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## Activating, de-activating gear connections

### 1 Description

#### 1.1 Situation till now

In the past gear connections of type “kSysGearPairConstraint” were always activated. Shifting action had to be modelled by placing an idler gear on an idler shaft and connecting this shaft with the underlying shaft through a set of couplings. This has the advantage that the bearings between the idler gear and the underlying shaft could be modelled as well.

In the transmission as to be modelled here, no bearings are placed between the idler gears and the underlying shaft. Hence, it would be a sensible modelling technique in KISSsys to put the idler gears directly on a shaft, connect all gear pairs and allow the gear connection to be active or inactive. This will save a great deal of modelling work in this case when bearings between the shafts are not interested.

#### 1.2 Program development

For this purpose, KISSsys library “templates.ks” has been modified such that a gear connection can be active or inactive. This will allow for simpler modelling. To use this new functionality, a variable “activated” of type real has to be added to the connection. In case the variable “activated” of type real is equal to “1”, the connection is closed. If the value is equal to “0”, then it is not activated.

If this is not yet working with your “templates.ks”, please contact KISSsoft AG and ask for new default templates for KISSsys. Note! These “templates” works only with release “KISSsoft-Hirware 04-2006”. See also reference model “205-Gear-activations.ks” used in the example.

#### 1.3 Installation

A simple one stage helical gearbox is modelled as shown below (the schematic is shown with power flow calculated):

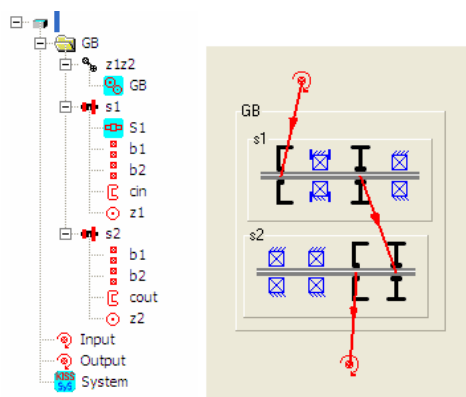
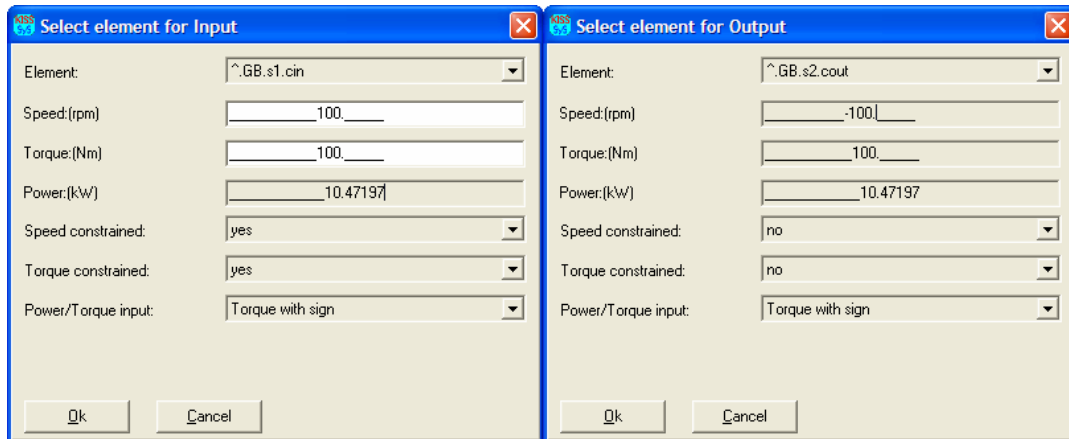


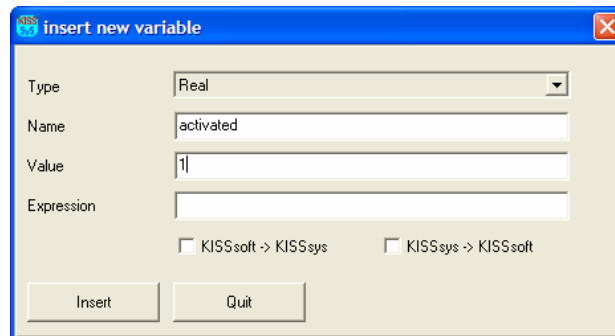
Figure 1.3-1 Left: Tree structure of example gearbox, Right: corresponding kinematics

Load is defined on the input, by defining input speed and torque. Output speed and torque follows based on kinematics. As no gear data is defined, KISSsys assumes that all gears have one tooth only. Hence, output speed is -100rpm and torque 100Nm. But in any case, the connection is active.



