

Error criteria in stateline concept based contouring system

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Key Words : Stateline( ), Error Criteria( 가 ), Jerk( ), Interpolation( )

Abstract

This paper examines the interpolation algorithms and error criteria using stateline based control architectures that is proposed in the University of British Columbia. The main purpose of this paper is checking the influences of jerk in error criteria and judging several interpolation algorithms that are used for positioning. The performance of the extended error criteria and interpolation algorithm are demonstrated by simulation. It is found that a slight improvement was achieved by applying jerk in the error checking criteria and that spline interpolation yields stable result.

1.

2.

Tomizuka[1]

Weck

가

Ye[2]

2.1 UBC

Koren [3]

British Columbia)

가 Fig. 1

UBC(University of

가

stateline

stateline

stateline

(AND)

low

high

stateline

high

가

jerk

가

CPU

CPU

가

가

†

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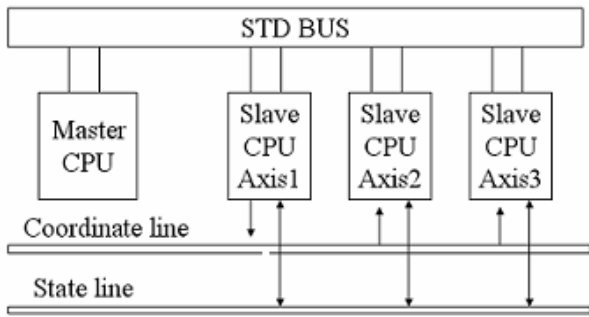


Fig. 1 UBC controller architecture

2.2

가 Fig. 2  
(ramp)

(steady-state

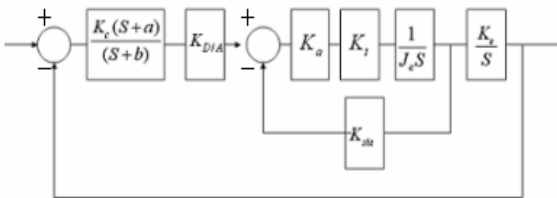
lag)

$$\phi = \frac{b K_{sta}}{a K K_e} \quad (1)$$

$$K_e: \quad K_{sta}: \quad K = K_c K_{D/A}$$

$$K_c: \quad K_{D/A}: D/A$$

a, b:



$$K_a: \quad K_t:$$

Fig. 2 Block diagram of the servo system

2.3

(interpolation algorithm)

CPU

가

가

가

가

가

Yellowley

Pottier[4]가

가

가

CPU 가 63Hz( 16ms

)

CPU 가 2,000Hz (

0.5ms

32

Yellowley  
(2)

Pottier[4]가

(3)

가

(4)

$$x = X_i + [X_{i+1} - X_i] \frac{t}{\Delta t} \quad (2)$$

$x: t$

$X_i:$

$\Delta t$  CPU

$t \quad 0 \leq t \leq \Delta t$

$$x = X_i + [X_{i+1} - X_i] \frac{t}{\Delta t} + \frac{[X_{i+2} - X_{i+1} - X_i + X_{i-1}]}{2\Delta t^2} \left( \frac{t^2}{2} - \frac{\Delta t}{2} t \right) \quad (3)$$

$$x = X_i + [X_{i+1} - X_i] \frac{t}{\Delta t} + \frac{[X_{i+1} - 2X_i + X_{i-1}]}{\Delta t^2} \left( \frac{t^2}{2} - \frac{\Delta t}{2} t \right) \quad (4)$$

$$V(t) = \frac{1}{2\Delta t} [(X_{i+1} - X_{i-1}) + (X_{i+2} - X_{i+1} - X_i + X_{i-1}) \frac{t}{\Delta t}] \quad (5)$$

$$\Delta E(t) = K_{ve} V(t) + K_{ac} A(t) = K_{ve} (V_{i+1} - V_i) + K_{ac} \frac{V_{i+1} - V_i}{N_f T_s}$$

$N_f:$

(6)

$V_i: i$

$T_s:$

$K_{ve}: 가$

$K_{ac}: 가$

3.

