maxon academy

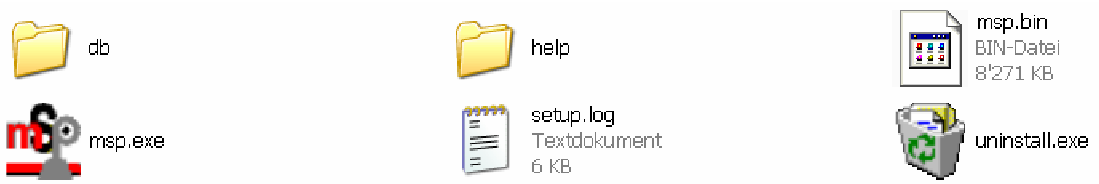
Practical Training with the maxon Selection Program (MSP)

Purposes and Goals
The participants …
- learn how to use the main parts of the maxon selection program.
- make a motor-gearhead selection for continuous and cyclic operation.
- calculate the mass inertia of a complex body.

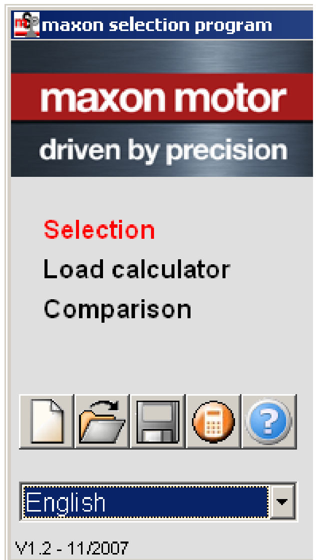
Exercise 1: MSP Download and Installation. Information on Versions.
Goal: Download the current version of the MSP. Get ready to start.

1. Download the current MSP version from www.maxonmotor.com and save it to your computer.

2. Run the installation program (maxon_msp_Setup.exe).
   The following file structure will be copied on your computer:



3. The folder **db** contains the data: Files with product data, combination information and files needed to run the program in different languages.
   – The database lists only products that can be found in the maxon catalog. Please note that not all the catalog products are listed. Due to their structure, some products cannot be integrated in the database, for example motors with integrated electronics.
   – From the saving date of the newest product file you can see how recent the database is. The database is updated typically once or twice a year (in April and if necessary in autumn).



4. The folder **help** contains the help instructions.

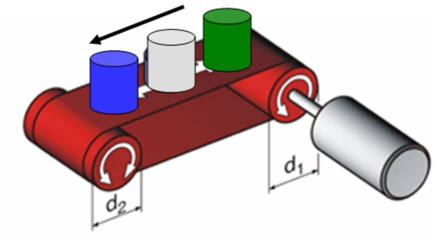
5. Start the MSP either by clicking on the MSP-icon ( ) on your desktop or by opening **msp.exe** in your program files.
   – In the lower left corner you find the program version (currently V1.2 dating from November 2007). Do not mix up the program version with the database version.

6. In the left panel you can set the operation modes (Selection, Load calculator, Comparison) and select the language. You find the menu buttons for creating, opening and saving MSP applications. In addition there is direct access to the load calculator (orange button) and the context help (blue button).

Exercise 2: Selection for Continuous Operation

Goal: Learn the main steps of using the *Selection* program mode by means of a simple example.

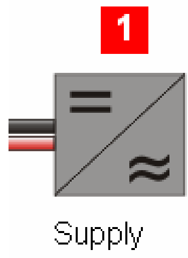
Conveyor belt application



A motor gearhead combination is needed for a conveyor belt application running with a power supply of 24 VDC and 5 A.
In a first approximation the conveyor belt is assumed to run continuously at a maximum speed of 0.5 m/s.
The friction of the empty belt is 40 N. Additional friction due to the load (max. 3 kg) amounts to 9 N. Hence we have a total load of 49 N.

1. Click on 'Selection' in the left panel. Read the instructions on the main part of the screen.

2. Power supply definition



Step 1: Click on the icon 'Supply'
Step 2: Enter the available supply voltage and supply current (for our example 24 V, 5 Amp).
Step 3: If your power supply allows for short term increased current you can define this in the 'Detail>>' part of the supply dialog window.
Step 4: Exit the supply dialog window by pressing 'OK'.

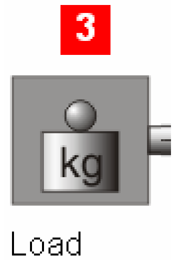
Note: If you do not know what kind of power supply you are going to use you can leave the predefined values or even set higher values. The MSP will show, for each solution, how much current and voltage is actually needed.

