Data transfer optimisation of tool models by data file manipulation

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Data exchange is the basis of a networked world

Through the global operating range of companies, complex supplier structures, media or system breaks within processes, the topic gains relevance. This applies to all sectors in which data is generated. In consideration of the manufacturing industry, the exchange of tool models plays a crucial role. For instance, for the management of server-based catalogues or the virtual commissioning of machines it is important to transfer the developers' 3D models to the operators. Although many institutions and committees are developing standards and guidelines to ensure an accurate transfer of information, an automated error-free data exchange, necessary for the vision of a smart factory and industry 4.0, is still not possible.



Investigations show the variety of problems

During the data exchange of 3D CAD models via the neutral data format STEP a lot of different errors can occur. Compatibility tests demonstrate the extend of the problem. The table below shows selected results. In this study STEP-files of five original 3D-models of common milling cutters are considered. The files which were exported from different systems are imported in 4 CAD-systems to assess the diverse results according to various criteria. Here the transfer of coordinate systems is considered.

	STEP	System 1	System 2	System 3	System 4
STEP-file 1	-	-	-	-	-
STEP-file 2	-	-	-	-	-
STEP-file 3	+	+	+	+	-
STEP-file 4	+	+	-	+	-
STEP-file 5	-	-	-	-	-

\+ correct transfer - insufficient transfer

Problems of the data transfer are caused by different sources

Depending on their cause problems can be classified as follows:

- User-related problems
- System specific inconsistency
- Ambivalence of the standard interface STEP

User-related problems arise due to individual decisions of the design engineer. In STEP-file 1, 2 and 5 this may have resulted in corrupted exported STEP-files. Problems that occur exclusively in one used software (e.g. System 4) can often be attributed to system-specific properties. Furthermore, inconsistencies in the interface implementation can cause inadequate files after the transmission.

Errors can be reduced by manipulation of STEP files

STEP files are text files in which the 3D model is mapped by linking different entities. By changing existing or adding new entries, many problems can be corrected.

As an example, where a manipulation of the STEP file leads to an improvement of the exchange result, an experiment from the shown table is used. Although all necessary information is available in STEP-file 4, System 2 can not display the coordinate systems.

For the presentation of coordinate systems following entries are available in the original STEP file:

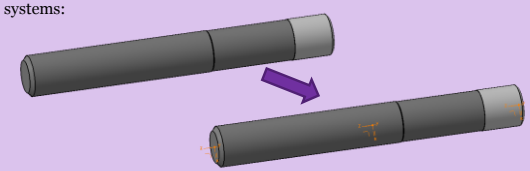
```
#161=AXIS2_PLACEMENT_3D('CIP',#233,#187,#188);
#163=AXIS2_PLACEMENT_3D('PCS',#235,#191,#192);
#164=AXIS2_PLACEMENT_3D('MCS',#236,#193,#194);

#11=ADVANCED_BREP_SHAPE_REPRESENTATION('DSMRH_6_10_77_10_5S-
None',(#34,#35,#161,#163,#164),#264);
#264=(GEOMETRIC_REPRESENTATION_CONTEXT(3)
GLOBAL_UNCERTAINTY_ASSIGNED_CONTEXT((#265))
GLOBAL_UNIT_ASSIGNED_CONTEXT((#271,#267,#266))
REPRESENTATION_CONTEXT('DSMRH_6_10_77_10_5S','TOP_LEVEL_ASSEMBLY_P
ART'));
```

In order to process the coordinate systems in System 2 as well, the following entities must be added:

```
#300=CONSTRUCTIVE_GEOMETRY_REPRESENTATION_RELATIONSHIP('coordinate
systems',$,#11,#301);
#301=CONSTRUCTIVE_GEOMETRY_REPRESENTATION('coordinate
systems',(#161,#163,#164),264);
```

The manipulated step file can now be displayed correctly, including all coordinate systems:



With the help of such a subsequent manipulation of already existing STEP files, incompatibilities between individual programs can be circumvented.

BUT...There are still many challenges

A working data exchange is of great importance for the successful realisation of a networked world and the vision of a smart factory or industry 4.0.
Research shows the current variety of problems, but at the same time help to develop solution strategies. The subsequent manipulation of existing files turns out to be a functioning and workable solution. However, there is a lot of work behind the identification of individual sources of errors. In addition, these studies must be carried out across the board for the entire program diversity. Long-term solutions can only be implemented with the help of system manufacturers, standardisation bodies and users. Thus, a whole industry is asked to pay attention to the problems and to implement universal, comprehensive solutions.