
CNC & ROBO-MAC

MULTI-AXES-CONTROLLER

INVERSE KINEMATICS

MATHEMATICALY 3D JOINT-BOX FOR ROTATION & TELESCOPE - AXES

Controller Version 5.8_2

**New:
Bezier-path
&
Freeform
Generator**

This simulation toolbox is invented

- to put together Robot's elements of any design & geometry like joint- and telescope arms in order to determine the movement of each "mathematic construction" in a very high precision.
- to calculate arm's angles and XYZ co-ordinates alternatively in 'Direct-' or 'Inverse Kinematics' and to visualise the robot system in the 3D-space.
- The result is available numerically (16-figure / floating point)
- The algorithm will be able to calculate also overlapped robot's movement in case the system is moved on an XYZ-table same time.

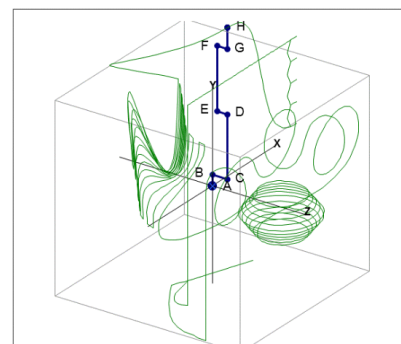
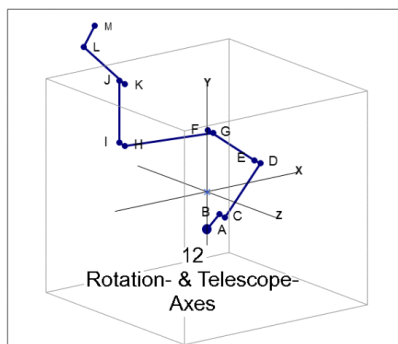
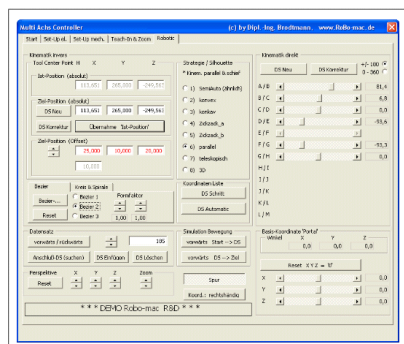
Fully compatibly to RoBo-mac's 8-axes continues path control the joint box allows to calculate 12 axes, each with 2 degrees of freedom (telescope & rotating axis) - to simulate system's motion path 3D.

Parameter & Configuration

The individual mechanics of the robot system and its kinematic possibilities are comprehended in the basic position (Home) as parameter. In addition, the adjustment of this basic position can be fixed in the 3D-space (centerpoint-offset, ceiling and wall mounting). The main axis may turn around by using its theoretical axis of rotation or may rotate on a circular path.

Visual control (eagle & mouse perspective)

Regardless of the actual simulation - calculated in *Inverse-* or *Direct Kinematics*- it will be possible to get a 3D view from any individual observation point to show "depth". – So, you will be able to "walk around the robot" or to visualise details as "an eagle or a mouse".



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Forward (direct) kinematics

The kinematic borders are defined by the axes lengths, its basic orientation XYZ and its maximum rotary angles. Each joint can have an individual basic orientation by using any angle in the 3D space. To simulate robot's movements the values are changed via slider, they are 'real time' visualised.

Inverse kinematics

To calculate suitable vector situations for the robot arms in spite of theoretically endlessly solutions you may select freely from several movement strategies & silhouettes:

- *Semi-Automatic* Will bring your (directly / by slider) pre-selected arm's silhouette in a precise position (TCP Error < 10^{-5} mm).
- *Convex:* The middle arm element lies above the goal
- *Concave* works vice versa to convex
- *Zigzag:* The arm elements form a zigzag silhouette
- *Parallel,* moves the "End Effector" in parallel with itself
- Telescope,* moves the "End Effector" like a telescope arm.

The inverse algorithm is based on trigonometric and iterative elements. It works regardless of the forward kinematics. Direct algorithm is just used to compare with inverse findings. Error of the positioning the TCP is less than 1/10.000 mm, mostly in a scale from 10^{-5} to 10^{-6} mm.

Continues path control & TCP track:

You may import a TCP-track from a CAD/CAE System in tabular form or use the Continuous-path Generator interactively (Off-line Teach-In), to create:

- A highly linear movement of the TCP
- or a smooth individual 3D-Bézier-Path.
- The simulator permits unlimited "Try & Error".
- It generates the co-ordinate list XYZ of the TCP as well as the corresponding movement protocol for the chosen configuration.
- Track and arm-silhouette are visualised 'real time' 3D;
- in the quick flow they appear "VIDEO".

System compatibility

The 3D joint box runs under EXCEL[®] from version '97/2003.

Test package & documentation

Free demo & test package <http://www.cnc-mac.de/html/download.html>

Video <https://www.youtube.com/watch?v=MJbAxZ3Iuio>