Bachelor Thesis

for the bachelors degree program in Mechatronics

Development of a Continuous Integration (CI) framework for OptiSlang workflows

In co-operation with

Robert Bosch GmbH

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Abbreviations

CAD ..... Computer Aided Design

CAE ..... Computer-Aided Engineering

GUI ..... Graphical User Interface

MOO ..... Multi Objective Optimization

PIDO ..... Process Integration and Design Optimization

Chapter 1

Introduction

1.1 Overview

This thesis explains about the creation and development of a framework for Optislang workflows. The workflow mostly contains modules created using Python and MATLAB.

1.2 Objective

The objective of this thesis are as follows:

- Develop a method to create a standalone version of MATLAB and Python based modules in Optislang for integration testing (only code based, without using GUI).
- Implement workflows in batch mode.
- Create a framework in Python to create modules and workflows.
- Establish a strategy to for automated integration testing in Github for modules based on Python and MATLAB.

1.3 Outline

- In Chapter 2, we are going to discuss about the MOO project, its role in the company and the modules created in Python and Optislang.
- In Chapter 3, we understand the creation of a framework to create standalone modules and workflows in Python.
- In Chapter 4, we will look into the automated integration testing in Github.
- In Chapter 5, we will discuss the results and evaluate the impact of the solution.
- Finally, Chapter 6 provides us the summary of the work, highlighting the achievements and feedback for development in potential areas.

Chapter 2

MOO Project

2.1 What is MOO?

Multi Objective Optimization (MOO) [1] and Simulation Driven Co - Design is an easy to use method developed for modular, automatized multi domain toolchains considering power loss, thermal calculations and lifetime assessments. In short, MOO is an optimization problem where we have at least two objective functions to optimize simultaneously.

This project is divided into many **action fields** wherein each action field focuses on tackling a defined problem. The table below explains more about each of the action fields.

Action Fields	Objective
Co-design, virtual modelling and credible simulation	• Identification of costs and relevant parameters by sensitivity analysis • All relevant input parameters are determined with sufficient accuracy • Necessary tool chains are available and automated • Virtual models are validated
Tools and Automation	• Parameterized CAD, simplified models • All necessary models are verified and can be incorporated in the workflows and provide reliable results • Professional programmed code • Data exchange works automated
Realistic requirements and confidence of input data	• Reduce the requirements given by the equipment manufacturer to what is really needed • Show benefits to the customers
Cross-domain collaboration and qualification - establishing in projects	• Cross-domain collaboration on the base of modelling approaches is established • Competence management and qualification program is established • Simulation driven co-design is established in and requested by the projects

Table 2.1: Action fields and Objectives of MOO

Name of
the

2.2 What is Optislang

Ansys Optislang [2] is a software platform which is used for design exploration, CAE based sensitivity analysis and optimization in conjunction with any product development tool. It is a Process Integration and Design Optimization tool or in short, a PIDO tool. Process Integration refers to automate and orchestrate manual simulation processes and to realize complex workflows. Design Optimization aims for better understanding of your design, optimizing the product, identify an improved design which has the desired qualities and resulting in a best design by reliability analysis and statistical analysis.

Optislang uses several solvers to look into aspects like mechanical, technical, mathematical and any other problems. This is easier in Optislang as it provides integration to create toolchains of many external programs like ANSYS, MATLAB, Excel, Python, CATIA and many more.

2.3 Modules and Workflows

2.3.1 Modules

For better functioning of MOO, modules are created by the system developers. The modules are defined either in MATLAB or Python. Each module is focused on solving a particular problem/issue in the workflow.

Bibliography

[1] Garai Balint. Introduction to MOO. https://inside-docupedia.bosch.com/confluence/display/MOO/Introduction, Online; Accessed on 27/05/2024.

[2] Ansys optislang. https://www.ansys.com/products/connect/ansys-optislang. Online; Accessed 10/05/2024.