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Report CNC Parametric Curve Interpolation and Trajectory Tracking
Part 5 of 5 Ribbon-10L and Ribbon-100L (x-y) parametric curves

ITEM	DESCRIPTION	RIBBON-10L CURVE					RIBBON-100L CURVE				
1	Run user feedrate command (mm/s)	FC10	FC20	FC25	FC30	FC40	FC10	FC20	FC25	FC30	FC40
2	Total interpolated u-points	7351	7352	7352	7353	7353	7480	7348	7349	7349	7350
3	Parameter completion (reached u-end)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Pushdown epsilon eps(u) algorithm										
4	Count before pushdown, eps(u) is below (1E-6)	0	0	0	0	0	919	0	0	0	0
5	Count pushdown points, eps(u) to below (1E-6)	7351	7352	7352	7353	7353	6561	7348	7349	7349	7350
	Epsilon eps(u) chord error										
6	Count eps(u) above (1E-6)	0	0	0	0	0	0	0	0	0	0
7	Count eps(u) in (1E-7, 1E-6)	7351	7352	7352	7353	7353	7480	7348	7349	7349	7350
8	Count eps(u) in (1E-8, 1E-7)	0	0	0	0	0	0	0	0	0	0
9	Count eps(u) in (1E-9, 1E-8)	0	0	0	0	0	0	0	0	0	0
10	Count eps(u) in (1E-10, 1E-9)	0	0	0	0	0	0	0	0	0	0
11	Count eps(u) below (1E-10)	0	0	0	0	0	0	0	0	0	0
	Count interpolated u-points										
12	Count_rising_S_curve u-points	370	370	370	370	370	436	370	370	370	370
13	Count_frate is_lower than fratelimit	3491	3310	3310	3308	3309	5562	3939	3733	3545	3307
14	Count_frate is_equal to fratelimit	0	0	0	0	0	0	0	0	0	0
15	Count_frate is_higher than fratelimit	3121	3303	3303	3305	3305	1047	2670	2877	3065	3303
16	Count_falling_S_curve u-points	369	369	369	370	369	435	369	369	369	370
	Count u-points histogram (G01 codes)										
17	Count u-points [0.00 <= u < 0.10)	749	749	749	749	749	815	748	748	748	749
18	Count u-points [0.10 <= u < 0.20)	791	792	792	792	792	791	792	792	792	791
19	Count u-points [0.20 <= u < 0.30)	795	794	794	794	794	794	794	794	794	794
20	Count u-points [0.30 <= u < 0.40)	711	711	711	711	712	711	711	711	711	711
21	Count u-points [0.40 <= u < 0.50)	629	629	629	630	629	629	628	629	629	629
22	Count u-points [0.50 <= u < 0.60)	629	630	630	629	629	628	629	628	629	629
23	Count u-points [0.60 <= u < 0.70)	711	711	711	711	711	711	711	712	711	711
24	Count u-points [0.70 <= u < 0.80)	794	794	794	795	795	794	794	794	794	794
25	Count u-points [0.80 <= u < 0.90)	792	792	792	791	792	791	791	791	791	792
26	Count u-points [0.90 <= u <= 1.00]	750	750	750	751	750	816	750	750	750	750
27	Check Total u-points	7351	7352	7352	7353	7353	7480	7348	7349	7349	7350
	Performance										
28	Total curve error (sum of epsilon(u))	0.007332	0.007331	0.00733	0.007331	0.00733	0.007227	0.007334	0.007335	0.007334	0.007334
29	Total dist traversed (sum of chord lengths)	15.2108	15.21069	15.20945	15.21391	15.21192	152.0974	152.1029	152.1321	152.1103	152.1394
30	Percent (Tot curve error / Tot dist traversed)	0.048201	0.048194	0.048195	0.048185	0.048187	0.004752	0.004822	0.004821	0.004821	0.00482

	Notes and remarks										
	Pushdown or reducing eps(u) algorithm means reducing chord length, thus reduces u_next and so results in generation of more interpolated u-points. See row Item(7). None of the eps(u) values exceed (1E-6).	See row Item(17) Count_frate is_higher than fratelimit. This count is about adjusting the current feedrate to follow the calculated feedrate_limit, and stay just below this feedrate limit. The calculated net feedrate limit is the minimum of four(4) feedrate limit constraints which comprise:									
		(C1) Absolute constraint not to exceed the user feedrate command, example FC20 (20 mm/s),									
		(C2) Constrain the feedrate to stay within the velocity range (min, max) allowable for the CNC									
		(C3) Constraint the feedrate to have chord error eps(u) absolutely below tolerance (1E-6) mm, as it tracks the curve trajectory, See row Item(7).									
		(C4) Constraint feedrate such that the normal acceleration (not tangential) stay within the acceleration range (min, max) allowable for the CNC machine.									
		Note that, in order to achieve meeting all 4 (C1, C2, C3, and C4) constraints simultaneously, sometimes the current feedrate at point u maybe higher than fratelimit calculated for the point u. Our runs showed that these feedrate overshoots are typically below 0.001 % of the calculated fratelimit.									