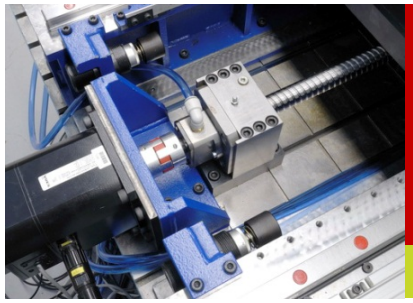

DEPARTMENT
OF PRODUCTION
MACHINES AND
EQUIPMENT

Comparison of interpolation types for toolpath creation using a CAM system

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8.2.2012

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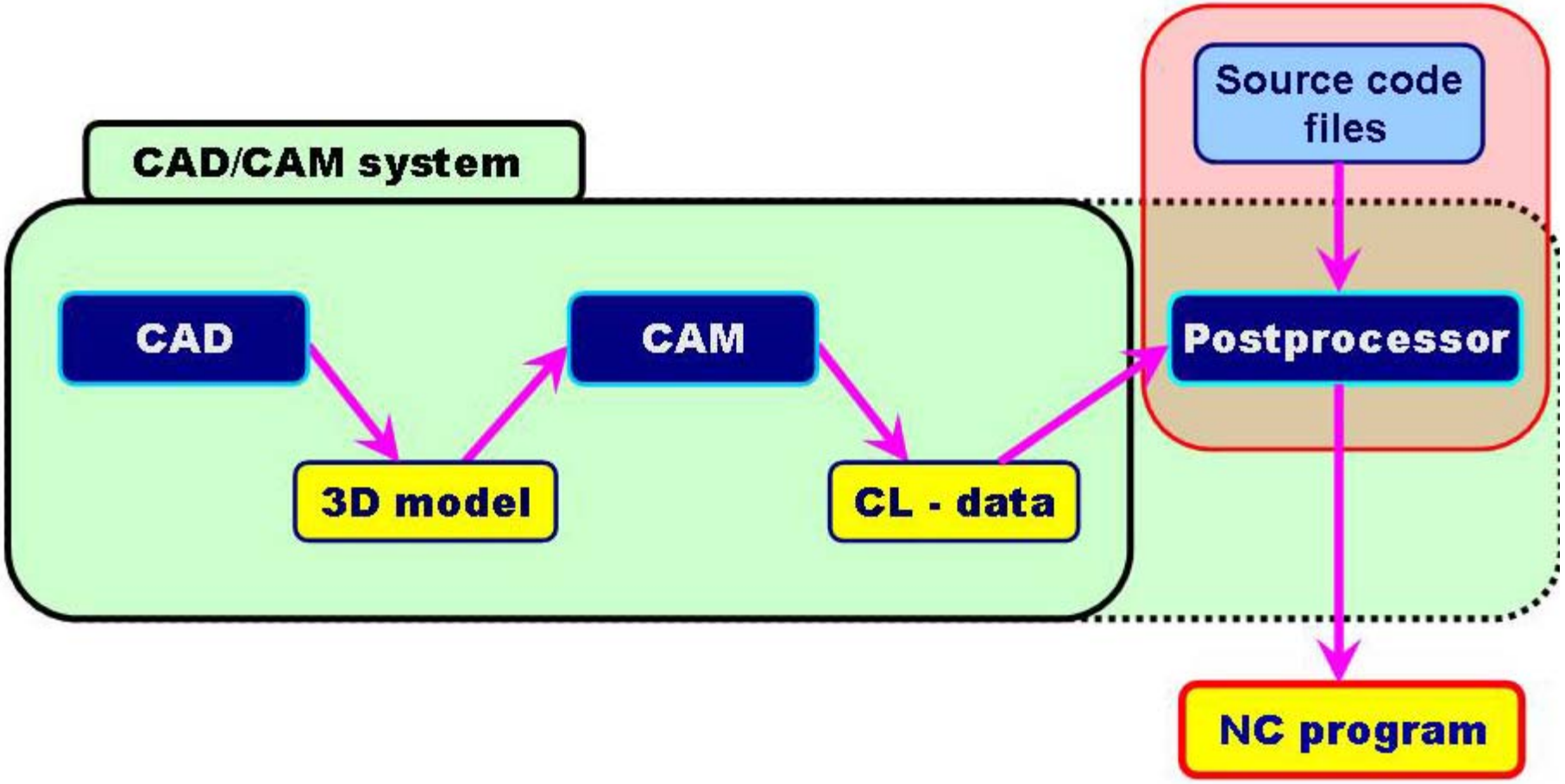
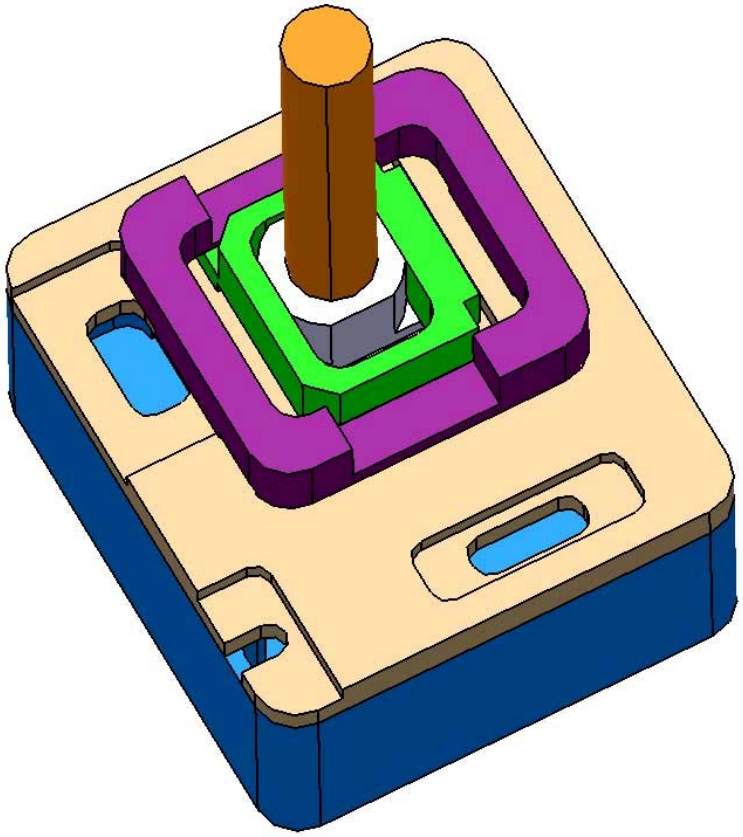
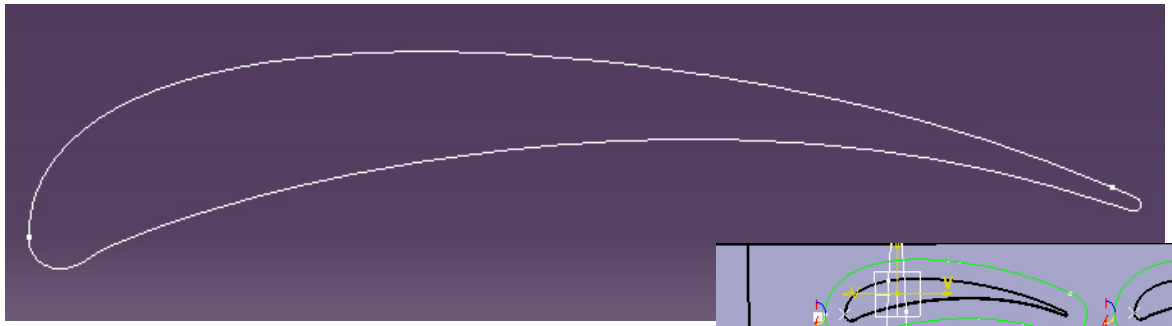
Introduction



