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Differential lock

1 Description

1.1 Task

Sometimes you may want to consider what the forces are in the differential lock to size the components correctly. In the example we don't consider the type of lock itself, but only how to add correct components and functionality in the model. Because of the large variation of the differential designs all special things cannot be described here. In case if you need some more instructions, please contact KISSsoft AG and ask for KISSsys support.

If you want to see also instruction how to model differentials itself, please review the KISSsys model "Bevel-gear-differential-simple.ks" and corresponding instructions "201-Bevel-gear-differential-simple.pdf".

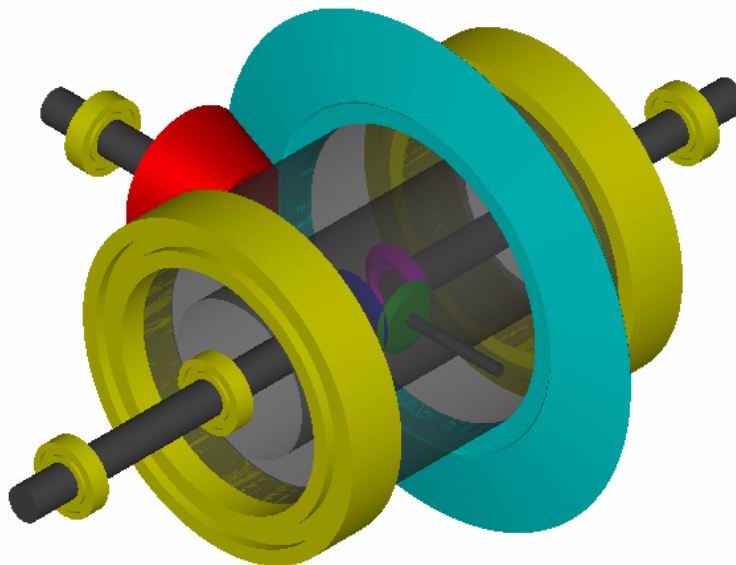


Figure 1.1-1 Bevel differential model

2 Modeling

2.1 Create coupling connection

Create coupling connection between the locked shafts. Add clutches to the “s2” and “s3” and create coupling connection between these two couplings.

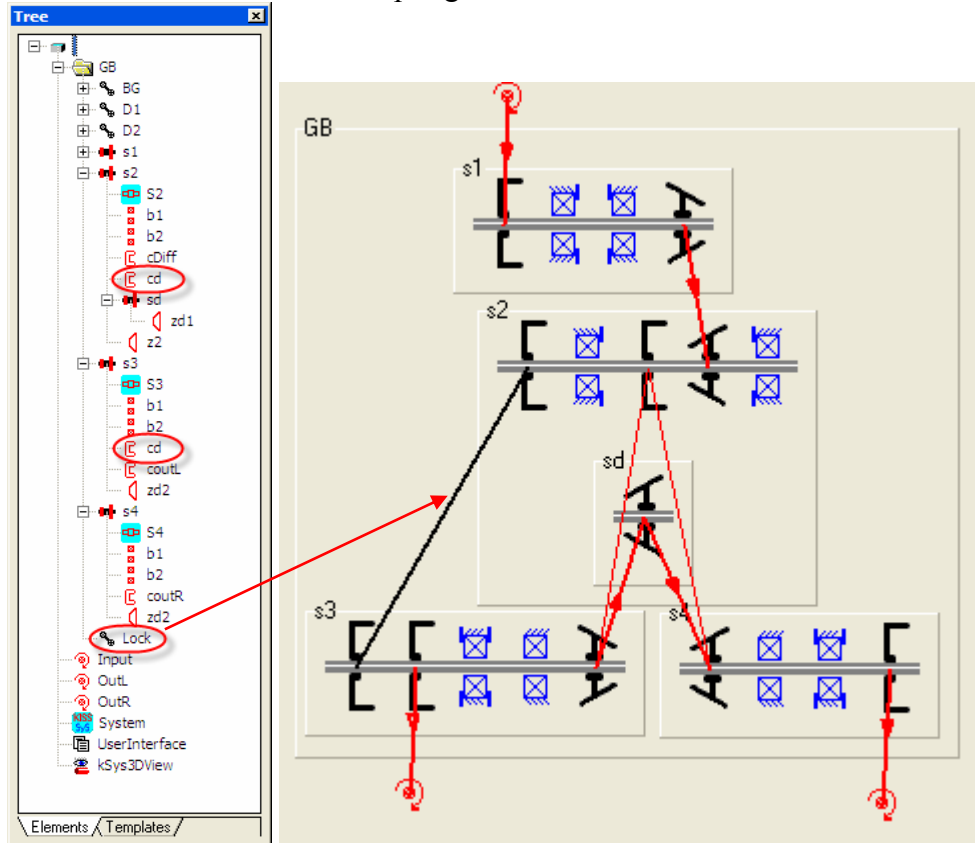


Figure 2.1-1 Definition of the differential lock

3 Model setup

3.1 Adding speed difference “k”

Definition of the output in the example model has to be made as follows:

1. Definition of global variable k
2. Setting the “kSysSpeedOrForce” element of the left output to “Speed constrained: yes”
3. Entering the expression for the correct speed calculation into the variable “speed” of the “kSysSpeedOrForce” element of the left output.

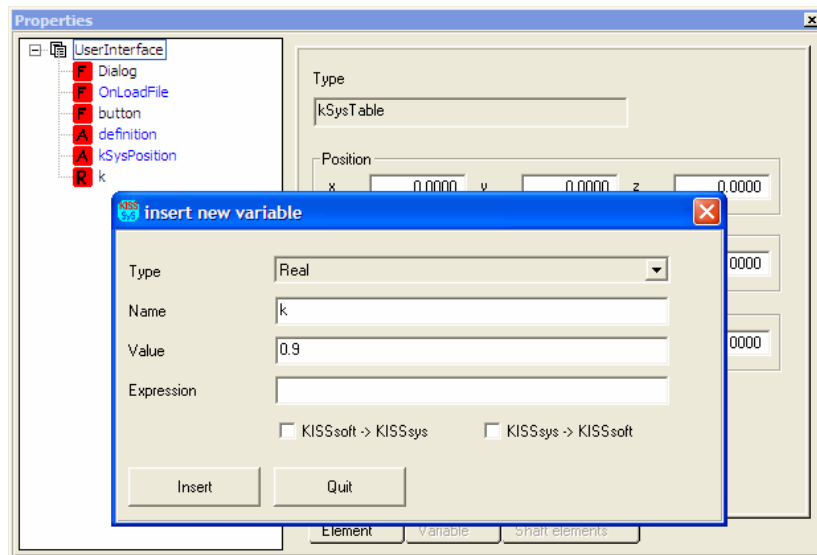


Figure 3.1-1 Define new variable "k"

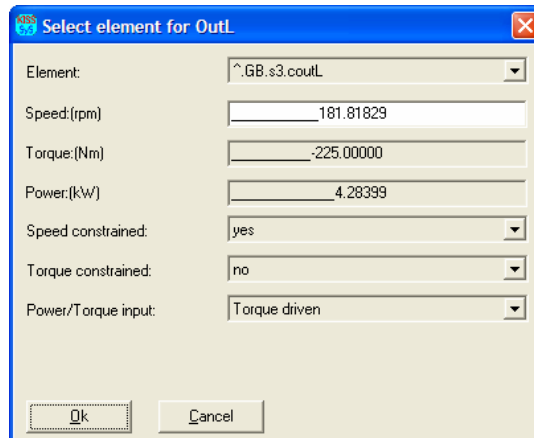


Figure 3.1-2 Constrain the speed value

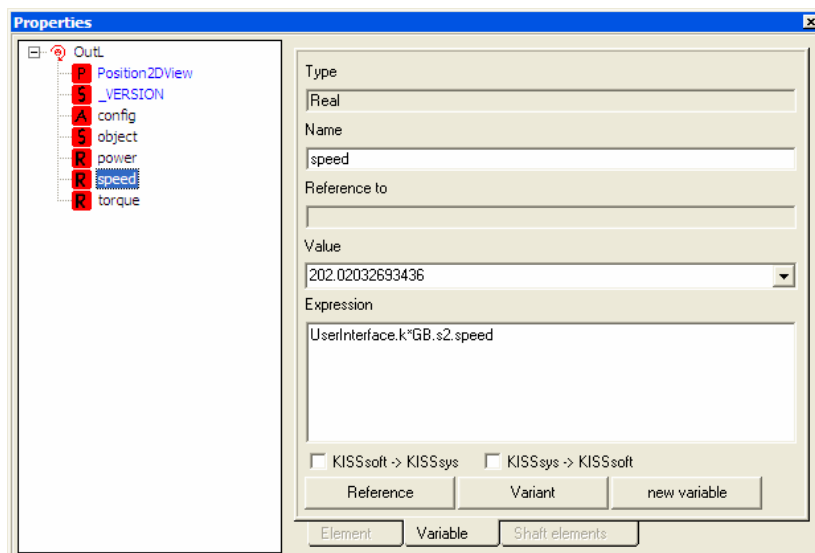


Figure 3.1-3 Make expression for the "OutL" speed

Attention: Expressions of the element variables are deleted every time you open the dialog of a "kSysSpeedOrForce".

