3.87 tooldata - Tool data

Usage

`tooldata` is used to describe the characteristics of a tool, for example, a welding gun or a gripper. These characteristics are position and orientation of the tool center point (TCP) and the physical characteristics of the tool load.

If the tool is fixed in space (a stationary tool), the tool data firstly defines position and orientation of this very tool in space, TCP. Then it describes the load of the gripper moved by the robot.

Description

Tool data affects robot movements in the following ways:

- The tool center point (TCP) refers to a point that will satisfy the specified path and velocity performance. If the tool is reorientated or if coordinated external axes are used, only this point will follow the desired path at the programmed velocity.
- If a stationary tool is used, the programmed speed and path will relate to the work object held by the robot.
- Programmed positions refer to the position of the current TCP and the orientation in relation to the tool coordinate system. This means that if, for example, a tool is replaced because it is damaged, the old program can still be used if the tool coordinate system is redefined.

Tool data is also used when jogging the robot to:

- Define the TCP which is not moving when the tool is reorientated.
- Define the tool coordinate system in order to facilitate moving in or rotating in the tool coordinate directions.

WARNING

It is important to always define the actual tool load and, when used, the payload of the robot (for example a gripped part). Incorrect definitions of load data can result in overloading of the robot mechanical structure.

When incorrect load data is specified, it can often lead to the following consequences:

- The robot will not be used to its maximum capacity
- Impaired path accuracy including a risk of overshooting
- Risk of overloading the mechanical structure

Components

`robhold`

robot hold

Data type: `bool`

Defines whether or not the robot is holding the tool:

- `TRUE`: The robot is holding the tool.

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- FALSE: The robot is not holding the tool, that is, a stationary tool.

`tframe`

tool frame

Data type: `pose`

The tool coordinate system, that is:

- The position of the TCP (x, y and z) in mm, expressed in the wrist coordinate system (tool0) (see figure below).
- The orientation of the tool coordinate system, expressed in the wrist coordinate system (see figure below).

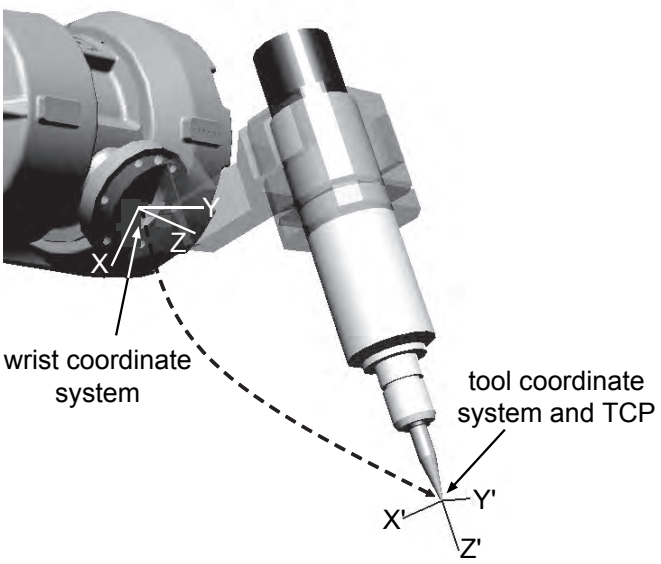

Figure 3.3: Robot held tool

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Note

If a stationary tool is used, the tool frame is defined in relation to the world coordinate system.