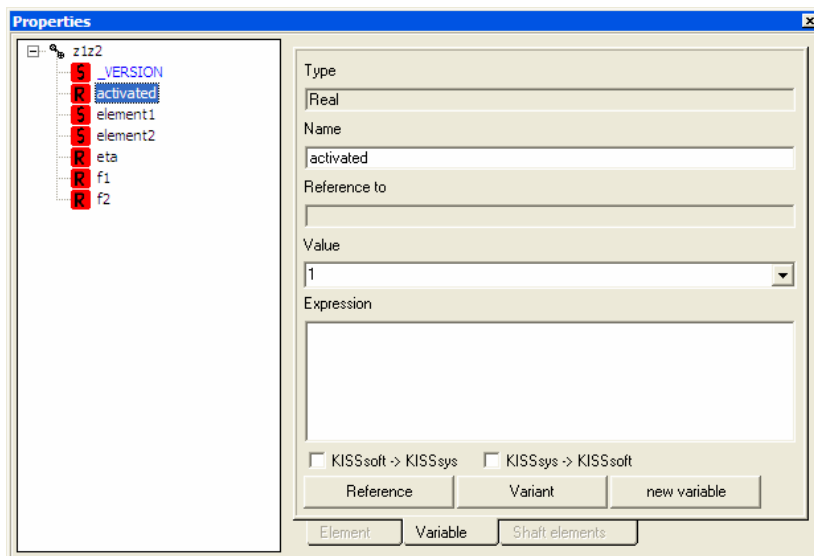
**Figure 1.3-2 Definition of Input / Output**

Now, a variable “activated” of type real is to be added to the connection gp1. For this, use right mouse click on the connection “z1z2” and select “add variable”. Add the variable as shown in the following figure:



**Figure 1.3-3 Adding a variable "activated" of type "Real" to the helical gear pair connection "z1z2"**

Using right mouse click in the tree structure on the gear pair connection “z1z2” and selecting “Properties”, the newly created variable is available:



**Figure 1.3-4 Properties of gear pair connection, with variable "activated" added**

With the value currently being equal to 1, the kinematic calculation can be executed. If the value of “activated” is set to 0, then the connection is not active.

## 1.4 Example

If we look at the following, simple KISSsys model having to parallel gear pairs:

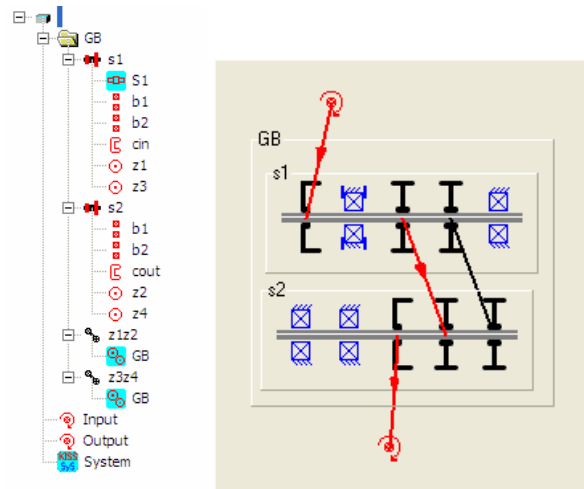


Figure 1.4-1 KISSsys model with two gear pairs in parallel

Then we will find - if we try to execute the KISSsys kinematic analysis - that KISSsys returns an error as follows:

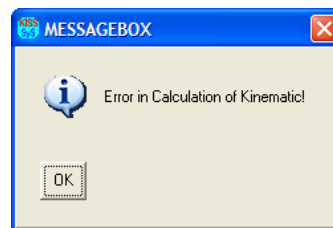


Figure 1.4-2 Error message that kinematic analysis failed

This is fairly obvious as one gear pair contains sufficient information to define the speed of shaft 2, based on the speed of shaft 1. The second gear pair defines another relationship or rather an additional relationship between the speed of shaft 1 and shaft 2. The system is over-constrained. What we now have to do is to set one of the variables “activated” in the connections to “0”, in this example, the one connecting the left gear pair z1z2:

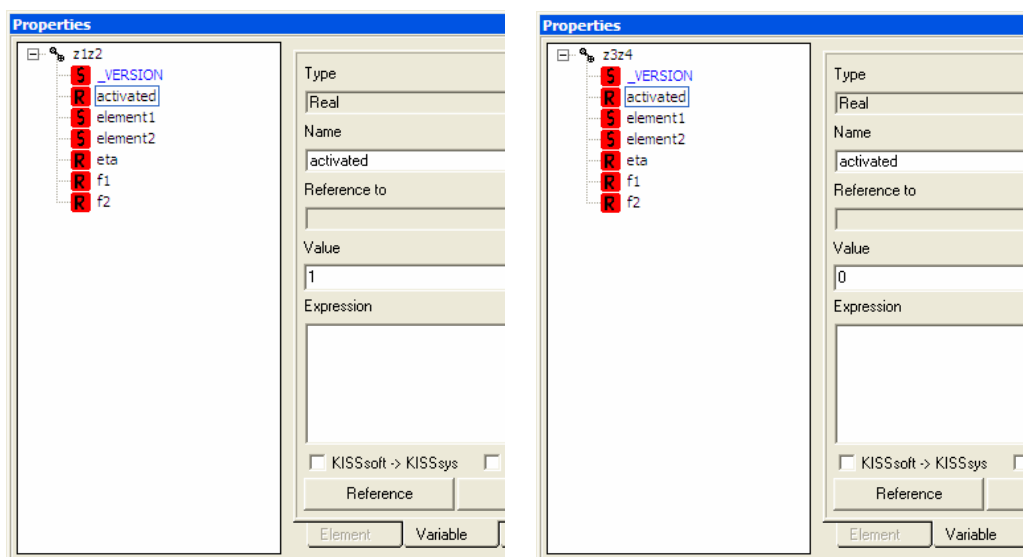


Figure 1.4-3 Activating connection z1z2 while de-activating connection z3z4

If we now execute the kinematic analysis, the power flow is as shown on the left of below figure. If the above is reversed, then, the power flow as shown on the right of below figure results:

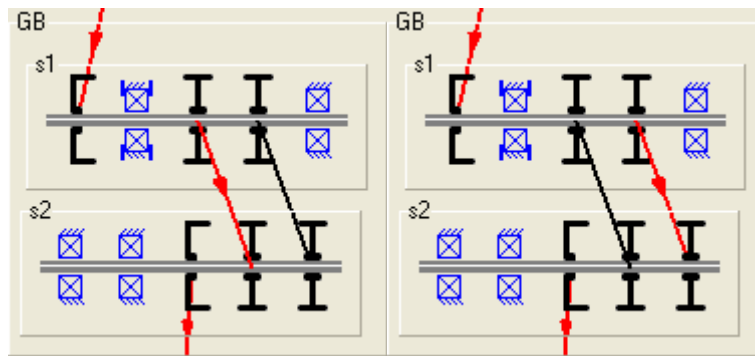


Figure 1.4-4 Two possible power flows

Still it is not very easy to change power flow, because user needs to change activation for each gear manually from the tree structure. If there are lot of gears to be activated and inactivated it is not efficient to do one by one. Easy way is to create a dialog to make power flow selections and let program automatically activate correct gears.

## 2 Model setup

### 2.1 „SetGear“ function

Create a new function called e.g. “SetGears” in some of the elements or table e.g. in your gearbox group.

