>
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Optimization Variables -

- Sandwich depth
- Thickness of layer t_0, t_{phi} and t_{90} associated with angles 0, phi and 90.
- Stacking sequence and
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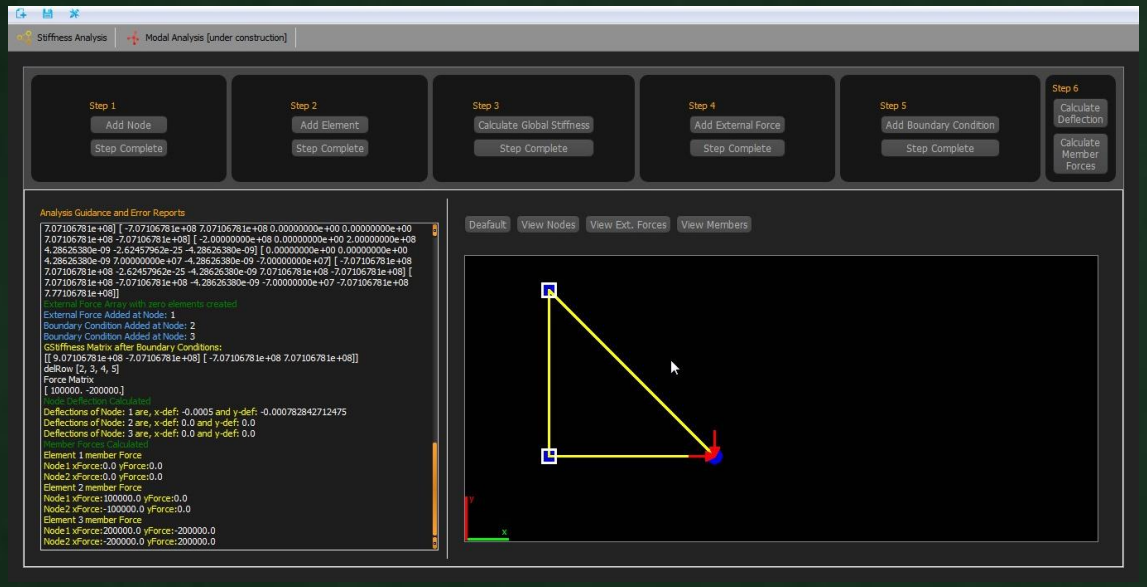
POST PROCESSING

Use the Analysis output and calculate the secondary variables. Import the data into SALOME Visualization Module to carry out the post processing.

Future Plan and Improvements

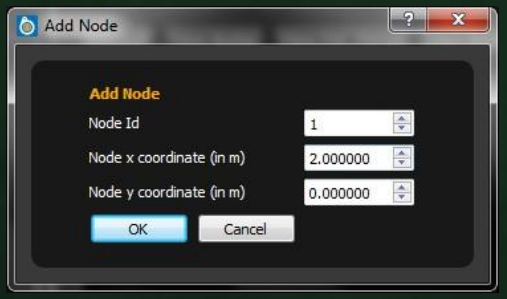
- Full Deployment and Validation of Concept.
- A complete Database instead of collection individual data files.
- Academic references in Guidance Module

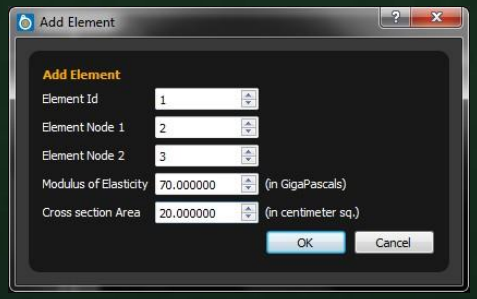
FE Tool for Static Analysis of Trusses

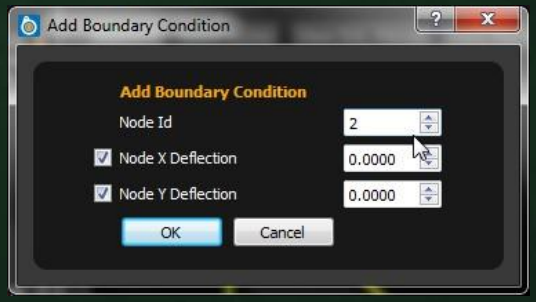


A simple application for Finite Element Static Analysis of Trusses with One Dimensional Rod Elements .

Python
PyQt
numpy







Thank You