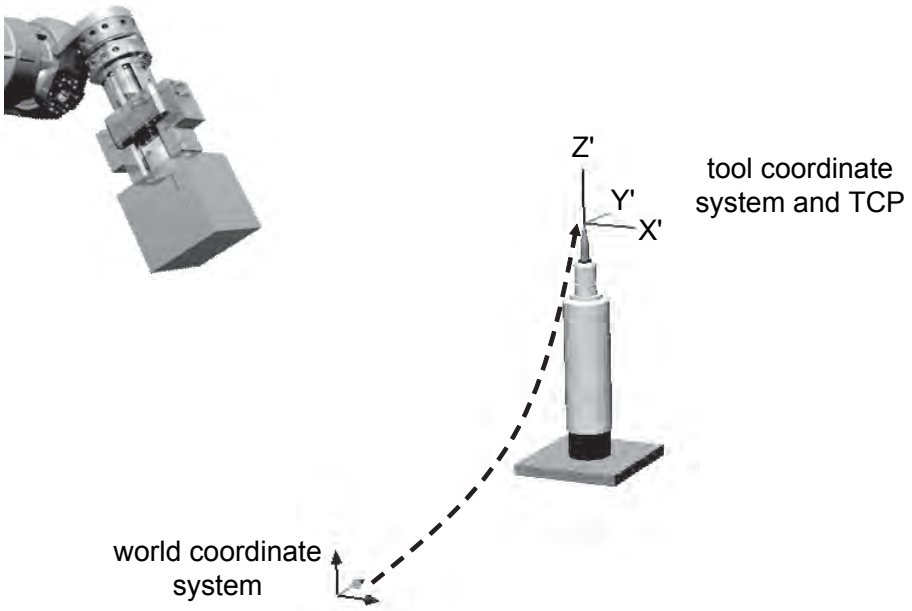

Figure 3.4: Stationary tool

`tload`

tool load

Data type: `loaddata`

Note

This data is used both for robot held tool and for stationary tool. For a robot held tool the data describes the tool load. For a stationary tool the data describes the load of the robot held gripper.

Robot held tool:

The load of the tool, that is:

- The mass (weight) of the tool in kg.
- The center of gravity of the tool load (x, y and z) in mm, expressed in the wrist coordinate system
- The orientation of the principal inertial axes of moment of the tool expressed in the wrist coordinate system
- The moments of inertia around inertial axes of moment in kgm^2. If all inertial components are defined as being 0 kgm^2, the tool is handled as a point mass.

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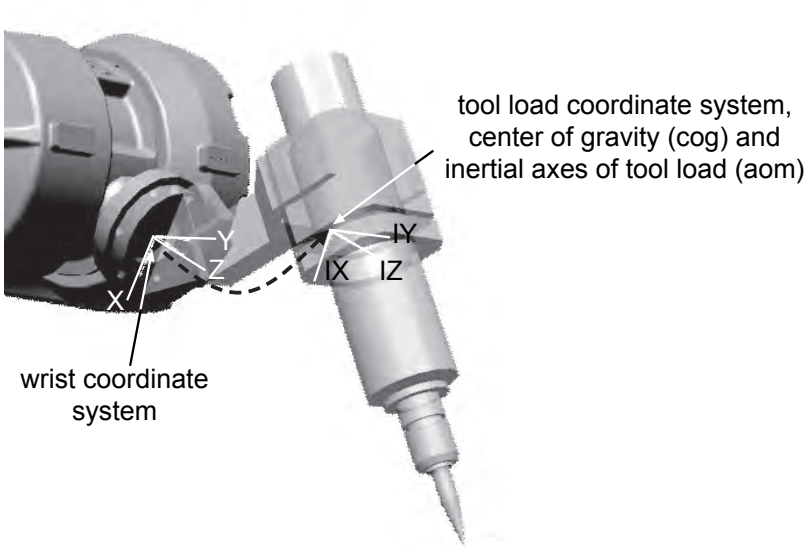

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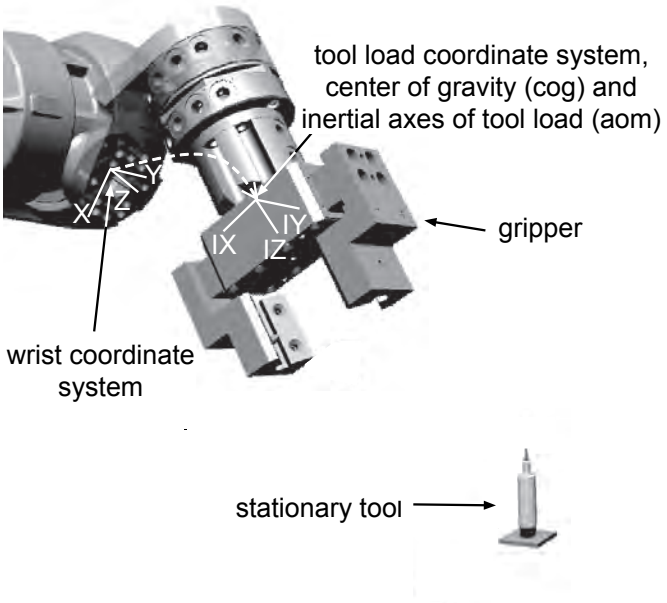
Stationary tool:

