

Tool Wrench Limit function



14.44. tool_wrench_limit_set(frame_offset, Fx, Fy, Fz, Mx, My, Mz)

Limit the wrench (forces and torques) caused by motion of the robot in a frame given relative to the tool flange. The wrench is limited in normal and reduced mode operation, as well as during protective stops, safeguard stops, 3PE stops and emergency stops. For this reason, it can affect robot motion speed to ensure adherence to safety limits. Usage can help prevent dropping items by limiting accelerations as well as reducing wrench applied to the attached tool.

This limitation does not affect the forces and torques that can be applied in force control.

Parameters:

frame_offset: Pose specifying frame relative to the tool flange similarly to how the TCP offset is specified. The first three coordinates specify translational offset along the x- y- and z-axis in meters. The last three specify the rotational offset using the axis-angle representation in radians.

Fx (optional): Float, setting maximum acceleration force along the X-axis in the specified frame.

Fy (optional): Float, setting maximum acceleration force along the Y-axis in the specified frame.

Fz (optional): Float, setting maximum acceleration force along the Z-axis in the specified frame.

Mx (optional): Float, setting maximum acceleration torque around the X-axis in the specified frame.

My (optional): Float, setting maximum acceleration torque around the Y-axis in the specified frame.

Mz (optional): Float, setting maximum acceleration torque around the Z-axis in the specified frame.

Any optional parameter not specified means the axis is only limited by standard robot limitations.

Example command: `tool_wrench_limit_set(p[0, 0, 0.1, 0, 0, 1.57], Mx=10, My=15)`

Example Parameters:

- `frame_offset = p[0, 0, 0.1, 0, 0, 1.57]` → limitation will be applied in a frame offset 10 cm in front of the tool flange rotated by 45 degrees around the axis of displacement.
- `Mx = 10` → acceleration torque will be limited to 10 Nm around the X-axis in the specified frame.
- `My = 15` → acceleration torque will be limited to 15 Nm around the Y-axis in the specified frame.

Remaining forces and torques will not be limited by this algorithm.

Example command: `tool_wrench_limit_set(get_tcp_offset(), Fz=50)`

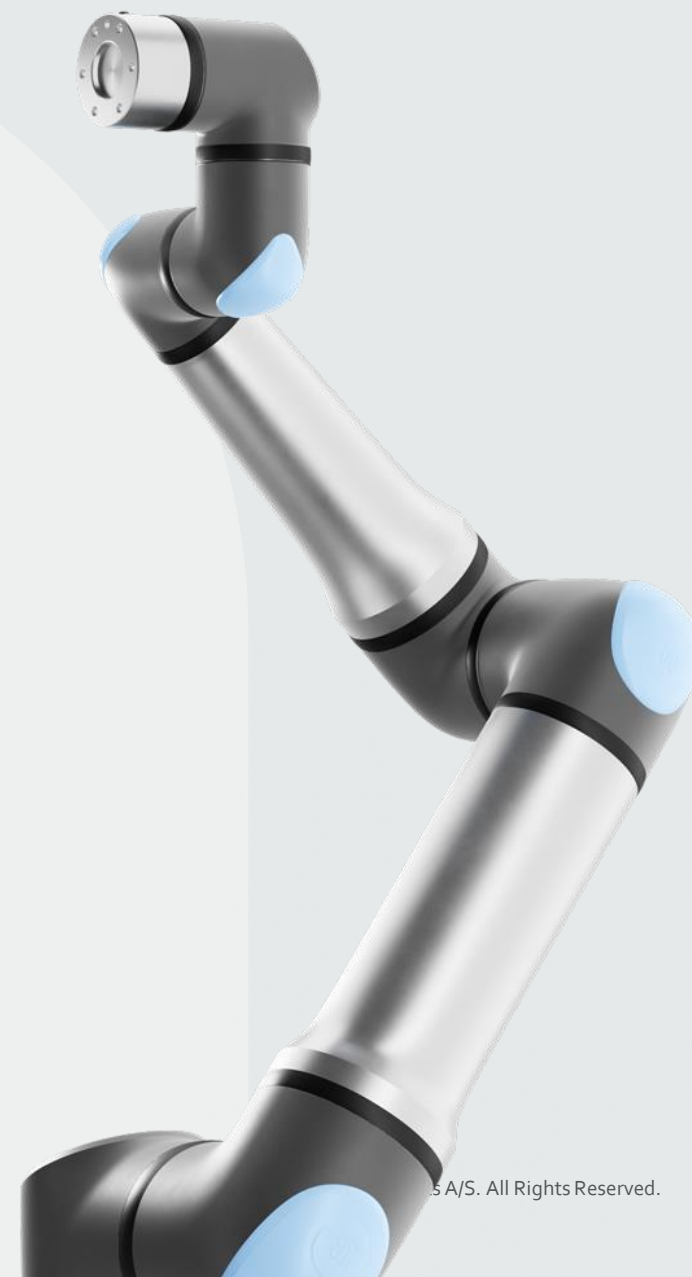
Example Parameters:

- `frame_offset` is equal to the active TCP offset.
- `Fz = 50` → acceleration force is limited such that force does not exceed 50 N along the Z-axis in the TCP frame.