3. Mechanical drive layout definition

Step 1: Click on the icon 'Drive layout'
Step 2: Select 'Conveyor belt' and move it to the drive layout area by using the arrow button.
Step 3: Enter the diameters of the pulleys (for our example 0.1 m). First change the unit to 'm' then enter the value. If you switch back to any other unit, the value will be converted. As you can see, there is a unit converter built in the MSP.
Step 4: Exit the dialog window by pressing 'OK'.

Note: Additionally, by entering the efficiency, you can take the losses of your drive mechanism into consideration. In our example the friction losses will be included in the load. Thus we leave the efficiency value at 100%.

4. Load definition for continuous operation



Step 1: Click on the icon 'Load'
Step 2: Enter the required maximum load speed and feed force (for our example 0.5 m/s and 49 N).
Step 3: Exit the dialog window by clicking on 'OK'.

Note: This is the simplest way of defining a load.
Since a conveyor is a linear device the load must be given as a linear speed and a force. For rotational drives the MSP asks for rotational speed and torque instead.
Note: As soon as the load is defined, the maxon selection program starts to search for suitable gearhead-motor combinations. The results are displayed in the list of solutions.

5. Analyze the list of solutions.
   There is no filtering applied when the list of solutions is composed: All possibilities within specification will be listed. This usually leads to a long list of gearmotor combinations. You will see the number of entries on the left.
   The task is now to reduce this list to the most appropriate solutions. For this purpose the program offers various possibilities for filtering, table manipulations and decision-making aids.

   Click on the 'Help' button to get information on the possible table manipulations and filters.
   - As a default the solutions are listed according to the motor load column.
   - Examine the list of solutions: Which motors do you find? Which gearheads? How much current and voltage is needed by the different solutions? What are the dimensions of the solutions? Which commutation system is used? …

   In the lower part of your screen a diagram is shown which aids rapid graphical evaluation of the marked solution.
   - You can enlarge the diagram by a double clicking on it or with right mouse click and 'Resize diagram'.
   - You can also find information about the interpretation in the 'Help' of the context menu.

6. Filtering the list of solutions
   If, for our example, you are looking for a brushless motor, a filter strategy with approx. 370 solutions could be:
   Step 1: Click on the filter button ‘Optimum range'. This eliminates all solutions which are too close to the maximum permissible load (close to the maximum continuous torque, no reserve) or which are under-loaded (too big a motor) or which do not make good use of the available voltage.
   This reduces the list to approx. 75 solutions.
   Step 2: Then look for solutions with brushless commutation. Select one of the brushless solutions and with right mouse click on 'brushless' select 'filter'. The corresponding column will be marked in red.
   This reduces the list to approx. 37 solutions.
   Step 3: Then look for solutions with a small diameter. Shift the diameter filter control to the left (32 mm).
   This reduces the list to approx. 4 solutions (each using a higher priced EC-4pole motor).
   If you set a higher diameter (e.g. >42 mm) you will have a wider choice of approx. 15 solutions based on EC 40, EC-max 40, and EC-4pole.
   Step 4: Select a solution according to your preferences.

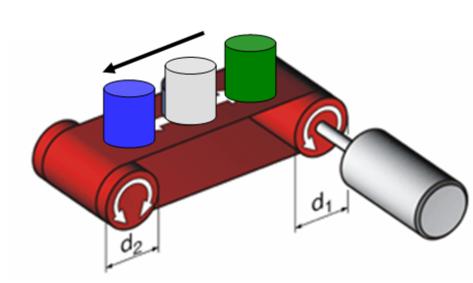
   Note: You can always go back to the original list by clicking on the 'Reset filters' button.
   Note: As you can see, extracting the “right solution” from the table depends not only on physical parameters (voltage, current, dimensions, …) but also on your preferences and the application (e.g. when selecting the commutation type and the amount of reserve).

7. Data sheet
   Step 1: Open the data sheet by double clicking on your solution. (or by using the context menu)
   Step 2: What information can be found on the different tabs of the data sheet?
   Step 3: Use the help button to get more information about the diagram.
   Step 4: Use the print button to print the data sheet.

8. Save your application
   Step 1: Save your application with the save button on the lower left panel.
   Step 2: Open your saved application and observe what happens.

Exercise 3: Selection for Simple Cyclic Operation
Goals: Know how to use preset filters for motors and gears. Advanced load input including short acceleration periods (simple cyclic operation). How to include electronics in the selection.

