KISSsys 03/2016 – Instruction 026

3D modelling

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1. Introduction

This tutorial explains how to model a gearbox by using the new 3D modeling feature. The basic modelling process is ruled by three steps in KISSsys: the user has to first define the kinematics, then the geometry of the elements, and finally the positioning in the global coordinate system. The main idea of this feature is that these three steps are now done all at once just by adding the elements in the three structure according to a default geometry given to each component of the gearbox.

2. First steps and default values

The first thing to know is that this feature is automatically active when opening a new KISSsys interface, but the user can deactivate it by going in the property window of the “System” element, and then selecting “Deactivated” in the variable “DefaultGeometry”.

Then the user has to activate the 3D view like below (double click or “Show”) to see properly what is happening in the background when he adds a new element to the three structure.

Finally, as mentioned before, to elements all have a default geometry that can be changed by the user. For that he needs to copy-paste the table “DefaultGeometry” from the templates:
When loading it for the first time it looks like below, with the standard values given initially (same used if this table is not inserted in the three structure). But then the user can modify these values, either each of them manually, either with the sizing buttons on the top.

When changing the size factor, all values are multiplied by this factor, and the approximate corresponding torque is shown below. If the gear teeth are sized, then the module of the gears is sized, otherwise not. If the bearings are sized then the closest bearing from the selected type is given automatically with the maximum inner diameter deviation given on the top right of the table (be careful, this is a long process). Then the shafts can be readapted to the bearings if needed (and then the size factor is updated accordingly).

Then the user can save his own default values by saving this table and loading it each time in a new model. The table can be loaded from the “Default templates” button, user defined templates (it is also possible but not recommended to overwrite the one in the templates).
3. Building a model with parallel shafts

To build a model, the user can then simply use all the existing methods to add an element in the three structure. When doing that the element will then be added with its default geometry and position.

When adding an element from the “Element Box”, the user just has to take care that the flag “Offset for new elements on shaft” is removed:

The basic positions of the elements on the shaft are then the following:

- a helical, worm or worm wheel gear is always centered on the shaft
- a face or bevel gear is always on one side of the shaft
- a pulley or coupling is on the other side of the shaft
- bearings are in between, one on the right side, the other one on the left. The first one is adjusted on both sides, the second one is a non-locating bearing. Supports respect the same rules but don’t have geometry, so they are not displayed in the 3D view

If a helical, worm or worm wheel gear is added to the model, the shaft is extended, and the elements on the right side of it are shifted to respect the previous rules.
If any other additional element is added, it is set at the same position as the first one of its kind. The other load elements (centrical load, additional mass ...) are not positioned and don’t have any geometry.

When the user adds a second shaft or group, it is then positioned next to it, at a predefined position so that the user sees all its shafts to assemble in the future.

It is also possible to “drag and drop” any element from the three structure to add it in the model. The element is then added as previously defined: it makes then even more sense for the shafts as they come with all element mounted on it:

To assemble the shafts, the user can then just add a connection element between two gears.
In this case, “Shaft10” is then automatically positioned in reference to “Shaft1” with a calculated center distance from the default geometry of the gears. If the user then adds a gear pair calculation element (not necessary at this step if the gearbox is not finished), the positioning of the shaft is then updated with the path to the center distance of the calculation element.

To see the positioning parameters of the shafts, the user has to do a right mouse click to the shaft element in the model tree and select “Dialog”. This method is just valid for normal shafts. If the position information of a coaxial group is out of interest, the “Dialog” window has to be started from the coaxial group itself.

See below before and after adding the calculation element:

4. Specificities for coaxial shafts

When building coaxial shafts, the shafts are set with the geometry below:

The first shaft is always without inner geometry, and behaves like a normal shaft previously explained. The other ones are set as hubs around it, centered like the gears previously. Adding another coaxial shaft results in extending the first shaft like for the gears as well.
Then the user can add a gear on the hub. If he adds more, the hub and the first shaft are extended. Connection bearings are also positioned automatically on each side of the hub.

If the user drags and drops the first shaft, it then copied as it is and added with all the elements and coaxial shafts linked to it. It is then positioned coaxially after the first shaft with a default position.

5. Specific rules for cylindrical planetary gearboxes

When building a planetary gearbox, some additional automated features are applied.

The diameter of the carrier shaft is extended when adding a carrier coupling on it.
When adding the planetary constraint (gear pair or general), the internal gear is created, and the carrier is repositioned to match the position of the planets' pin.

See below before adding the constraint:

And after adding the constraint:
6. Specific rules for differential gearboxes

When adding the bevel gear planetary constraint, the carrier geometry is modified to fit the deferential type.

See below before adding the constraint:
And after adding the constraint:

For the second axle, you can then just drag and drop the first axle to get the same shaft without inner geometry:
And then when adding the second bevel gear planetary constraint, the shaft is positioned correctly:

7. Next steps

After these steps, the user can then simply add couplings and boundary conditions to run the kinematics.
He can also add different calculation element to the shafts and the gears to be able to modify their geometry. See below after adding a shaft calculation to “Shaft1”.

If he adds both, he can also size the different elements with the different functions available.