Design of a parametric motor in CATIA

Internship at Linköping Institute of Technology

By

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Date: 05/03/2008

Abstract

This report presents the design of a parametric motor on CATIA and how his parameters are controlled by an Excel sheet. There are three main subsections: firstly a presentation of the context and objectives of this project, secondly a presentation of the parametric motor which include the presentation of the Catia design and of the Excel sheet and finally an explanation of the method used to design and define the parameters of this motor.

Contents

Introduction and Context

This project is included in a bigger project which is the integration of parametric CAD and dynamic model for industrial robot design. The goal of this main project is to combine several models from different engineering domains such as mechanics, drives, electronics and control in order to facilitate and optimize the way of designing. Combine all these models enable engineers to have a global view and analysis of the product.
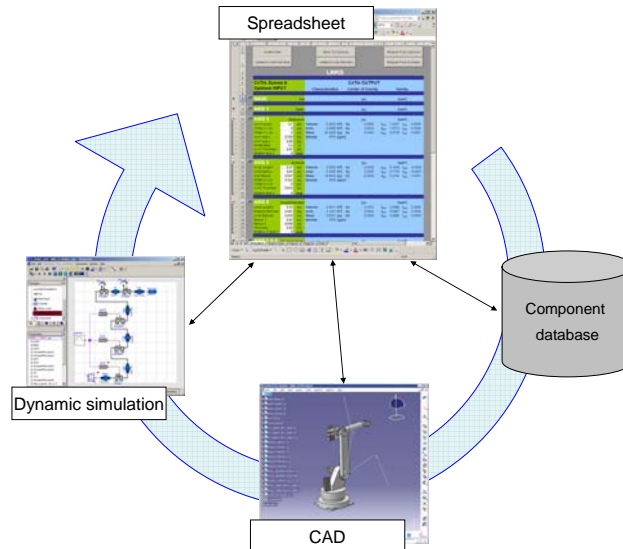

Figure 1 Scheme of the principle of the main project

This section of the internship is only interested in the link between CATIA and Excel, the dynamic approach will be treated later. Thus the objectives of the project were to:

- Control with an Excel sheet the dimensions of the motor (Width and Length)
- Control the level of details and the options (Brake, Encoder) of the CAD model
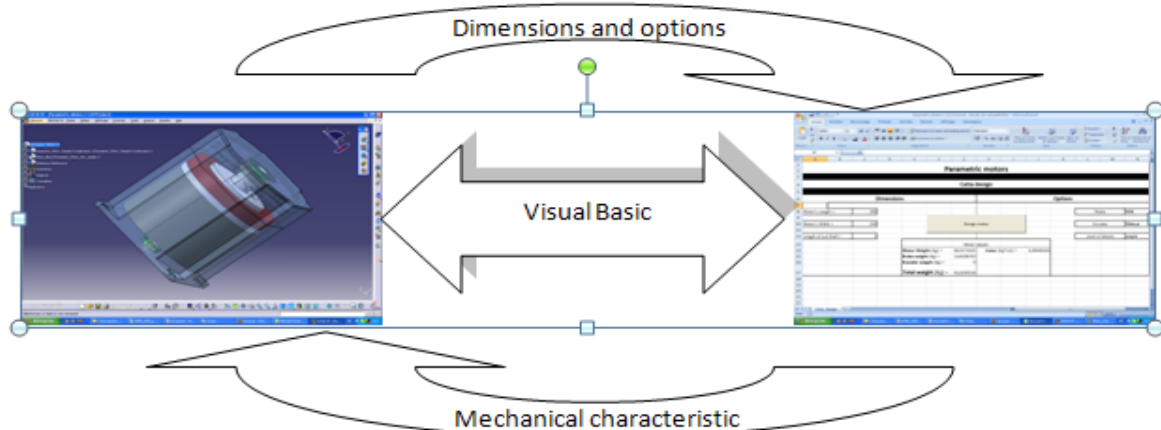- Display the mechanical characteristics (Inertia of the rotor, Weight) on the Excel sheet