가

3.1

stateline

가

(5)

$$|E| \leq \left| K_{ve} V_i^s \right| + \delta_{static} \quad (7)$$

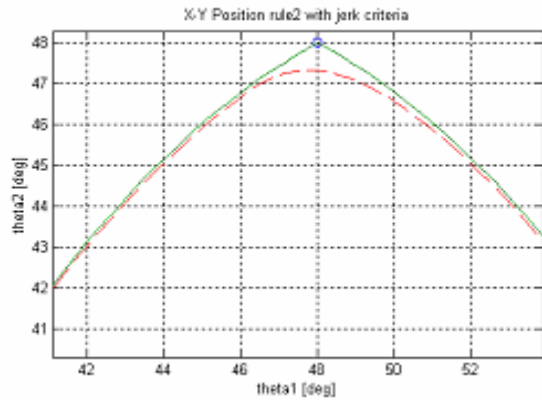
$\delta_{static}:$

3.2 stateline

stateline 가  
stateline 가

(6)

[7] 가 (Rule 2)  
가 jerk  
( Rule 2)



(b)

Fig. 3 Sharp corner tracking: (a) Rule 2, -, reference position, --, actual position  
(b) jerk applied Rule 2, -, reference position --, actual position

Rule 2

$$\left| E + K_{ve}(I_{i+1}V_{i+1}^s - I_iV_i^s) + K_{ac} \frac{I_{i+1}V_{i+1}^s - I_iV_i^s}{N_f T_s} \right| \leq \left| K_{ve} I_{i+1}V_{i+1}^s \right| + \delta_{static}$$

Rule 2:

jerk

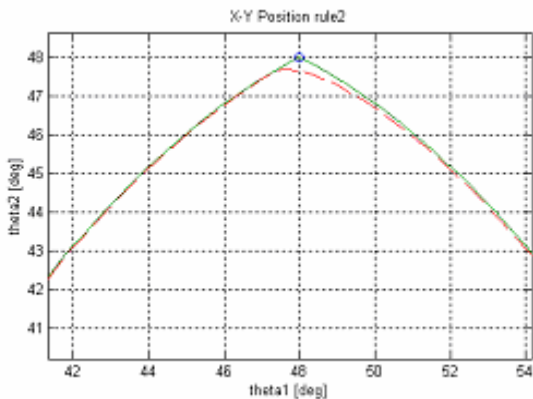
$$\left| E + K_{ve}(I_{i+1}V_{i+1}^s - I_iV_i^s) + K_{ac} \frac{I_{i+1}V_{i+1}^s - I_iV_i^s}{N_f T_s} + K_{je} \left( \frac{I_{i+2}V_{i+2}^s - I_{i+1}V_{i+1}^s}{N_f T_s} - \frac{I_iV_i^s - I_{i-1}V_{i-1}^s}{N_f T_s} \right) \right| \leq \left| K_{ve} I_{i+1}V_{i+1}^s \right| + \delta_{sta}$$

$K_{je}$  : jerk

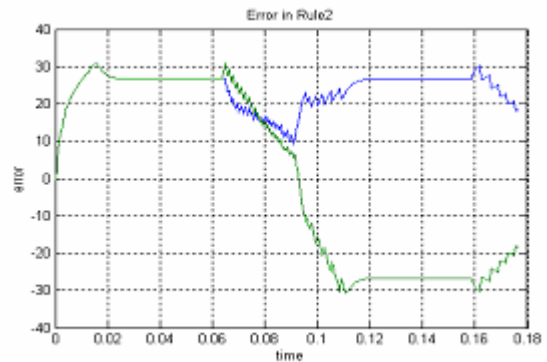
4. SIMULATION

4.1 Jerk

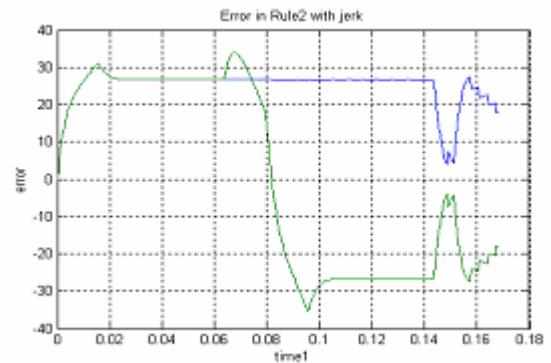
Jerk 가  
Rule2 Rule2 가  
jerk 가



(a)