Feed-rate measurement method

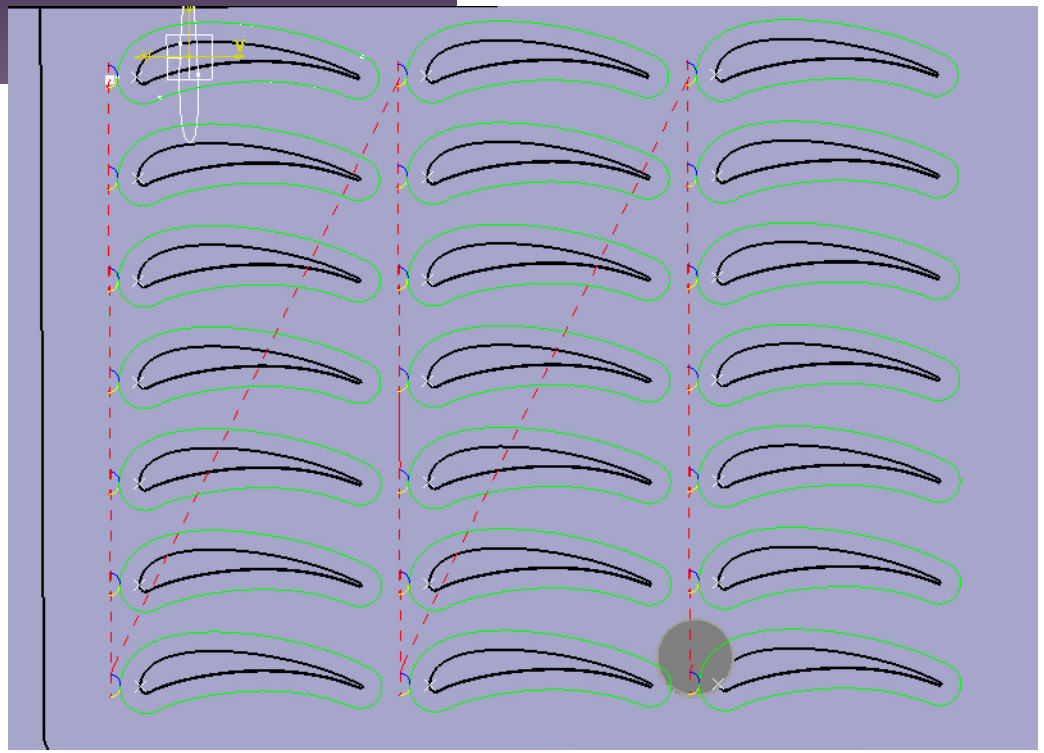


Testing part and toolpath creation



blade profile

toolpaths



Postprocessor

```
$$  End of generation of : Tool Change.17
$$ OPERATION NAME : Profile Contouring.46
$$  Start generation of : Profile Contouring.46
LOADTL/1,1
SPINDL/ 13000.0000,RPM,CLW
RAPID
GOTO  /   17.92919,  142.58062,  142.00000
RAPID
GOTO  /   17.92919,  142.58062,   -8.00000
FEDRAT/  4000.0000,MMPM
GOTO  /   17.92919,  142.58062,  -10.00000
INTOL /    0.00100
OUTTOL/    0.00000
AUTOPS
INDIRV/    0.00473,    0.99999,    0.00000
TLON,GOFWD/      (CIRCLE/     15.92921,    142.59009,    -10.00000,$
      2.00000),ON,(LINE/     15.92921,    142.59009,    -10.00000,$
                             15.93868,    144.59006,    -10.00000)
FEDRAT/  4000.0000,MMPM
INDIRV/   -0.99998,    0.00625,    0.00000
TLON,GOFWD/      (CIRCLE/     15.97927,    151.08505,    -10.00000,$
      6.49512),ON,(LINE/     15.97927,    151.08505,    -10.00000,$
                             15.48769,    144.60857,    -10.00000)