The load of the gripper holding the work object:

- The mass (weight) of the moved gripper in kg
- The center of gravity of moved gripper (x, y and z) in mm, expressed in the wrist coordinate system
- The orientation of the principal inertial axes of moment of the moved gripper expressed in the wrist coordinate system
- The moments of inertia around inertial axes of moment in kgm^2. If all inertial components are defined as being 0 kgm^2, the gripper is handled as a point mass.



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> **Note**
>
> Only the load of the tool/gripper is to be specified in `tooldata`. The payload handled by a gripper is connected and disconnected by the instruction `GripLoad` and defined with a `loaddata`.

Instead of using the instruction `GripLoad` it is possible to define and use different `tooldata` for *gripper with gripped workpiece* and *gripper without workpiece*.

Summary

Position and orientation of TCP in `tooldata` are defined in the wrist coordinate system for a robot held tool.

Position and orientation of TCP in `tooldata` are defined in the world coordinate system for a stationary tool.

The `loaddata` part in `tooldata` is in all cases related to the wrist coordinate system, regardless of the fact whether a robot held tool (to describe the tool) or a stationary tool (to describe the gripper) is used.

Basic examples

The following examples illustrate the data type `tooldata`:

Example 1

```
PERS tooldata gripper := [ TRUE, [[97.4, 0, 223.1], [0.924, 0,
     0.383 ,0]], [5, [23, 0, 75], [1, 0, 0, 0], 0, 0, 0]];
```

The tool is described using the following values:

- The robot is holding the tool.
- The TCP is located at a point 223.1 mm straight out from the mounting flange and 97.4 mm along the X-axis of the wrist coordinate system.
- The X' and Z' directions of the tool are rotated 45° in relation to Y direction in the wrist coordinate system.
- The tool mass is 5 kg.
- The center of gravity is located at a point 75 mm straight out from mounting flange and 23 mm along the X-axis of the wrist coordinate system.
- The load can be considered a point mass, that is, without any moment of inertia.

Example 2

```
gripper.tframe.trans.z := 225.2;
```

The TCP of the tool, `gripper`, is adjusted to 225.2 in the z-direction.

Limitations

The tool data should be defined as a persistent variable (PERS) and should not be defined within a routine. The current values are then saved when the program is saved and are retrieved on loading.

Arguments of the type tool data in any motion instruction should only be an entire persistent (not array element or record component).

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Predefined data

The tool `tool0` defines the wrist coordinate system, with the origin being the center of the mounting flange. `tool0` can always be accessed from the program, but can never be changed (it is stored in system module BASE).

```
PERS tooldata tool0 := [ TRUE, [ [0, 0, 0], [1, 0, 0 ,0] ], [0.001,
     [0, 0, 0.001], [1, 0, 0, 0], 0, 0, 0] ];
```

Structure

```
< dataobject of tooldata >
  < robhold of bool >
  < tframe of pose >
    < trans of pos >
      < x of num >
      < y of num >
      < z of num >
    < rot of orient >
      < q1 of num >
      < q2 of num >
      < q3 of num >
      < q4 of num >
  < tload of loaddata >
    < mass of num >
    < cog of pos >
      < x of num >
      < y of num >
      < z of num >
    < aom of orient >
      < q1 of num >
      < q2 of num >
      < q3 of num >
      < q4 of num >
    < ix of num >
    < iy of num >
    < iz of num >
```

Related information

For information about	See
Positioning instructions	*Technical reference manual - RAPID overview*, section *RAPID summary - Motion*
Coordinate systems	*Technical reference manual - RAPID overview*, section *Motion and I/O Principles - Coordinate systems*
Define payload for robots	*GripLoad - Defines the payload for a robot on page 235*
Definition of load data	*loaddata - Load data on page 1523*
Definition of work object data	*wobjdata - Work object data on page 1635*