Conveyor belt application



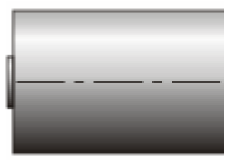
A rough estimation of the acceleration process shows that approximately 10 N additional force is needed during the 1 s acceleration process. Acceleration and deceleration takes place every few seconds.

The conveyor belt runs in a factory hall that can be as hot as 40°C in summer.

Due to life expectancy reasons the motor should be a brushless EC motor.

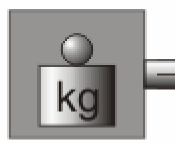
1. Preset motor filter
   Step 1: Click on the icon ‘Motor’.
   Step 2: Omit all DC motor types.
   Step 3: Set the ambient temperature to 40°C.
   Step 4: Exit the dialog window by pressing 'OK'.

   Note: Because we have already defined the load, the MSP restarts the selection whenever one of the dialogs is closed.



2. Load definition for simple cyclic operation
   Step 1: Click on the icon ‘Load’.
   Step 2: Click on the button ‘Cyclic’.
   Step 3: Enter the required maximum feed force and its duration (for our example 59 N and 1 s).
   Step 3: Exit the dialog window by pressing 'OK'.

   Note: This is a very easy way to include a known short-time peak load.

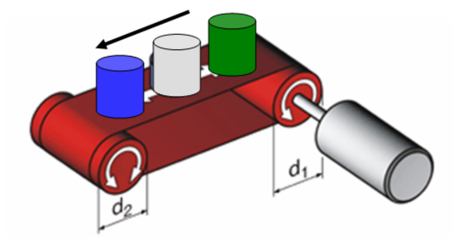


3. Analyze and filter the list of solutions in a similarly to the previous exercise.
   Hints:
   – Observe the additional operating point in the diagram!
   – Click on the measuring device  between gearhead and conveyor belt to get information about the required torque and speed at the gearhead output.

4. controller selection.
   Step 1: Mark a solution.
   Step 2: The compatible controllers will be shown at the bottom
   Step 3: Mark a controller and observe how the diagram changes.
   Step 4: Check for compatible feedback devices (encoders) by opening the data sheet (double click or right mouse click)

Exercise 4: Selection for Complex Operation Cycles
Goal: Know how to input load for complex operation cycles.

Conveyor belt application



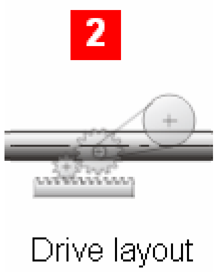
A more exact motion analysis shows a motion with short interruptions (ON 4 s, OFF 0.5 s). However, acceleration and deceleration rates are low (acceleration time approx. 0.5 s).

The belt has a width of 20 cm, a total length (back and forth) of 12 m and a specific mass of 500 g/m.

The pulleys are made of aluminum.

For true cyclic operation the MSP takes into account the acceleration forces which are calculated from the speed profile and mass inertias of all moving parts.

1. Mass inertia of a mechanical drive:



Step 1: Click on the icon 'Drive layout'.
Step 2: Click on the button 'Detail >>'.
Step 3: Calculate the mass inertias of the pulleys. Click on the orange button next to the input field.
Step 4: Select the 'Cylinder/Disk' as a body shape for the pulley and move it to the right. Enter diameter (10 cm), length (20 cm), and the material (Al) for the pulleys. Since the pulleys rotate around the central axis the distance s = 0. Leave the dialog. The mass inertia of the pulley will automatically appear in the input field.
Step 5: Repeat step 4 for the second pulley.
Step 6: Enter the mass of the belt manually (for our example 12 times 500 g/m = 6 kg)
Step 7: Exit the dialog window by clicking on 'OK'.

2. Working cycle input

Step 1: Click on the icon 'Load'.
Step 2: In the cyclic load input click on the button 'Detail >>'.
Step 3: Select 'Speed mode' under motion profile.

Note: In the 'Position mode' motion profile you can enter target position and duration for each movement. The necessary velocities and speeds will be calculated automatically.

