

The Research and Realization of Track interpolation based on the point-to-point comparison method of CNC in Scilab

Huang Bin
Information Center
Guizhou University
Guiyuan, China
bhuan@gzu.edu.cn

Xie Xiaoyao
Key Laboratory of
Information and
Computing Science of
Guizhou Province
Guiyuan, China
xyx@gznu.edu.cn

Gao Jianling
Information Center
Guizhou University
Guiyuan, China
jlgao@gzu.edu.cn

Abstract

Track interpolation is the core technology in CNC. Though from the theory of NC machining, Track interpolation is the way which departs the basic NC curve into the least square movement amount which is needed by the movement of NC machine tool, because the processing must densify the coordinate points along the given curve. It not only needs high precision but also it should be finished in short time. So, it's very difficult. So since the invention of NC technology, the research of track interpolation never has stopped. All interpolation algorithms have been various. The paper introduces the circular arc interpolation in classic point-to-point comparison method and its realization in Scilab.

Track interpolation of point-to-point comparison method

Point-to-point comparison method is to compare the working point with the given figures track in every step to decide the direction of next feeding. It makes the working track approximation the given figures track. Track interpolation of point-to-point comparison method is to compare the distance of working point to center of a circle with radius of working circular arc. According to result of departure, we know the working point is within or out of the working circular arcs and set the next feeding direction to approximation working circular arc.

(1) judgement of departure

Any working point $P_i(X_i, Y_i)$ in first quadrant, discriminant of departure of circular arc interpolation is: $F_i = X_i^2 + Y_i^2 - R^2$

If $F_i = 0$, working point is on circular arc; if $F_i > 0$, working point is out of circular arc; if $F_i < 0$, working point is within circular arc.

(2) Recurrence computation of counter-clockwise of first quadrant

If $F_i \geq 0$, feeding a step towards $-X$ direction.

Coordinate of new working point is: $X_{i+1} = X_i - 1$

New departure is: $F_{i+1} = (X_i - 1)^2 + Y_i^2 - R^2 = F_i - 2X_i + 1$

If $F_i < 0$, feeding a step towards $+Y$ direction

Coordinate of new working point is: $Y_{i+1} = Y_i + 1$

New departure is: $F_{i+1} = X_i^2 + (Y_i + 1)^2 - R^2 = F_i + 2Y_i + 1$

Circular arc interpolation of other quadrant (clockwise or counter-clockwise) function of departure can follow this method.

(3) judgement of end point

Judging from the total steps Σ according to direction of X , Y coordinate points, as $\Sigma = |X_e - X_0| + |Y_e - Y_0|$. Calculating $\Sigma - 1$ every step. When $\Sigma = 0$, it's destination.

General idea of any two points of circular arc interpolation

(1) Calculate the total steps according to the inputting coordinate of starting point and end point and set count = 0.

(2) Judging whether or not the count is less than total steps, being fit then moved to 3, not being fit then moved to 4.

(3) According to the result of interpolation departure and direction of travel, it is calculated in formula to get the interpolation direction.

(4) Finishing interpolation.

Realization in Scilab

Scilab is a scientific software package for numerical computations providing a powerful open computing environment for engineering and scientific applications. Scilab is an open source software. The main window of Scilab is the computing platform of human-computer interaction. User can solve some simple questions by using command. But when solving big problems, using script file is very necessary. So firstly set a interpolation function. It using the formula to realize the interpolation of circular arcs of any two points and plot2d function draw all interpolation track. Editing a script file to call the interpolation function. The script file includes setting user's inputting starting point of circular arcs and end point and interpolation direction and etc.

Result

Interpolation computation of cutter has important position in CNC software. The realization of track interpolation based on the point-to-point comparison method of CNC in Scilab has the feature of operating simply and having good vision. It's good for learners to study and understand CNC technology, and their study interest will be increased.

Key words: CNC, interpolation, point-to-point, Scilab