Figure 2 illustrative scheme of the link between CATIA and Excel

1. Presentation of the parametric motor

Before this project the motors in the robot were parallelepiped with two levels of details, with or without edge.
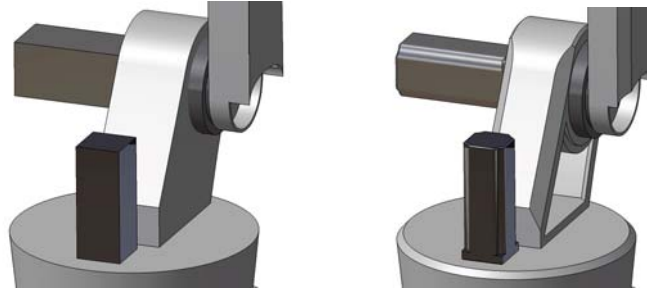
Figure 3 Different levels of details on the motor

1.1 The different parts of the motor

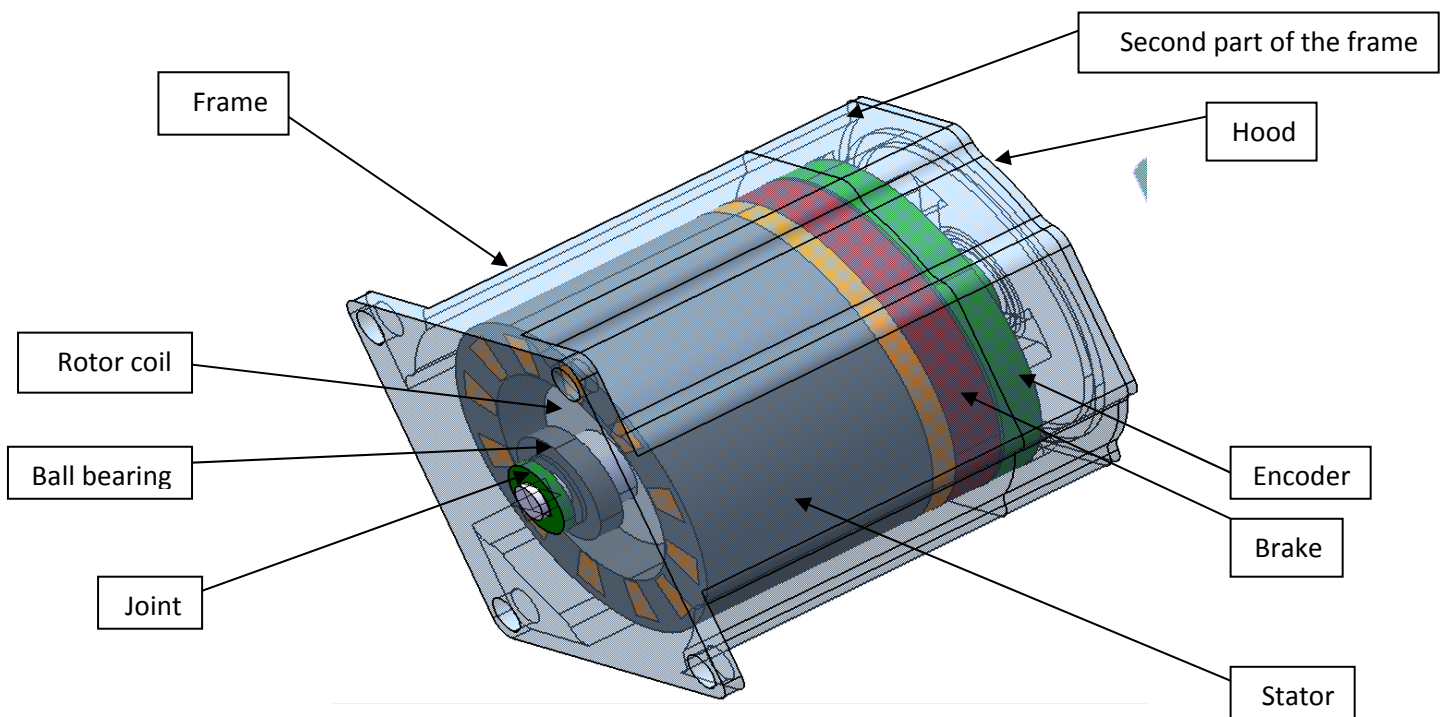The parametric motor contains 9 different parts including the brake and the encoder.

Figure 4 Global view of the motor

As brakes and encoders can be options on a motor, it is possible to remove it from the model. These options can be chosen in the Excel sheet.