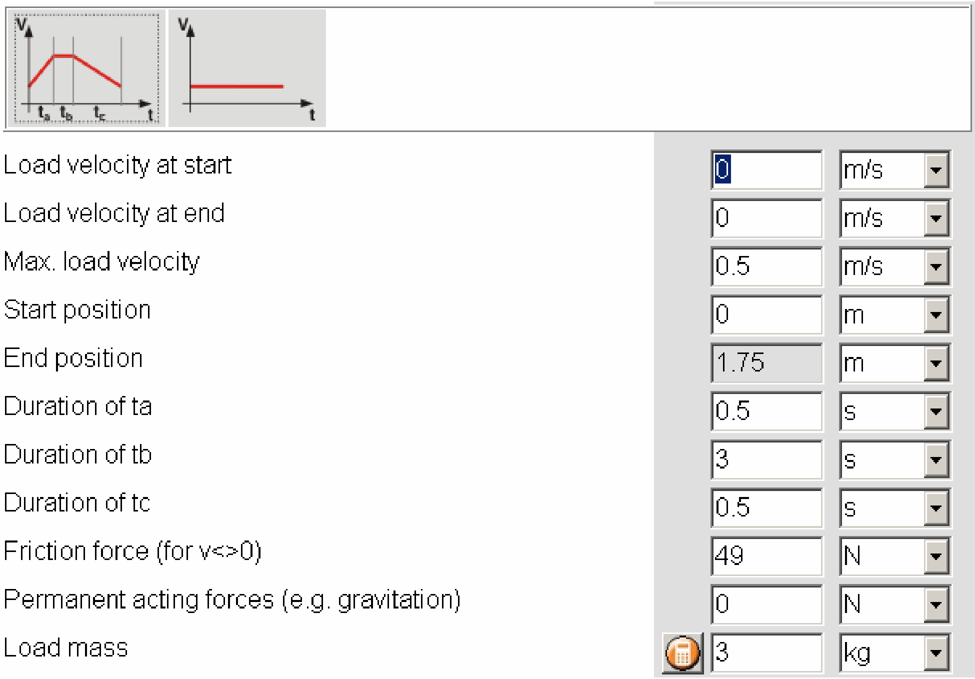
Step 4: Compose your required working cycle with the available speed profiles. There is room for up to 6 different profiles. Enter the required parameters: Speed, time duration, forces and mass inertias.
(Input for conveyor example: see next page)

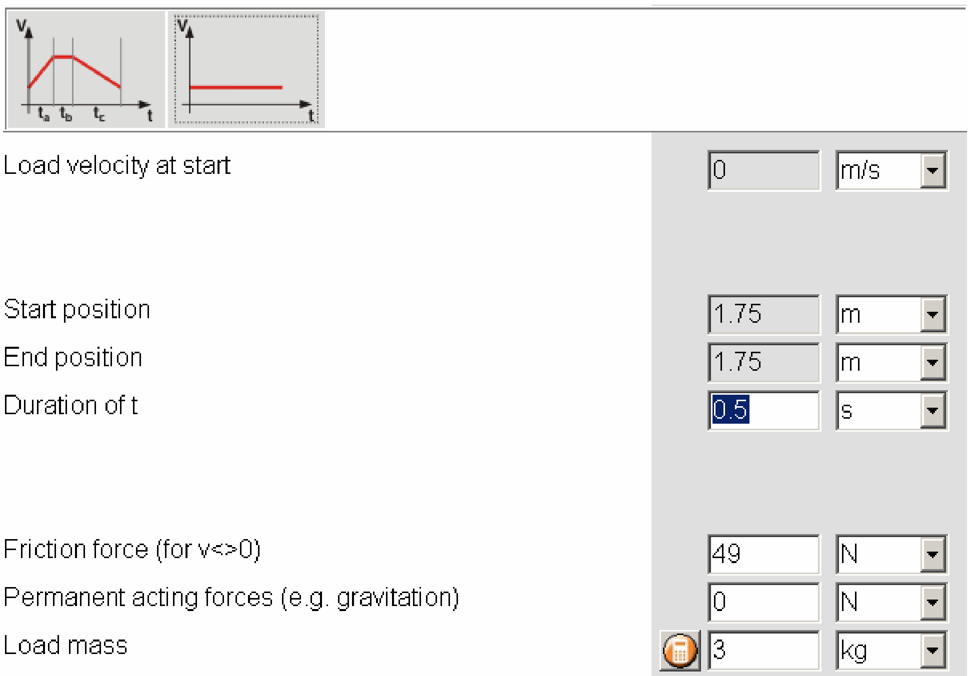
Note: The MSP assumes this working cycle is repeated continuously.
If the movement is to be made sporadically add a sufficiently long pause (= 'Constant/break') at the end.
The key motion data are recalculated according to the motion profiles and shown in the upper part of the dialog window. You can follow the influence of a motion parameter change.

Step 5: Exit the dialog window by clicking on 'OK'.