GOTO  /   15.23022,  144.63186,  -10.00000
GOTO  /   14.97350,  144.66199,  -10.00000
GOTO  /   14.74732,  144.69425,  -10.00000
GOTO  /   14.56122,  144.72510,  -10.00000
GOTO  /   14.32710,  144.76968,  -10.00000
GOTO  /   14.14120,  144.80971,  -10.00000
GOTO  /   13.91121,  144.86495,  -10.00000
GOTO  /   13.72901,  144.91326,  -10.00000
```

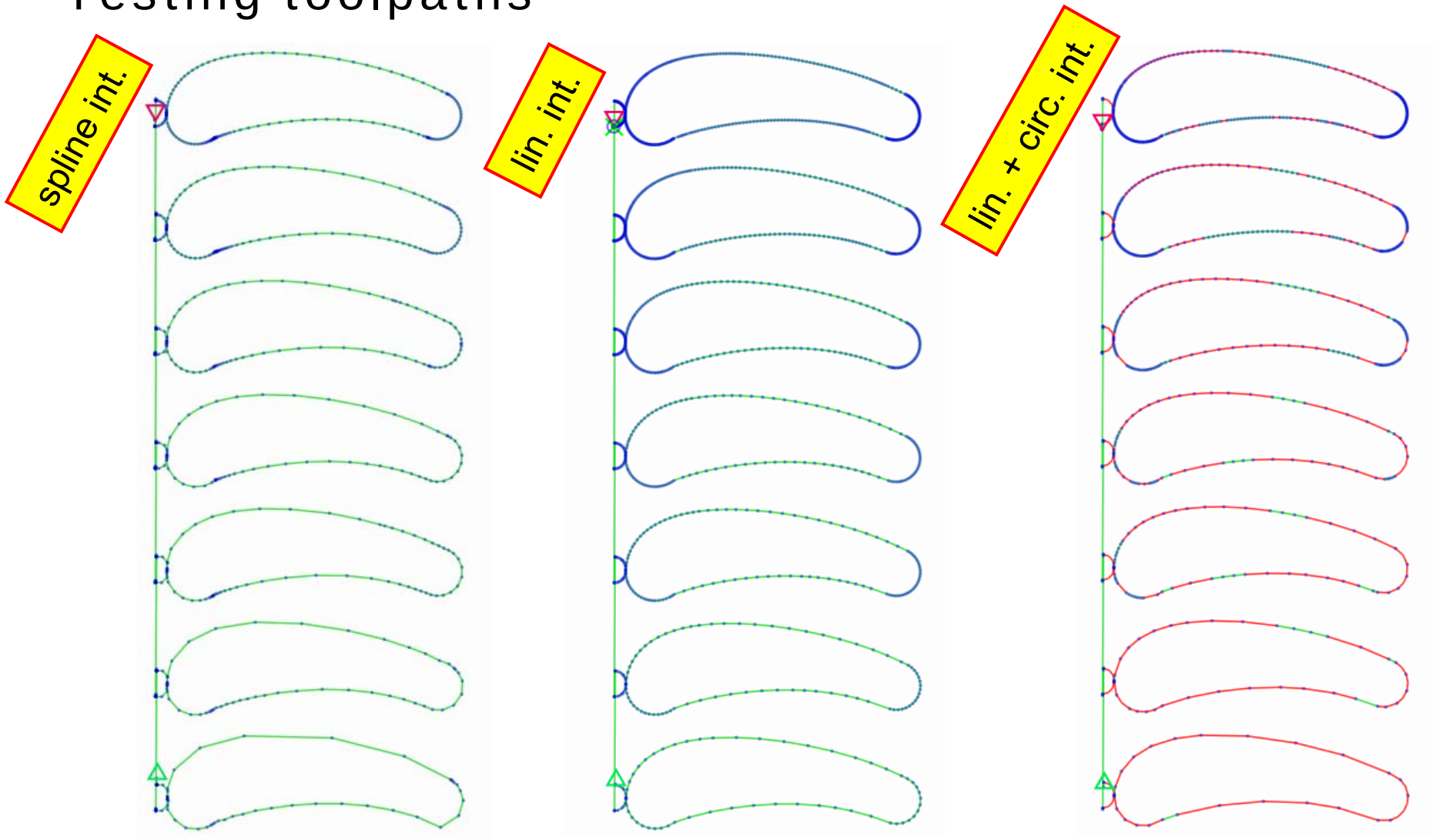
```
N45 soft
N50 ffwon
N55 R10=6000
N60 R11=4000
N65
N70 ; ========= VYMENA NASTROJE ========
N75 ; NASTROJ: FREZA D7.82 R0.00
N80 ; ================================
N85 T10 D01
N90 G56
N95 ; ================================
N100 ; OPERACE: Profile Contouring.46
N105 ; ================================
N110 S13000 M03
N115 G1 X17.929 Y142.581 F=R10
N120 Z142
N125 X17.929 Y142.581
N130 Z-8
N135 M08
N140 Z-10 F=R11
N145 G3 X15.939 Y144.59 I-2 J0.009
N150 G2 X15.488 Y144.609 I0.041 J6.495
N155 G1 X15.23 Y144.632
N160 X14.974 Y144.662
N165 X14.747 Y144.694
N170 X14.561 Y144.725
N175 X14.327 Y144.77
N180 X14.141 Y144.81
N185 X13.911 Y144.865
N190 X13.729 Y144.913
```