1.2 Levels of details and externals dimensions of the motor

There are three levels of details in this motor:

Detailed: There are edges on the frame, and the geometry of the stator is designed as near as possible like the reality.
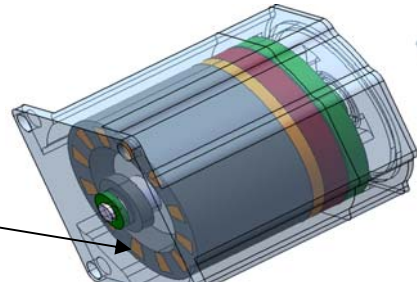

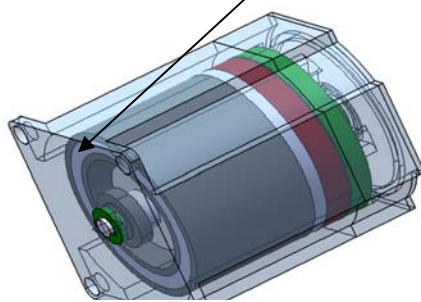*Difference of geometry in the stator between the copper part and the iron part*

Figure 5 detailed motor

Simple: There is no edge, and the geometry of the stator is designed to respect the proportions between Iron and copper.
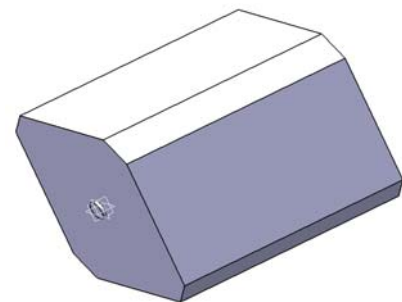
Figure 6 simple motor

Very simple: the motor is a simple part with the externals dimensions of the motor

Figure 7 very simple motor

The different parameters of the motor are his externals dimensions (width and length) and the length of the out shaft. Consequently the motor can take any dimensions the user wants.
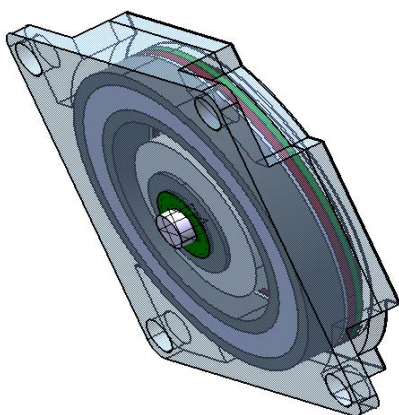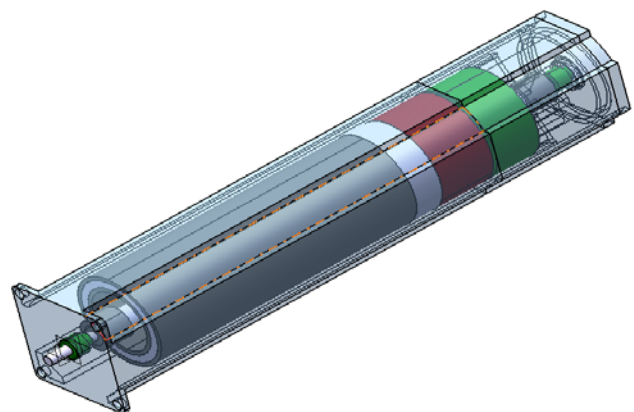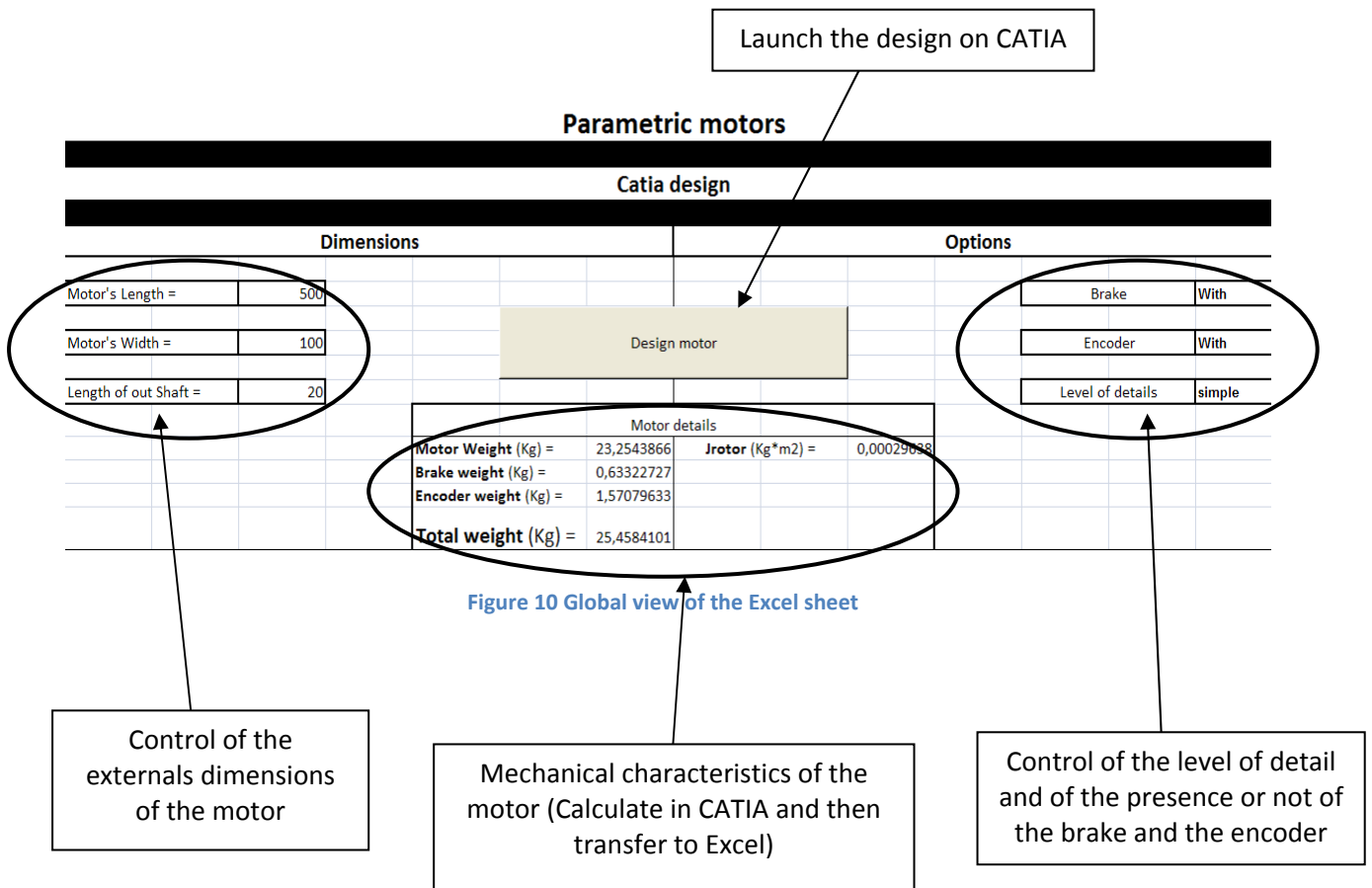