Conveyor belt application

For the conveyor example we compose the motion of a 'Trapezoidal' profile followed by a 'Constant/break'.



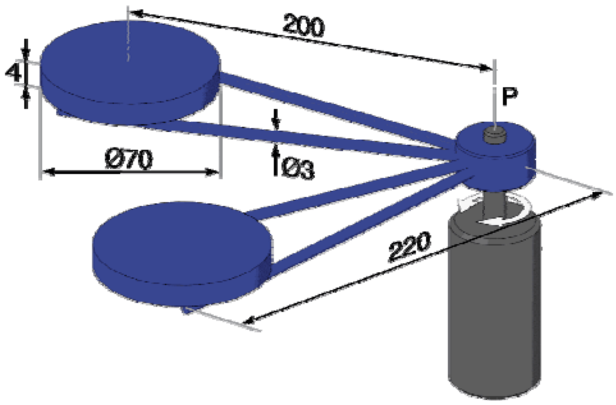


Exercise 5: Mass Inertia Calculator

Goal: Learn how to use the *Inertia calculator*

1. Open the Mass inertia calculator. Orange button on the left panel.

2. Enter the aluminum shutter structure (see diagram).
   Step 1: For the two disk shaped shutters select 'Cylinder / Disc' and add it to the structure (Button '>')
   Step 2: Enter the dimensional parameters of the disks. Do not forget they are at a certain distance from the rotation axis P.
   Step 3: For the 4 rods select 'Cylinder / Bar across' and add them to the structure (Button '>')
   Step 4: Enter the dimensional parameters of the rods. Do not forget their center of mass is at a certain distance from the rotation axis P.



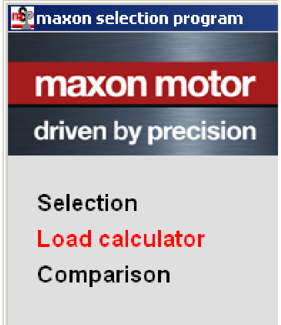
Note on simplifications

- The central piece around P can be disregarded when calculating the mass inertia.
- The two shutters could be replaced by one shutter of twice the thickness.
- The 4 rods could be replaced by one rod of twice the diameter.

3. Questions:
   Which parts contribute most to the mass inertia?
   How large is the mass inertia of the total structure?
   How large is the mass of the total structure?

Exercise 6: Load Calculator

Goal: Learn how to use the *Load calculator* program mode.



1. Choose 'Load calculator' on the left panel. Read the instructions on the main part of the screen.

2. Define the power supply.

3. If necessary define the drive layout and enter your load points.

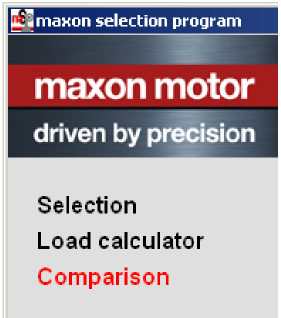
4. Select a motor-gearhead combination
   Step 1: Click on the icon ‘Motor’.
   Step 2: Enter a 'Motor No.' or select a 'Motor program'.
   Step 3: Mark the desired motor in the list, then press 'OK'.
   Step 4: Select the matching gearhead from the list.

5. Results:
   You can open a data sheet of your drive.
   You can judge from the diagram if the drive can fulfill the load requirements.

   Note: This operation mode does not select, but rather gives you information on an existing drive.

Exercise 7: Gearmotor Comparison

Goal: Learn how to use the *Comparison* program mode.



1. Choose 'Comparison' on the left panel. Read the instructions on the main part of the screen.

2. Define the power supply. Enter the voltage for the comparison.

3. If necessary define the drive layout and enter your load points.

4. Enter a drive for comparison or which you want to replace.
   Step 1: Select a motor from the list and move it to the left by clicking on '<' or enter the motor data if the motor is not contained in the list.
   Step 2: Select a gearhead from the list and move it to the left by clicking on '<' or enter the gear-head data if the gearhead is not contained in the list.
   Step 3: Exit the dialog window by clicking on 'OK'.

   Note: You can edit the list with the corresponding buttons (adding '>' /deleting 'Del' new motors / gears). The 'CLR' button empties the input fields.

5. Scroll through the list of similar drives. In the diagram the drive to compare is marked with blue line (speed torque line at given voltage for comparison; vertical line of max. rated torque).

   Note: The solutions are listed in descending similarity of the speed torque line. The rated torque has no influence on 'Similarity'.