15 SINGULARITY AVOIDANCE FUNCTION

For most of six-axis robots in FANUC, the singularity that occurs at elbow (at the boundary between "up" and "down" configurations) or at the boundary between "front" and "back" configurations causes regional structure degeneracy. This kind of singularity can easily be avoided by restricting the workplace of a robot. However, the wrist singularity may happen virtually any place inside the workplace. When a FANUC robot travels through/near a wrist singular position, motion performance becomes undesirable because

- Joint 4 and 6 will change a lot within a short time period;
- The TCP speed of the robot will slowdown;
- Path may deviate from the commanded one if a motor speed exceeds its limit.

Singularity avoidance function will provide a real-time solution to avoid the wrist singularity. With this function, the followings are achieved.

- The rotation of joint 4 and 6 is minimized, and robot can travel through/near a wrist singular position smoothly, and TCP speed can be maintained;
- This function works for both LINEAR TPE program motion and LINEAR jogging.

To use this function, singularity avoidance function option (A05B-2600-R792) or Motion package (A05B-2600-R809) is required. Some robot models do not support this function.

15.1 HOW TO USE SINGULARITY AVOIDANCE

How to use singularity avoidance in jogging and TPE program will be explained below.

15.1.1 How to Use Singularity Avoidance in Jogging

Enabled/disabled status of singularity avoidance function in jogging can be confirmed by checking whether “S/” is added before the manual-feed coordinate system shown in the teach pendant.
Example: “S/WORLD”
If “S/” is added, the singularity avoidance in jogging is enabled. If “S/” is not added, the singularity avoidance in jogging is disabled. Enabled/disabled is automatically determined at power on depending on the selected program.

In order to select enabled/disabled, refer to the following procedure.

Procedure 15-1 Select enabled/disabled of singularity avoidance in jogging

Step

1 Press the [FCTN] key, and select “T/Singularity JOG” to toggle enabled/disabled of singularity avoidance in jogging.

15.1.2 How to Use Singularity Avoidance in TPE Program

Enabled/disabled of singularity avoidance in TPE program can be selected for each program. When a new TPE program is created, the enabled/disabled of the program is automatically determined depending on the enabled/disabled status of singularity avoidance in jogging. Please note that in the case that the user loads a TPE program which is saved before the singularity avoidance option is added or is saved in the system which does not have the singularity avoidance option, the singularity avoidance is disabled for the TPE program.

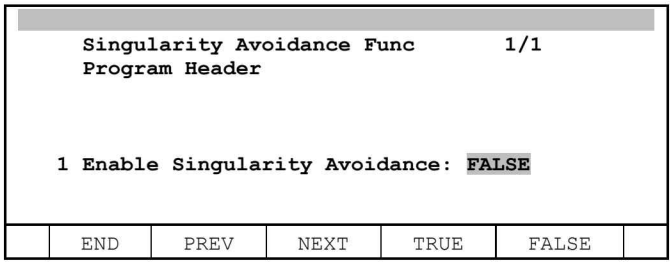
In order to select enabled/disabled for each program, refer to the following procedure.

Procedure 15-2 Select enabled/disabled of singularity avoidance in program

Step

1 In the program select screen, move the cursor to the program and press the F2, DETAIL key to enter the detail screen.

2 Press the F3, NEXT key, and the following screen will be displayed. (This screen shows the singularity avoidance is disabled.)



3 In order to enable the singularity avoidance, press the F4, TRUE. In order to disable the singularity avoidance, press the F5, FALSE.

15.2 LIMITATIONS

Singularity avoidance function has the following limitations.

- This function is supported only in Handling Tool.
- Some robot models does not support this function.
- This function cannot be ordered with Coordinated motion option.
- This function cannot be used with Line tracking option.
- This function cannot be used with Continuous turn option.
- This function cannot be ordered with Shape GenerationII option.
- This function can be used only for linear motion. This function cannot be used for Circular/Arc motion.

15.3 CAUTIONS

Keep the following important information in mind when you set up and use singularity avoidance.

- With the singularity avoidance function, actual wrist configuration (flip/nonflip) might be different from the taught destination positions. The function might change configuration internally not only for the destination position in the motion line where singularity is detected but also for the subsequent destination positions in the following motions in the TP program.
- Since the function will change configuration internally, single step forward and backward might produce different behavior. To prevent the above from happening, during single step forward motion, the system will post a warning message "MOTN-208 Config Not Reached" at the point where the actual configuration is different from the taught one. By observing the message, the user should re-touch up the taught point at the specific line shown in the warning message this will update the taught configuration to the actual configuration. As a result, when stepping backward, the motion will behave the same way as stepping forward.
- Jogging and program motion might be different when the robot moves near singularity.
- If the destination position is inside singularity zone, the taught position is changed.
- The function might not help for the singularity at the corner path.