Figure 8 Width: 50 Length : 100

Figure 9 Width : 100 Length 500

1.3 Excel Interface

The externals dimensions and the level of detail of the motor are linked to an Excel sheet which enables the user to control them.

Figure 10 Global view of the Excel sheet

In the "very simple" level of details, only the motor weight is available. In fact, because of his very simple design it is not possible to estimate in Catia the rotor Inertia and the weight of the brake and the encoder.

2. Designing method

2.1 Catia design

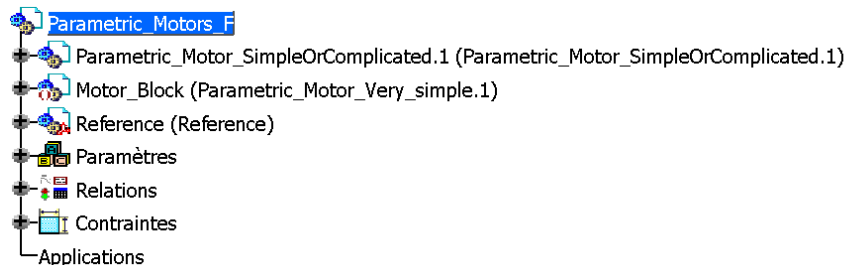The global product "Parametric_Motors_F.CATProduct" is composed of one product and two parts:

Figure 11 global view of the tree of the parametric motor

- The "parametric_Motor_simpleOrComplicated" contain the motor design with the levels of details: "Simple" and "Complicated".
- The" Motor_Block" is the "very simple" motor
- The "reference" enable to position the two first products

These parts are activated or deactivated by rules to define the level of details.

The "Motor_block" contain 3 parameters the width, the length and the length of the out shaft. It is a simple part which only contains two pads. It is design to be update as fast as possible after a change of dimensions.