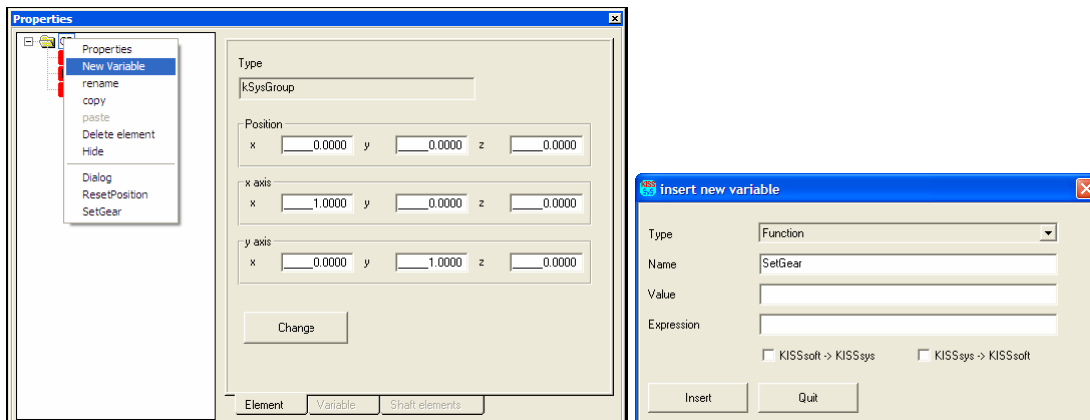
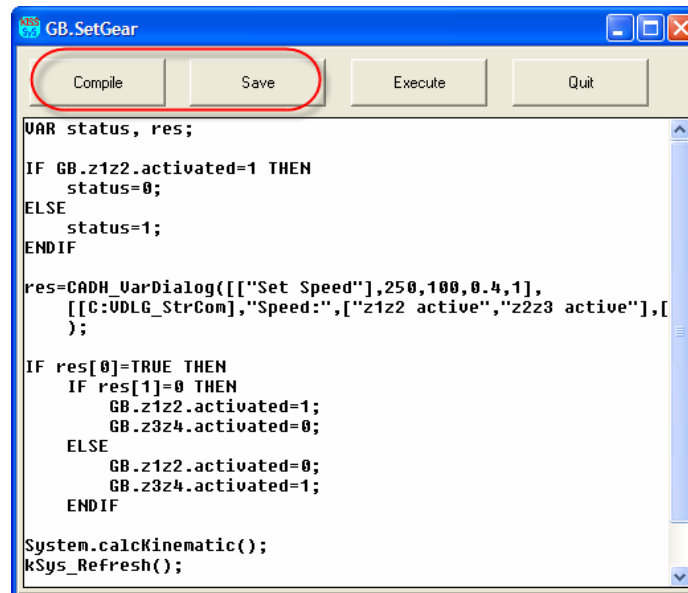


Figure 2.1-1 Create a new variable to the “Gearbox” component

After you have created this new function it is necessary to create a “code” to what it should do. To do this select “SetGear” -> “edit” and you can then start to type in function code. After it is finished you need to remember to **compile** and **save** it in edition window.



**Figure 2.1-2 Create a function code in edition window**

The following code will explain how this function should look like

<pre> VAR status, res;  IF GB.z1z2.activated=1 THEN     status=0; ELSE     status=1; ENDIF  res=CADH_VarDialog(["Set Speed"],250,100,0.4,1, [[C:VDLG_StrCom],"Speed:",["z1z2 active","z3z4 active"],[status],1] );  IF res[0]=TRUE THEN     IF res[1]=0 THEN         GB.z1z2.activated=1;         GB.z3z4.activated=0;     ELSE         GB.z1z2.activated=0;         GB.z3z4.activated=1;     ENDIF ENDIF  System.calcKinematic(); kSys_Refresh();  ENDIF </pre>	<p>Definition of local variables</p> <p>If connection z1z2 is closed, we set “status” to 0, otherwise, to 1</p> <p>Using CADH_VarDialog, a dialog is created that shows a drop down list. If the value of “status” is 0, then the first element of the list [“z1z2 active”, “z3z4 active”] is shown, if it is 1, then the second is shown as default.</p> <p>The dialog returns an array that is written into “res”. If “Ok” has been pressed, the first member of this array is “TRUE”. If “Cancel” has been pressed, then it is “FALSE”. Only if “Ok” has been pressed, we proceed. The second member of array “res” indicates whether the first or second element of the list [“z1z2 active”, “z3z4 active”] has been selected. If the first has been selected, hence res[1] is 0, then we activate z1z2 and deactivate z3z4.</p> <p>Finally do the kinematic calculations and Refresh of the whole system</p>
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Then you may use that function to operate clutch changing, that you don’t have to do it manually for all clutches separately. In this example this function is created to “GB” and can be operated from “tree structure”.

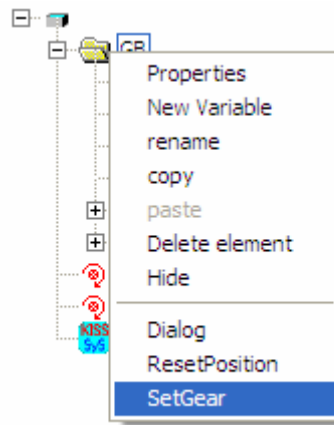


Figure 2.1-3 Operate function from the tree structure

Now different selections for power flows will give directly new results and that can be also seen from schematics.