Create a “link” to that variable in the “UserInterface”. Insert a “Real” and make it to be reference to the created variable “k”.

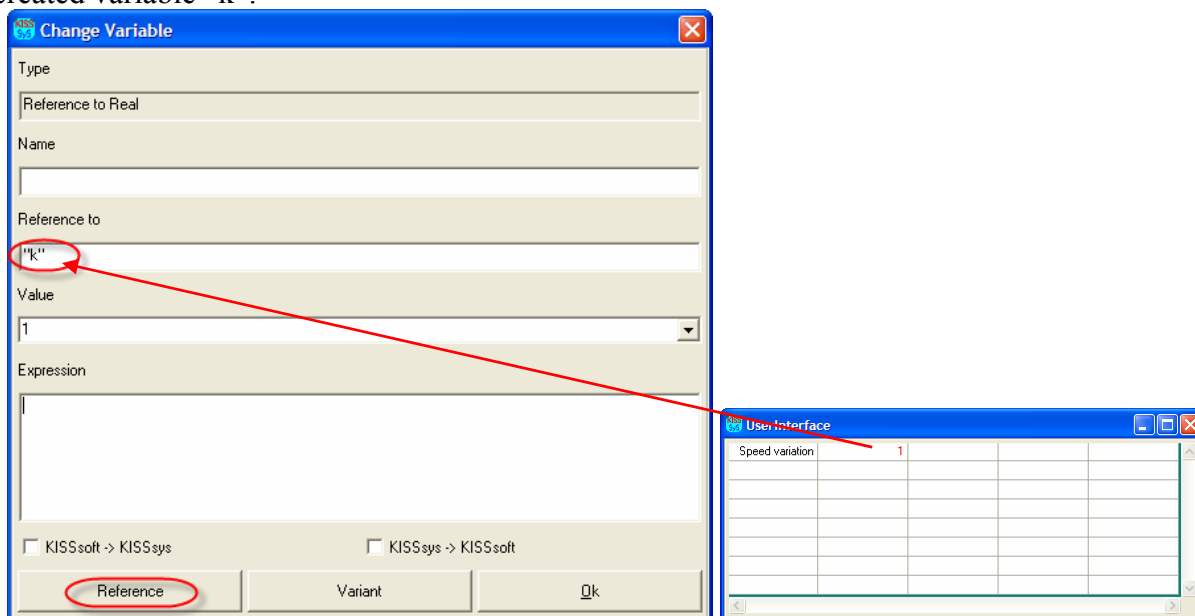


Figure 3.1-4 Create access to the "k" factor

Create also another new variable to show differential lock mode (open/closed). Initial value can be given, e.g. “Closed”. Variable type should be “String”

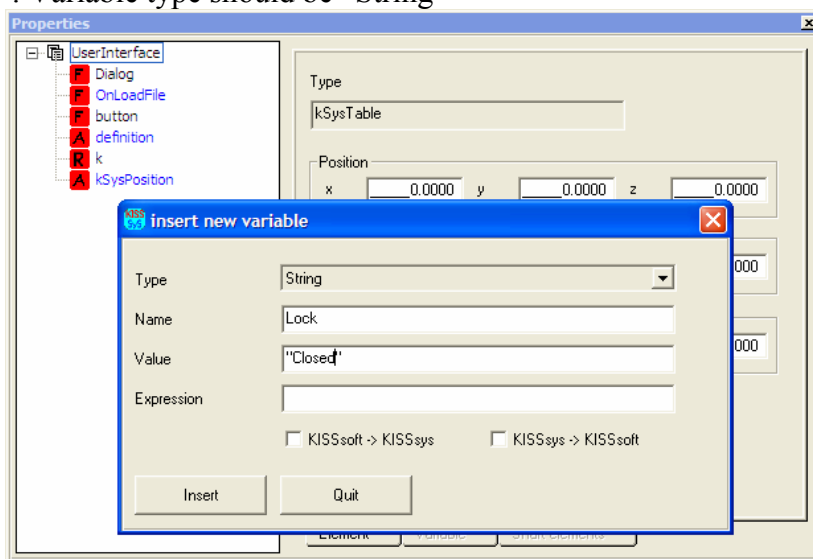


Figure 3.1-5 Create variable for the mode

3.2 Function to select “mode”

Create new function for calculation with different differential modes. Insert this new function in UserInterface, name it e.g. “Mode”