Postprocessor

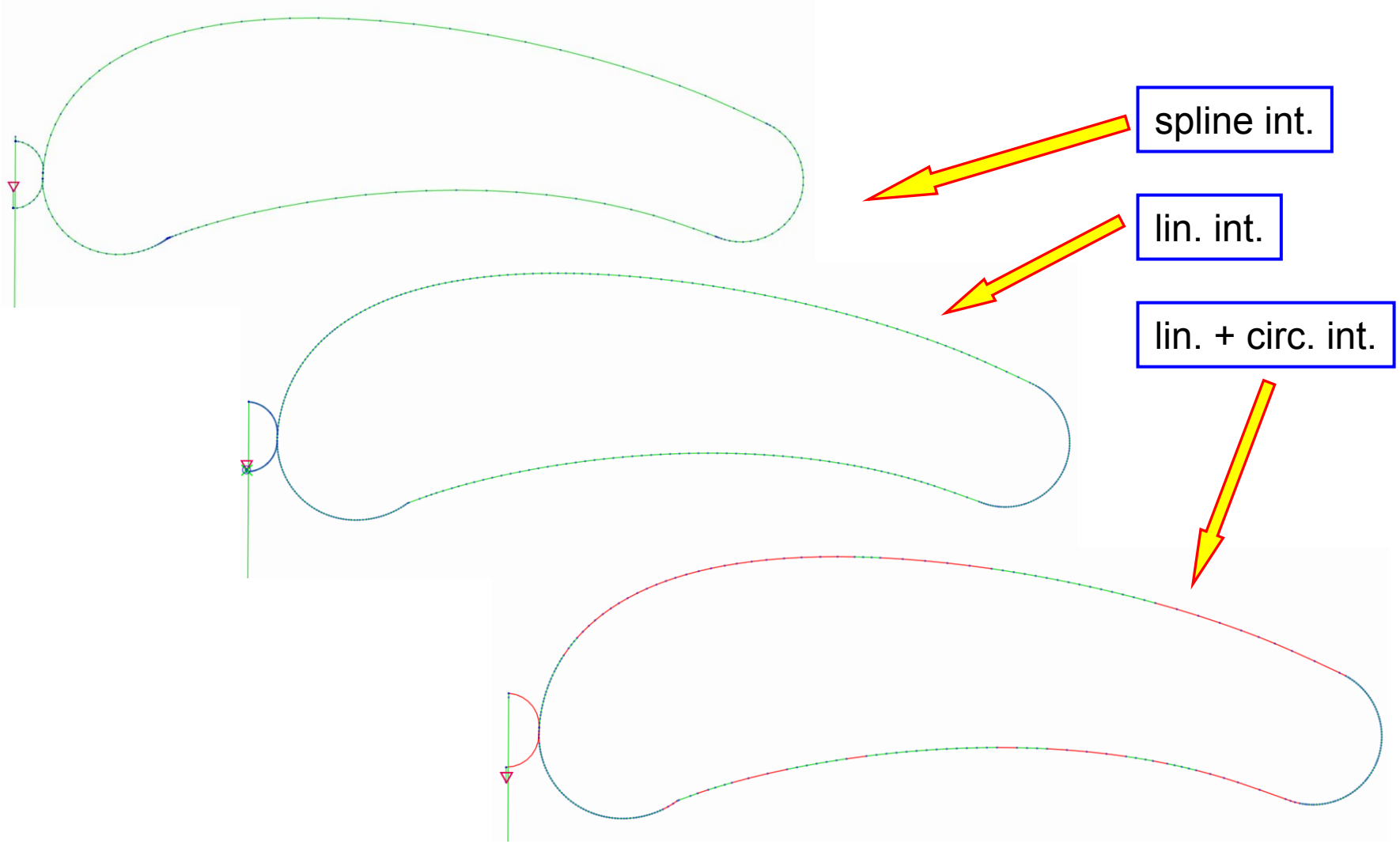
```
LOADTL/1,1
SPINDL/ 13000.0000,RPM,CLW
RAPID
GOTO  /   17.92919,   28.58062,  142.00000
RAPID
GOTO  /   17.92919,   28.58062,   -8.00000
FEDRAT/  4000.0000,MMPM
BEGIN NURBS_SIEMENS (D=3,F=4000.000,AXIS=    0.00000,    0.00000,    1.0$
0000)
N0, XT=   17.92919, YT=   28.58062, ZT=   -8.00000,DK=    0.00000,W=   $
 1.00000;
N1, XT=   17.92919, YT=   28.58062, ZT=   -8.66667,DK=    0.00000,W=   $
 1.00000;
N2, XT=   17.92919, YT=   28.58062, ZT=   -9.33333,DK=    2.00000,W=   $
 1.00000;
N3, XT=   17.92919, YT=   28.58062, ZT=  -10.00000,DK=    0.00000,W=   $
 1.00000;
END NURBS
BEGIN NURBS_SIEMENS (D=3,F=4000.000,AXIS=    0.00000,    0.00000,    1.0$
0000)
N0, XT=   17.92919, YT=   28.58062, ZT=  -10.00000,DK=    0.00000,W=   $
 1.00000;
N1, XT=   17.93086, YT=   28.84889, ZT=  -10.00000,DK=    0.00000,W=   $
 1.00000;
N2, XT=   17.85166, YT=   29.24362, ZT=  -10.00000,DK=    0.80445,W=   $
 1.00000;
N3, XT=   17.60723, YT=   29.69917, ZT=  -10.00000,DK=    0.37943,W=   $
 1.00000;
N4, XT=   17.37818, YT=   29.98402, ZT=  -10.00000,DK=    0.35983,W=   $
 1.00000;
N5, XT=   17.11219, YT=   30.21514, ZT=  -10.00000,DK=    0.35277,W=   $
 1.00000;
```

```
N45 soft
N50 ffwon
N55 R10=6000
N60 R11=4000
N65
N70 ; ========= VYMENA NASTROJE ========
N75 ; NASTROJ: FREZA D7.82 R0.00
N80 ; ================================
N85 T10 D01
N90 G56
N95 ; ================================
N100 ; OPERACE: Multi-Axis Curve Machining.16
N105 ; ================================
N110 S13000 M03
N115 G1 X17.929 Y28.581 F=R10
N120 Z142
N125 X17.929 Y28.581 M8
N130 Z-8
N135 G1 X17.92919 Y28.58062 Z-8.00000 F4000.0
N140 BSPLINE SD=3 F4000.0
N145 X17.92919 Y28.58062 Z-8.66667 PL=0.00000
N150 X17.92919 Y28.58062 Z-9.33333 PL=2.00000
N155 X17.92919 Y28.58062 Z-10.00000 PL=0.0
N160 BSPLINE SD=3 F4000.0
N165 X17.92919 Y28.58062 Z-10.00000 PL=0.00000
N170 X17.93086 Y28.84889 Z-10.00000 PL=0.00000
N175 X17.85166 Y29.24362 Z-10.00000 PL=0.80445
N180 X17.60723 Y29.69917 Z-10.00000 PL=0.37943
N185 X17.37818 Y29.98402 Z-10.00000 PL=0.35983
N190 X17.11219 Y30.21514 Z-10.00000 PL=0.35277
```