(a)



(b)

Fig. 4 Sharp corner tracking error: (a) Rule 2, axis error (b) jerk applied Rule 2, axis error

4.2 Interpolation

(2)- (4)

(2)-(4)

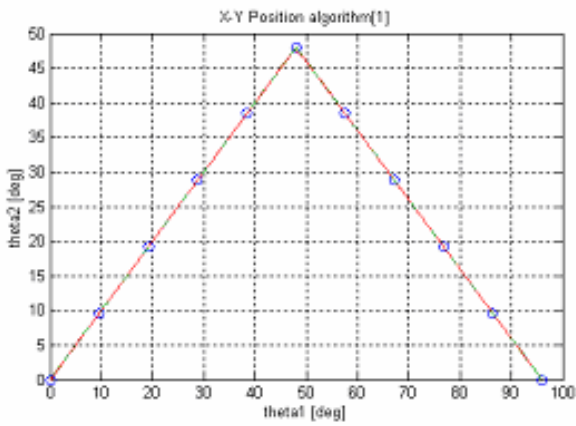
(3), (4)

가

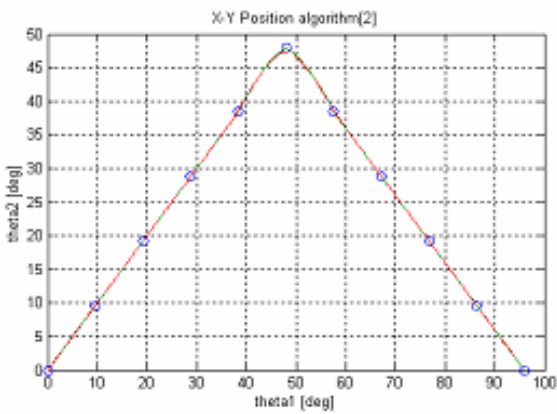
(2) ,

(2), (4)

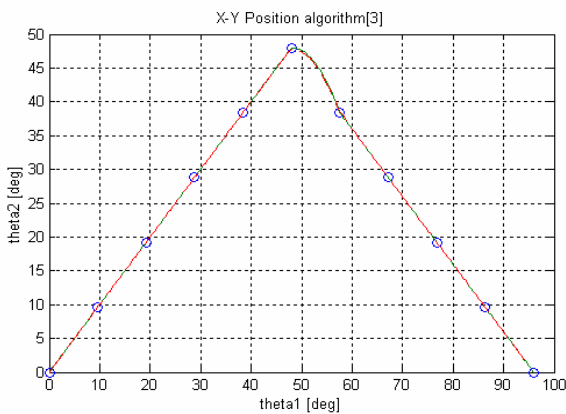
가 가  
가



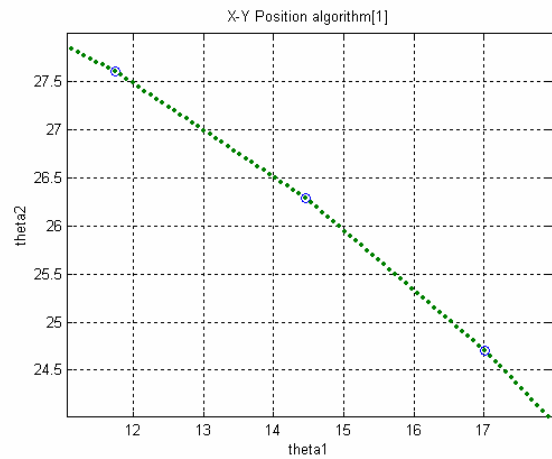
**Fig. 5** Corner tracking (2): o, reference position (master), ., reference position (2nd stage interpolation), .., actual position