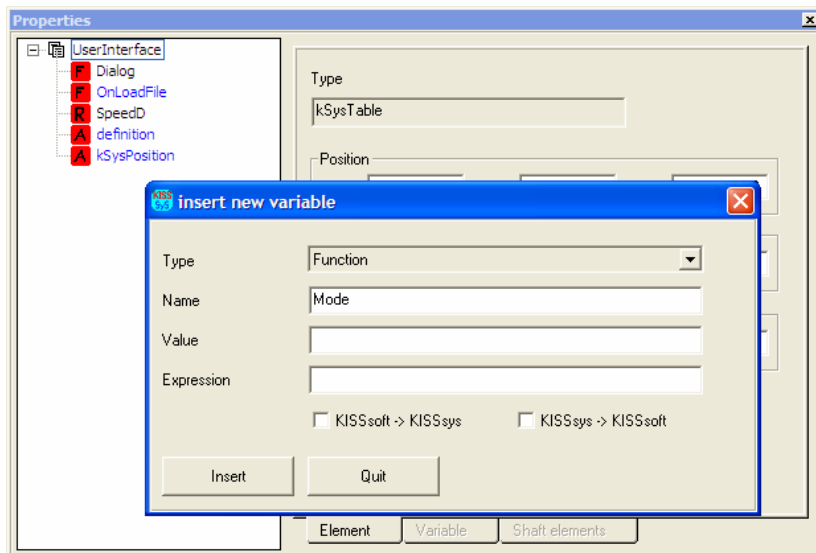


Figure 3.2-1 Create a function to select calculation mode

Select “edit” to write functionality.

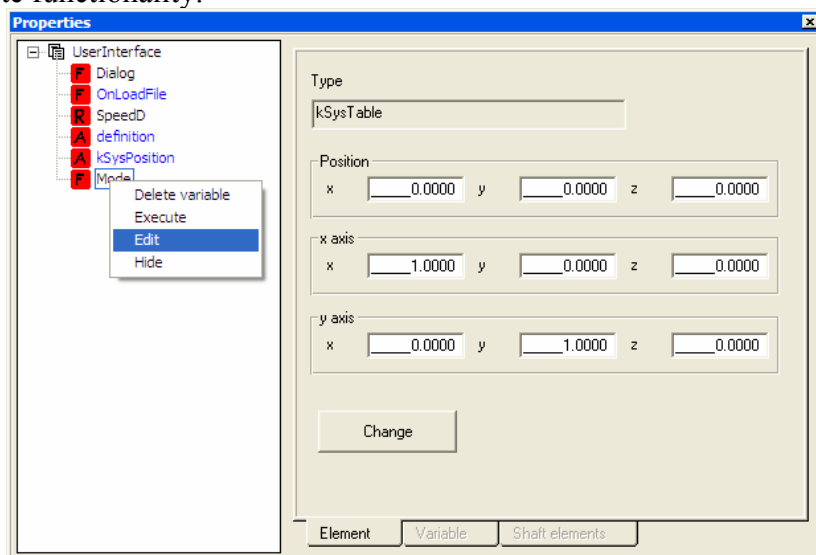


Figure 3.2-2 Access to edit window to create functionality

Type in the function core to be able to do selections and calculations. Function code is as follows. (You may Copy-Paste this to your model)