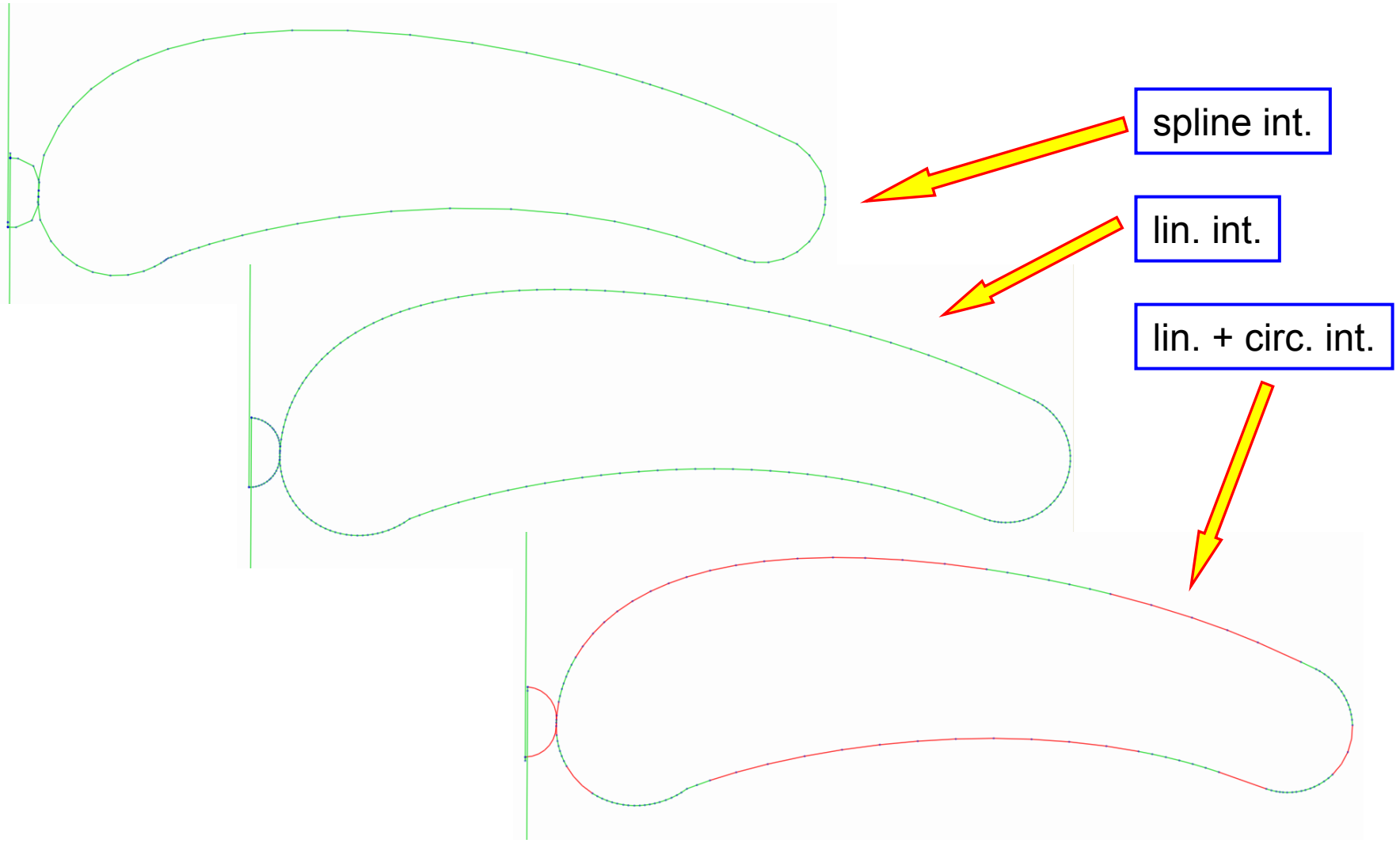
Testing toolpaths