The "parametric_Motor_simpleOrComplicated" is composed of all the different parts of the simple and the complicated models. Consequently it contains two stators one detail and one simple. It also contains the brake and the encoder. The presence or not of these parts in the model is managed by rules (Knowledge advisor). The rules activate or deactivate the parts in the different cases. Moreover this assembly contains another assembly "Parametric_Motor_M" which contain all the parts which are rotating.
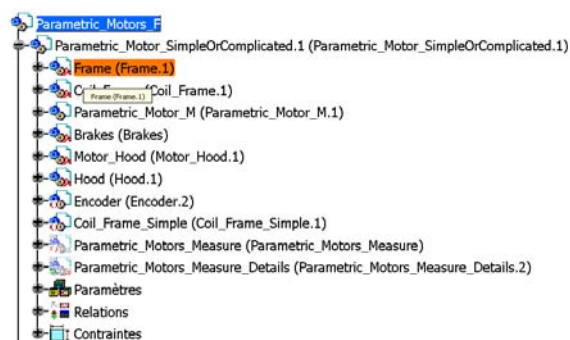

Figure 12 View of the tree of parametric_Motor_simpleOrComplicated

Then "parametric_Motor_simpleOrComplicated" is also composed of two special parts, which are called "Parametric_Motor_Measure" and "Parametric_Motor_Measure_detail". These parts are used to estimate the mechanical characteristic of the motor and contain several partbody which are the publications of the different parts of the assembly.
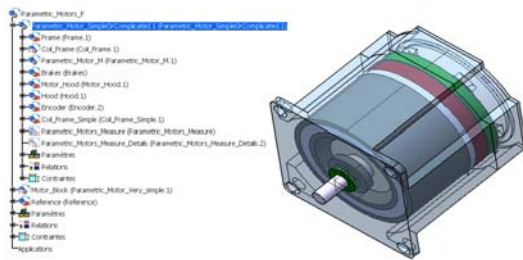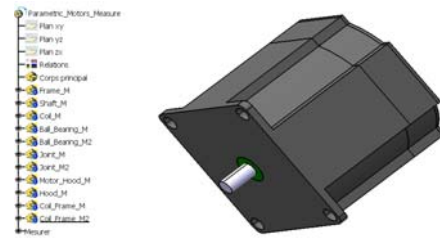
Figure 13 global product

Figure 14 Part which contain all the publications

This method of estimation of the mechanical characteristics permits to avoid some problems with the update of the measure inertia function in the assembly. Actually the update work in the part but not in the assembly.

The differences between the "simple" and "Details" models are the deactivation of the more complicated functions in the simple model. Thus all the edges have been deleted, moreover the design of the stator is different. The more complicated model contains circular patterns (nearest from the reality) and the simple model does not.
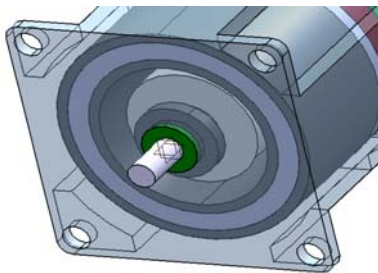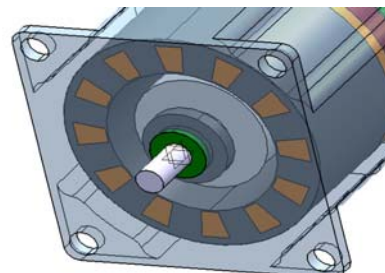

Figure 16 Simple model

Figure 15 Detail model

2.2 Excel interface implementation

There are two different Excel sheets:

- "Parametric_Motors_V2_English.xls": made for the English version of Catia.
- "Parametric_Motors_V2_French.xls": made for the French version of Catia.

The goal of the Excel sheet is to define the dimensions, the options, and the level of detail of the motor and then to display the mechanical characteristics. These functions have been implemented in Visual Basic through a macro.

The major difficulty in the implementation was to deal with the name of the parameters because if two parameters have the same name in a part and in a product, visual basic can't choose the right parameters to update and display en error. Thus the parameters which are updating in Catia via visual basic have a specific name.

Conclusion and perspectives

This project is closed for the moment but have to be linked with another task which is the dynamic analysis through Modelica. Indeed the choice of a motor can't be separated from the dynamic aspect. Consequently the design of the different parts of the motor should change in order to be adapted to the dynamic analysis.

The next tasks of this internship are firstly the design and the kinematic simulation of a parametric gearbox secondly the dynamic analysis of the robot and finally the dynamic analysis of the gear box.