Code	Description
<pre> VAR mode, res; mode = ["Open", "Closed"]; res = CADH_VarDialog(["Select mode",250,170,0.4,1], [C:VDLG_StrCom,"Lock", mode,Lock], [C:VDLG_Real,"Difference", k], [C:VDLG_Prompt,"If \"open\" speed difference Left/Diff housing.",20], [C:VDLG_Prompt,"If \"closed\" torque difference Left/Right.",20]); IF res[0] THEN UserInterface.Lock = res[1]; UserInterface.k = res[2]; IF UserInterface.Lock = "Open" THEN GB.Lock.setConfig(0,0); OutL.setConfig(1,0); OutL.OBJ_SetMemberExpr("speed","GB.s2.speed*UserInterface.k"); OutL.OBJ_SetMemberExpr("power",@"KISSsys.Power(torque,speed)"); GB.D1.D1.H = 20000; GB.D2.D2.H = 20000; GB.D1.D1.CalcMethod=10040; </pre>	<p>Define variables for the function</p> <p>Define operation modes</p> <p>Create dialog to select mode and speed difference</p> <p>If ok is pressed do all otherwise leave function</p> <p>Set selected mode to variable “lock”</p> <p>Set speed difference to variable “k”</p> <p>If mode is “Open”</p> <p>Open the clutch connection.</p> <p>Define configuration for the output (right is given left is calculated)</p> <p>Set lifetime to desired value.</p> <p>Set differential gear calculation method to “ISO 10300”</p>

<pre> GB.D2.D2.CalcMethod=10040; ELSE GB.Lock.setConfig([1,0],0); OutL.setConfig(0,[1,4,OutR.power*UserInterface.k]); OutL.OBJ_SetMemberExpr("power","OutR.power*UserInterface.k"); GB.D1.D1.CalcMethod = 10030; GB.D2.D2.CalcMethod = 10030; ENDIF ENDIF </pre>	<p>If mode is "Closed" Set speed difference to be zero. Close the clutch and set speed difference in clutch to be zero. Define configuration for the output (right is given left is calculated) Set differential gear calculation method to "static"</p>
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Note! Calculation method is changed in this example depending on the operation mode. See chapter 4 for KISSsoft AG recommendations for the calculation method.

3.3 Create access to function

Add new function in "UserInterface" as a calculation button to operate model and change differential modes.

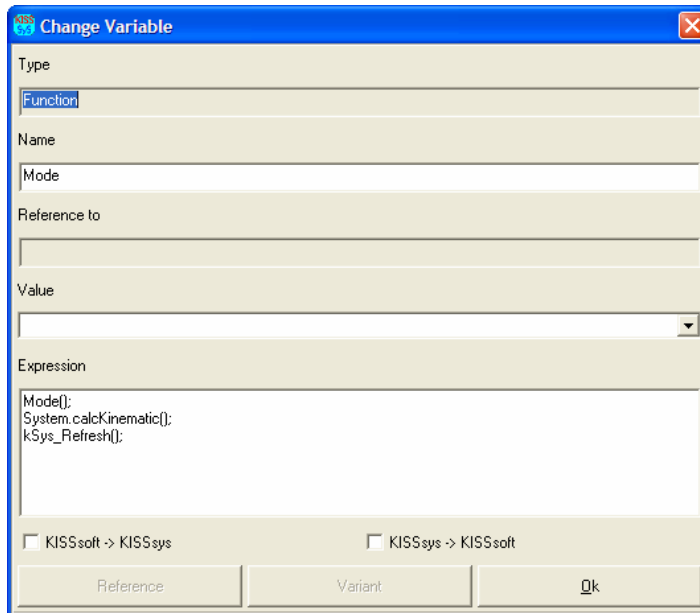


Figure 3.3-1 Add calculation "button" to the "UserInterface" table

Dialog for the new function looks like follows. This will appear every time when function is called.

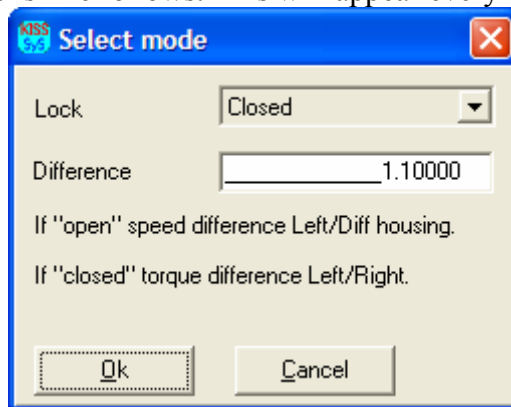


Figure 3.3-2 Dialog for the selection

4 Calculations

4.1 Differential bevel gears

Recommended calculation method for the bevel gears in differential arrangement is “Static calculation” in every case. This means that even if there is some speed difference inside the differential calculation is based on the static calculation with maximum possible torque. This torque needs to be defined manually for the calculations and is not taken from the values in KISSsys.

4.2 “Simplification”

In case if you are not interested any calculations inside differential, it is recommended not to model it at all, but to use even more simplified method considering differentials as black box and to divide only torque between two outputs having equal speed.