OpenForm - A New Intuitive Graphical User Interface for Industrial Forming Simulation

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Since the mid nineties sheet metal forming simulation has been widely used to take the uncertainty out of the die design process. When forming simulation was first introduced into the work of die designers the main focus was on the prediction of thinning, cracking and draw-in of the sheet metal. Later, the prediction of wrinkling, springback and surface defects became challenges finite element forming simulation packages had to cope with. While the prediction of thinning, cracking and material draw-in has now become a relatively easy task for numerical simulation, springback prediction and the detection of surface defects are still great challenges requiring advanced finite element simulation software and considerable expertise and experience in its application. More recently, hot forming simulation has added to the complexity of numerical simulation in the field of sheet metal forming. Since thermodynamical effects also have to be considered in the simulation of hot forming processes, even more experienced users are necessary to ensure that reasonable results are achieved.

However, as a rule die designers are not numerical experts, and the use of more advanced finite element software remains a hurdle. Therefore, in the past, forming simulation software packages were assessed not so much by the complexity of their underlying physical models or the integrity of their numerical algorithms as they were for their user-friendliness and the efficiency with which input data could be generated even by inexperienced users. This is particularly reflected by the widespread use of so-called inverse or one step solvers.

However, there seems to be a growing awareness among die designers that a rise in the quality of simulation results demands more advanced physical and mathematical models and therefore requires the use of finite element software that is, inevitably, more difficult to handle. As such, in a growing number of companies, more than one software package is used for sheet metal forming simulation. There is forming simulation software that is widely and efficiently deployed for the prediction of thinning and cracking but that fails to deliver good springback results. On the other hand, software that is used for more challenging tasks is often considered inefficient in everyday work. However, the use of different simulation software products increases the costs of numerical forming analysis considerably: not only because of additional licence fees but also because of costly training of staff members or even the engagement of new staff. While OEMs might still be able to cope with the problem of additional costs for software and training, for most of the smaller part suppliers an increase of CAE costs is prohibitive.

To overcome this problem GNS has developed a new intuitive graphical user interface for industrial sheet metal forming simulation, called OpenForm. OpenForm is extremely easy to handle and can be used as a pre- and post-processor independently of a particular finite element forming simulation package. The software was designed to enable those who are not finite element experts to carry out multi step forming simulations with even complex multi purpose finite element codes.

OpenForm consists of a number of different modules for model set-up, material data evaluation, automatic mesh generation and results analysis. The implicit finite element forming simulation software INDEED is also part of the OpenForm software, i.e. OpenForm is a forming simulation package that does not require any additional software to carry out complex high end forming simulations. However, the name OpenForm refers to the „open" concept of the software. This is illustrated best by OpenForm's most important and, at the same time, most innovative module OF/ProcessGenerator. With this module die designers can define all steps of a complex multi step forming process independently of the simulation software that is to be used for the simulation of the process. This is achieved by means of a firm separation of the physical process definition and the numerical input data. To make the handling as easy as possible, the physical process can be defined graphically by means of symbolic representations, i.e. icons, of all tools and blanks involved in the forming process. Thus, multi step forming processes can be „symbolically" defined by a very intuitive and simple drag-and-drop procedure. For a number of common forming processes pre-defined templates are offered by OF/ProcessGenerator. User-defined forming processes can also easily be stored as templates. The translation of the defined physical forming process into numerical input data is done by solver-specific converters automatically, using appropriate parameter settings. Thus the user does not have to deal with numerical algorithms and solver-specific properties. However, simulation experts can always change all parameter settings to their own preferred values and store them as templates. Since the physical process is, of course, independent of the simulation software the decision of which software is to be used can be made when all other work has been completed. Therefore, OpenForm can also be used to switch easily between different forming simulation packages, choosing the one most suited to the task in question. OF/ProcessGenerator can already interpret AutoForm input files and convert them into the internal OpenForm Process Language (OFPL). From there the INDEED converter can generate proper INDEED input automatically. Therefore, by means of OF/ProcessGenerator, AutoForm input can be used to carry out high end forming simulations with INDEED. The conversion of AutoForm input data into input data for the aforementioned finite element solvers will also be possible in the near future.

Since only one graphical user interface has to be used for different finite element forming simulation software the costs for training can be drastically reduced by OpenForm. The easy handling of OpenForm guarantees that users with very little knowledge in numerical simulation can handle different forming simulation software with only a few days of training. Besides this, the set-up of a forming simulation independently of a particular simulation software is an important step on the way to standardisation of industrial forming simulations.

The open concept of OpenForm is, of course, carried through all the different modules of the program. For example, the OF/PostProcessor can read in and process result data from various finite element solvers such as INDEED, AutoForm (ASCII) and LS-Dyna. Test data in the AutoGrid format can also be read in and processed. All result data from the different solvers is handled in exactly the same way, removing the need for solver-specific post-processors. OF/PostProcessor provides the user with all forming-specific functions necessary for detailed analysis and documentation of the simulation results. OF/PostProcessor is also very user friendly, and its use is self-explanatory, reducing the need for expensive training.