A Method to Dramatically Improve Modeling Time and Efficiency Through an Excel-Based Automation Tool

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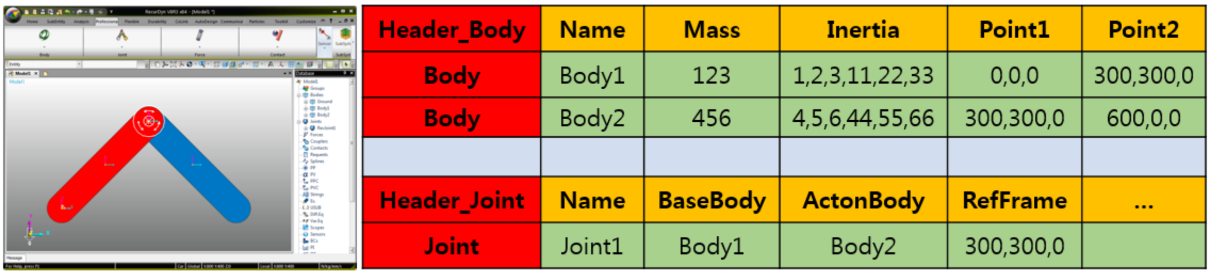
Abstract

In CAE software, modeling time and efficiency has begun to become a significant focus because modeling takes significant time. Reducing modeling time and improving modeling efficiency can be achieved through various methods. The primary method is to customize the tool so that common tasks are automated. In the experience of the authors, automation can dramatically reduce the time and efficiency of modeling in CAE software. However, usually, creating such automation requires using the customization tools included in the CAE software. These tools are usually based on programming or scripting languages that have deep access to the capabilities of the CAE software. These tools can be extremely powerful, but they also require significant programming skills. Therefore, they do not get used as much as they could. Some programming tools for customization also allow the CAE software to access spreadsheets or other external applications or files. This capability also extends the potential power of the customization tools. But they require even more skill and more time to design the customizations.

Our goal is to find a way to dramatically reduce the complexity of customization without reducing the customization power. Through this simplification of customization, we expect to dramatically improve the efficiency modeling in CAE software compared to customization directly through programming or scripting. Our method is a spreadsheet-based tool that retains most of the power of direct programming, but without requiring any programming from the user. We call our solution eTemplate.

In eTemplate, the model data is first stored in a spreadsheet like a Microsoft Excel spreadsheet file. A parsing engine written using the programming tools for customization of the CAE software reads the data from the spreadsheet and uses it to build a model in the CAE environment. However, unlike other existing methods mentioned above, no programming is required from the user to enable to the CAE software to access the data contained in the spreadsheet. The parsing engine required to extract the data from the spreadsheet and create model data in the CAE software is already coded and does not require modification by the user.

The data required to define a model in CAE software is usually rather simple. In multibody dynamics, for example, the data to define a model at a minimum consists of the definitions of a number of bodies, their masses, their positions in 3-dimensional space. Usually, it will also consist of a number of joints connecting those bodies and maybe a number of springs, for example, that apply forces between the bodies and regions of the bodies in which contact between the bodies can occur. eTemplate is designed to exploit this simplicity of data. For eTemplate, the data for each of these items is placed on a line in the spreadsheet in a format that is reasonable for the data that defines that object. Figure 1 shows an example of the data to define 2 bodies and a simple joint between them.



Header_Body	Name	Mass	Inertia	Point1	Point2
Body	Body1	123	1,2,3,11,22,33	0,0,0	300,300,0
Body	Body2	456	4,5,6,44,55,66	300,300,0	600,0,0
Header_Joint	Name	BaseBody	ActonBody	RefFrame	...
Joint	Joint1	Body1	Body2	300,300,0	

Figure 1 : New Methodology for Automation and Customization of RecurDyn/eTemplate.

The data to define a model is very simple in this format. It is obvious how the data can be extended and how eTemplate can be adapted to any particular CAE software through this method. Furthermore, the customization capabilities built into the spreadsheet applications dramatically extend the power of eTemplate. Spreadsheets themselves can be easily customized and tailored for a specific purpose. The methods of such customization of spreadsheets are well known to most engineers. Simple cell formulas, for example, such as the cell formulas “=a1+b1” or “=cos(c3)*d2+b5” dramatically extend the power of spreadsheets. Using these well-known customization capabilities already built into spreadsheets, a user can create a spreadsheet that has a small number of spreadsheet cells used to define key parameters of a model. From these key parameters, the spreadsheet can automatically generate the data required for the model in the format required for eTemplate, which eTemplate can then use to construct the data for a model in the target CAE software. In this manner, eTemplate offers tremendous customization power that is easy to use and easy to learn.

This tool was originally created for the multibody dynamics simulation software RecurDyn, and RecurDyn and multibody dynamics software will be used as the primary example of the CAE tool in this paper. But it could be easily adapted for use with other software. As described above, the data to define a model in most CAE software is very similar in its structure.

Therefore, eTemplate is a method that requires no programming skills, but offers a similar level of customizability to CAE software. eTemplate leverages the power already built into spreadsheet applications such as Microsoft Excel. These customization capabilities are generally well known to engineers. This gives eTemplate a huge potential to improve to dramatically reduce the modeling time and increase the efficiency of using CAE software.

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