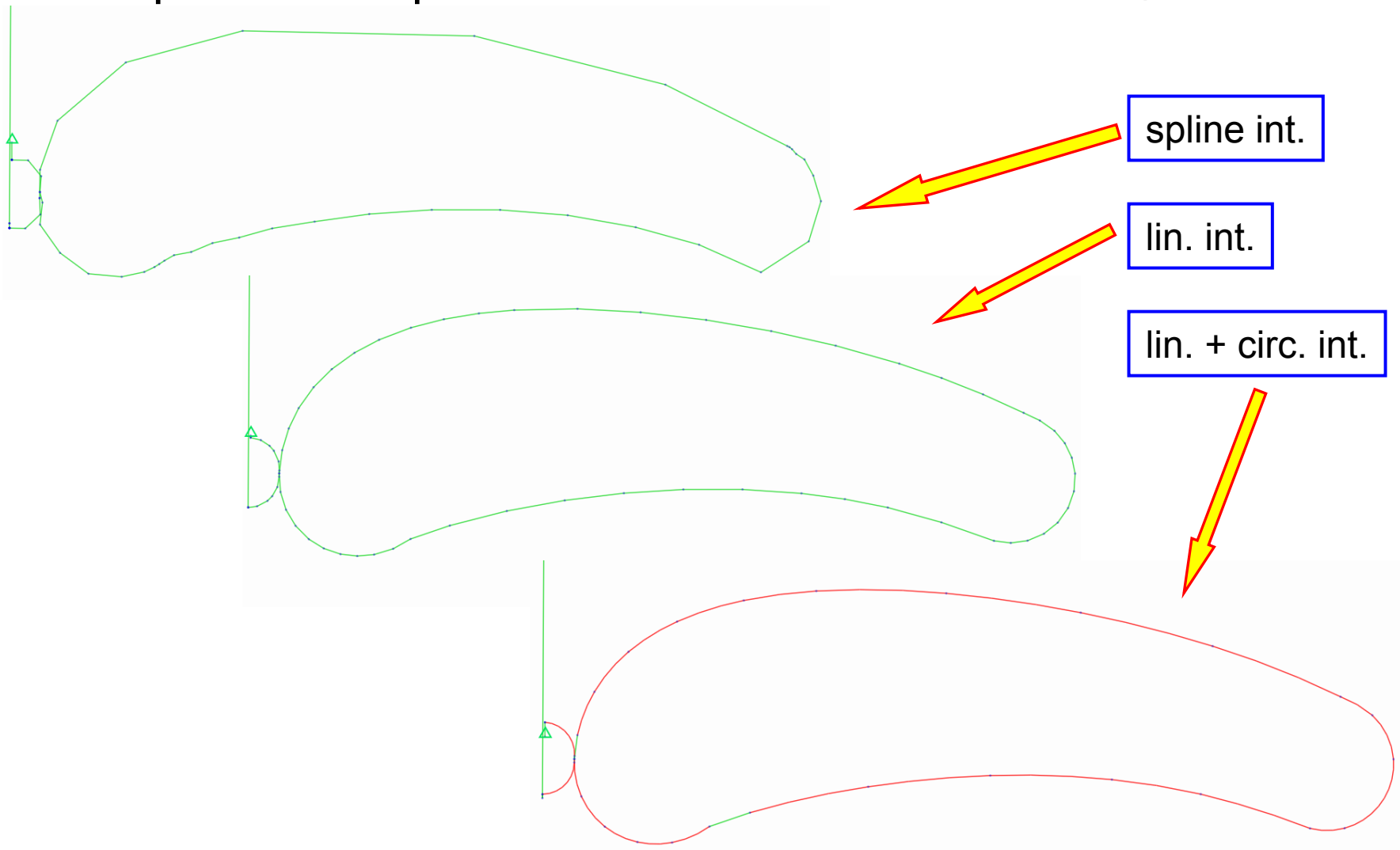
Toolpath computation tolerance value 0,002 mm