NOTICE

The set limit is persisted until shutdown of the controller or until explicitly disabled by executing `tool_wrench_limit_disable()`.



Use case examples

- Gripper drops items because of too high acceleration
 - Limit **torque** at the point of contact in the plane of contact (usually around 10 Nm for M_x and M_y is a good starting point)
 - Will work well for all payloads as long as specified correctly
- Object is fragile and may break if accelerations are abrupt
 - Limit force along the relevant axis/axes
- Generally, a torque limit around an axis will correspond to a force limit around a perpendicular axis with the relation being e.g. :
$$F_x = M_y / \text{payload_offset_norm_from_contact_point}$$
(which axes depends on the direction of motion)

Suggestion

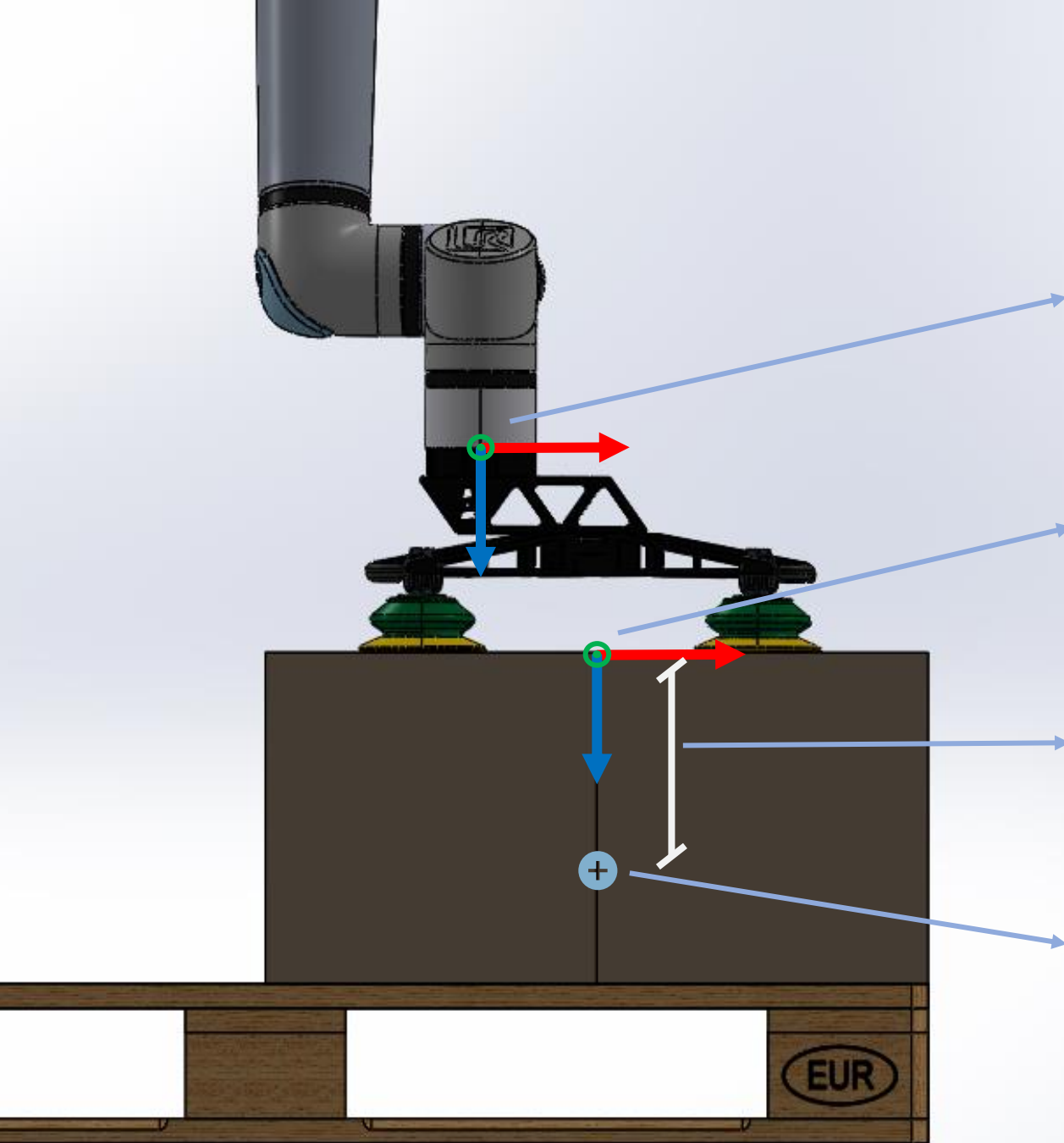
As seen in the Script manual, all parameters are optional, so a good idea would be to **start by setting only some values for torque limitation**. Example:

`tool_wrench_limit_set (p[0, 0.08, 0.1, 0, 0, 0],  $M_x=10$ ,  $M_y=10$ )`

And depending on results continue adding other parameters.



Graphic Example



frame_tool_flange

default robot frame, in the middle of the flange.

frame_offset

input of the tool wrench limit function, it is suggested to define it equal to the TCP being used.

payload_offset_norm_from_contact_point

normal distance from the frame_offset to the CoG of the items to lift.

CoG

center of gravity of the items to lift.