Speed selection “z1z2”

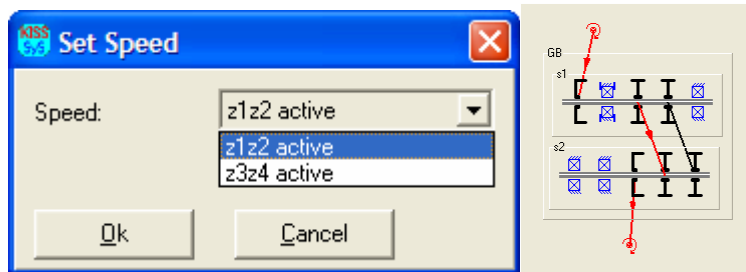


Figure 2.1-4 Select speed "z1z2"

Speed selection “z3z4”

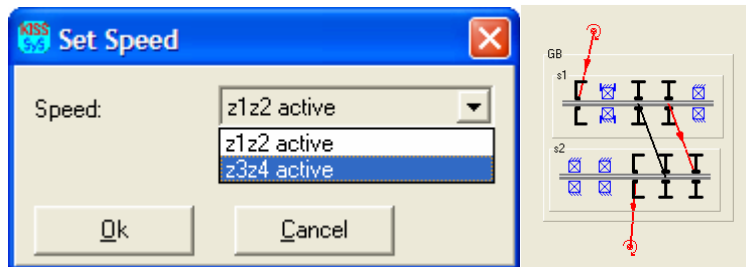
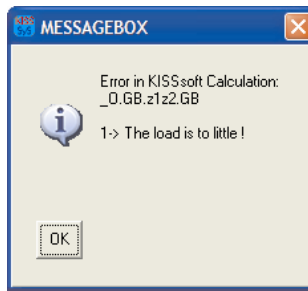


Figure 2.1-5 Select speed "z3z4"

It is of course possible to add any number of possible selections in the list. And also to make several gear activations when speed selected (number of gears to activate and number of gears to inactivate).

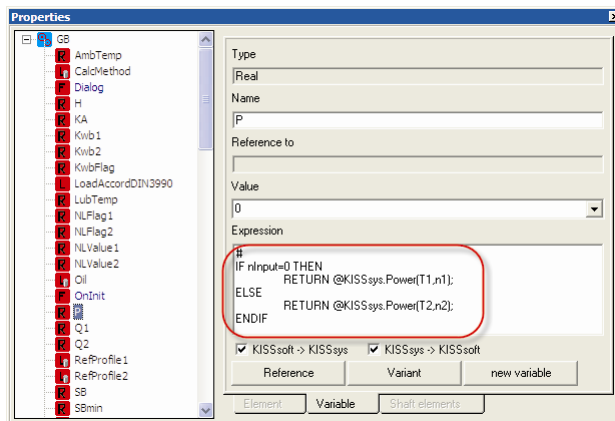
## 2.2 Calculation setup

In case when gear pair are inactive, but calculation module is added gear sees no load and when “kSoftCalculation“ is performed an error message appears because of no power in gears.

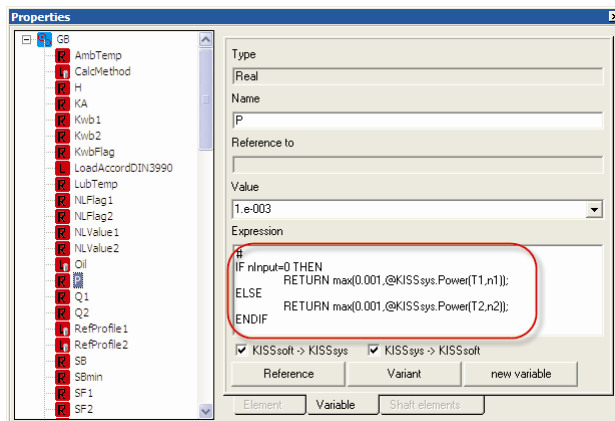


**Figure 2.2-1 Error in gear calculation without load**

To get rid of this message user needs to modify default settings for the power definition. Select gear calculation from the tree select “properties” and look for the variable “P” defining the power in the gears. Modify default expression to take maximum power calculated form the sped and torque or minimum value e.g. 0.001kW (depending the size of the gearbox). Now if gear pair is inactive instead of using zero power, very small value is used. This has no effect for the strength calculation, but error message is disappeared.



**Figure 2.2-2 Initial definition for the calculation power**



**Figure 2.2-3 Modified expression to take maximum value of the threshold or calculated value**