Toolpath computation tolerance value 0,016 mm

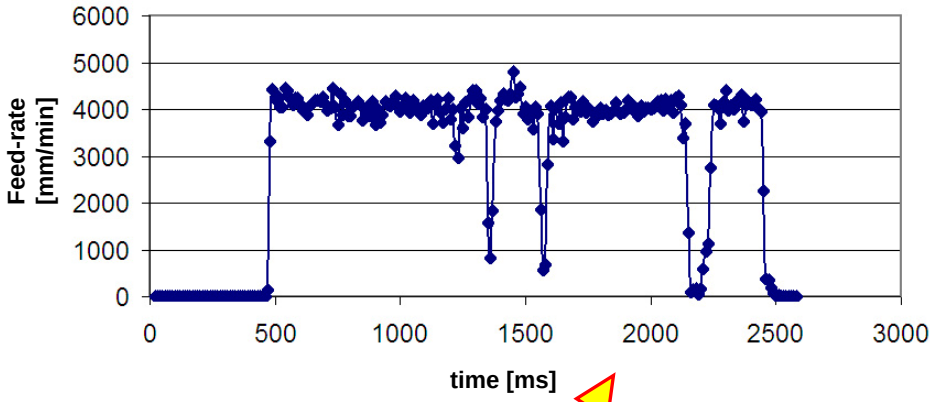


Toolpath computation tolerance value 0,08 mm

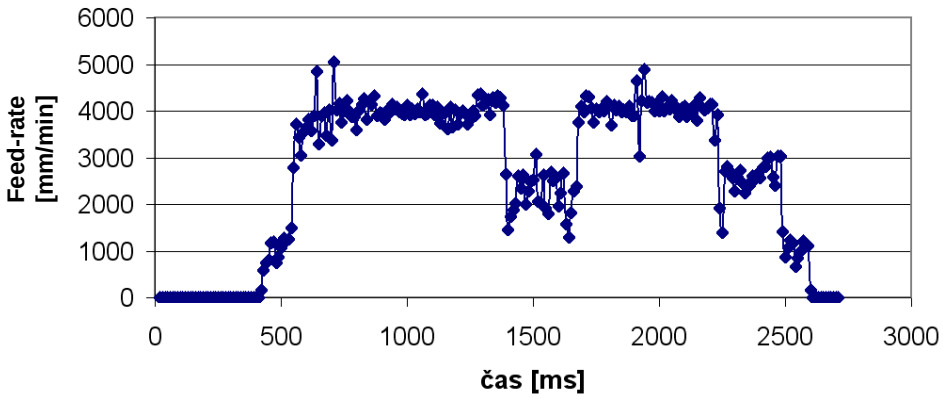


Toolpath computation tolerance value 0,002 mm

Characteristic of feed-rate



Characteristic of feed-rate

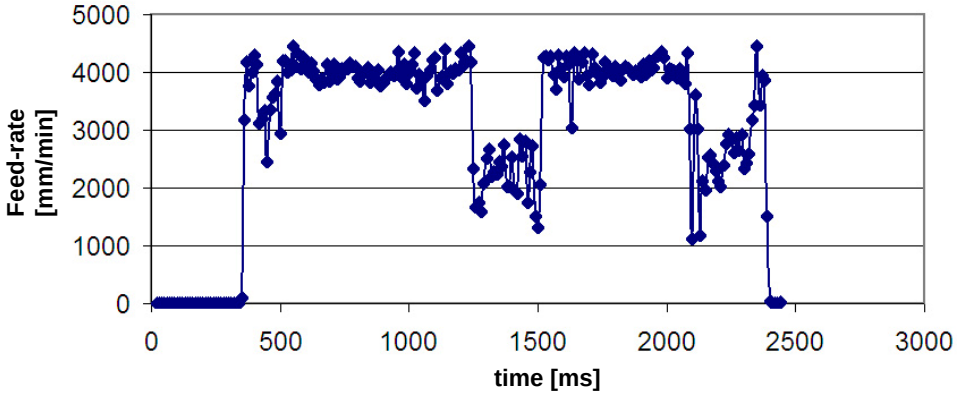


spline int.

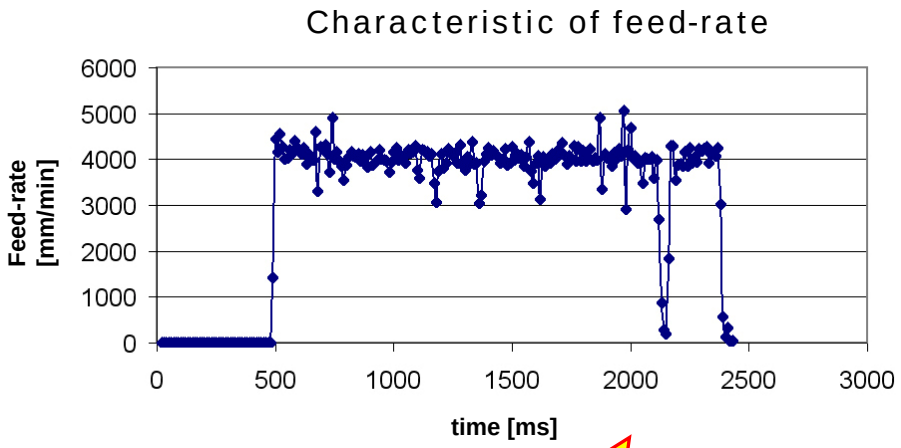
lin. int.

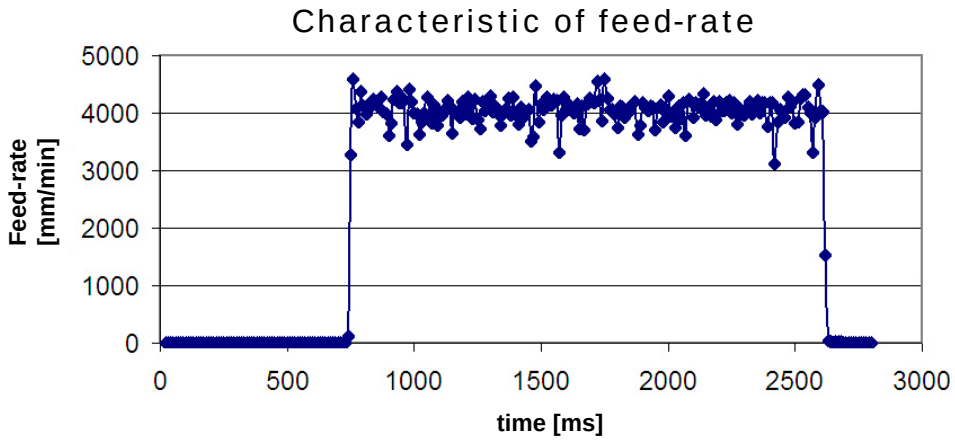
lin. + circ. int.