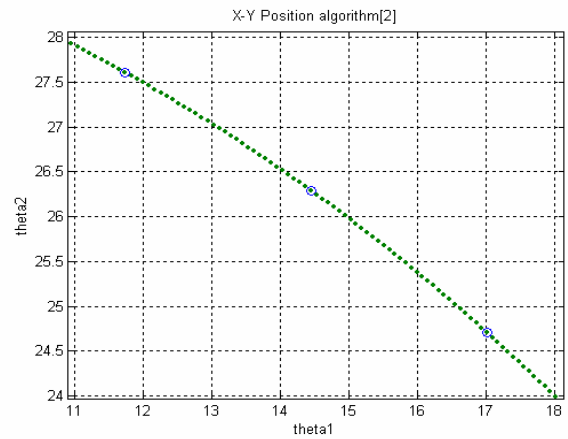
**Fig. 6** Corner tracking (3): o, reference position (master), ., reference position (2nd stage interpolation), .., actual position



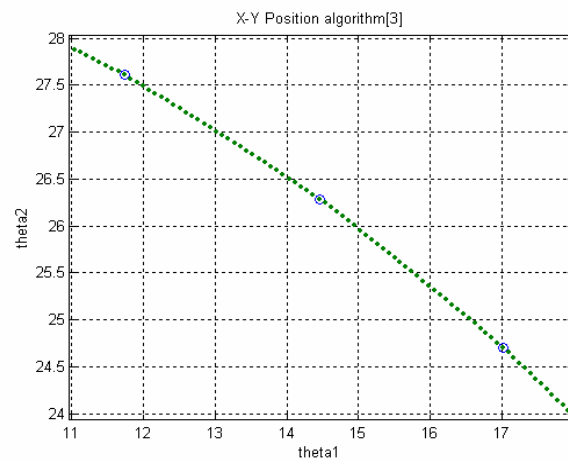
**Fig. 7** Corner tracking (4): o, reference position (master), ., reference position (2nd stage interpolation), .., actual position



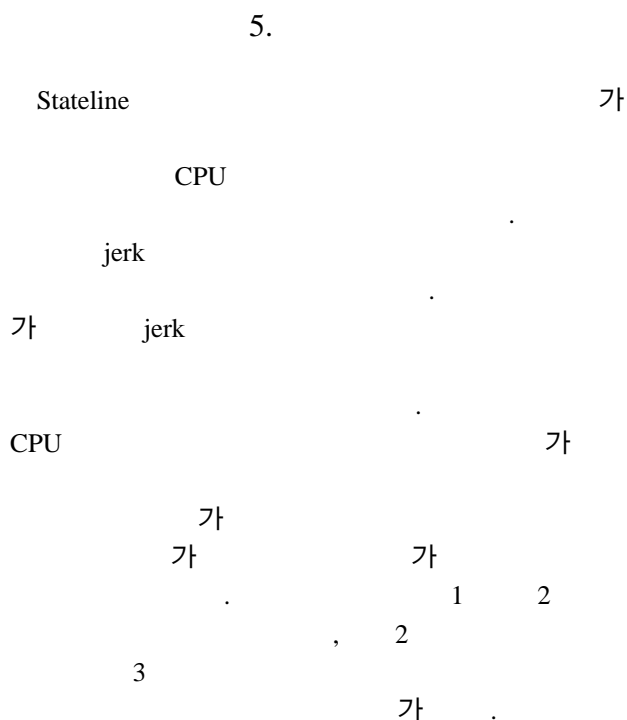
**Fig. 8** Circle tracking (2): o, reference position (master), ., reference position (2nd stage interpolation)



**Fig. 9** Circle tracking (3): o, reference position (master), ., reference position (2nd stage interpolation)



**Fig. 10** Circle tracking (4): o, reference position (master), ., reference position (2nd stage interpolation)



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