Characteristic of feed-rate



Toolpath computation tolerance value 0,016 mm

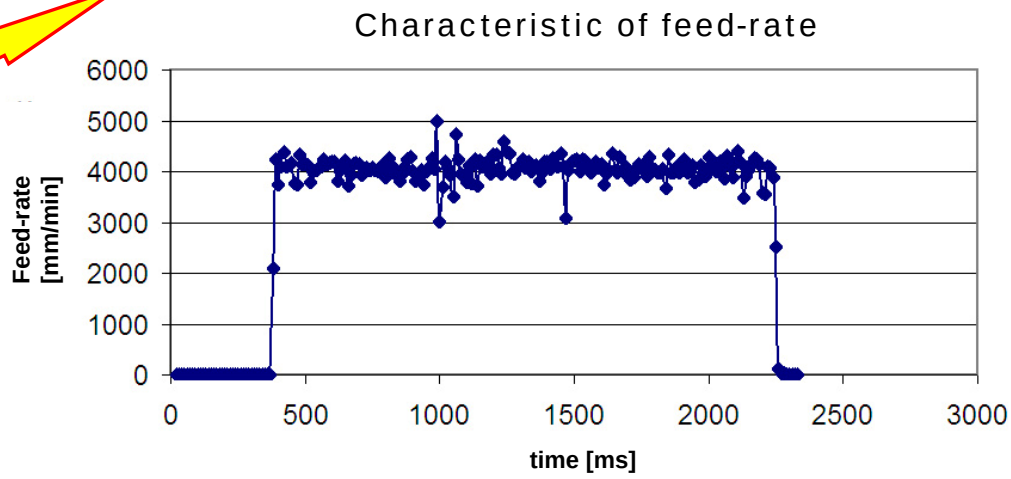




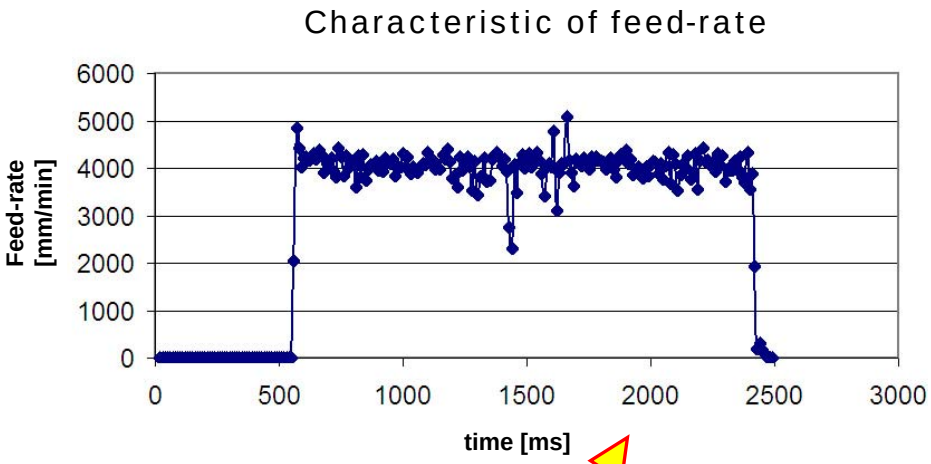
spline int.

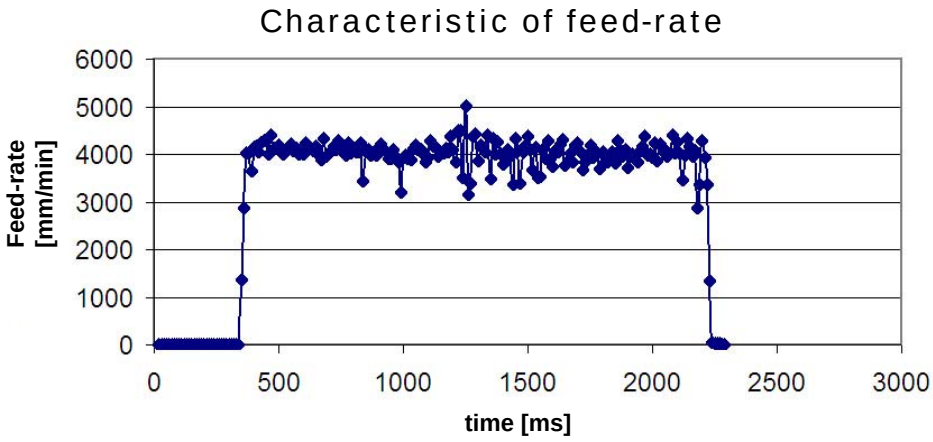
lin. int.

lin. + circ. int.



Toolpath computation tolerance value 0,08 mm

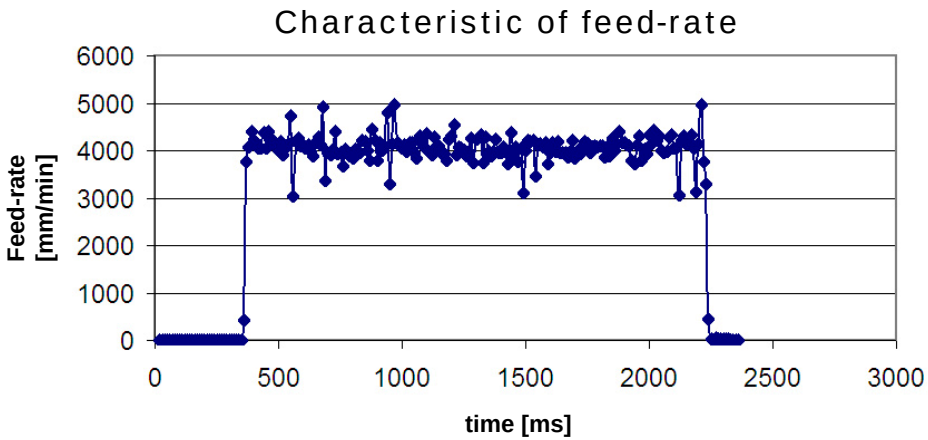




spline int.

lin. int.

lin. + circ. int.

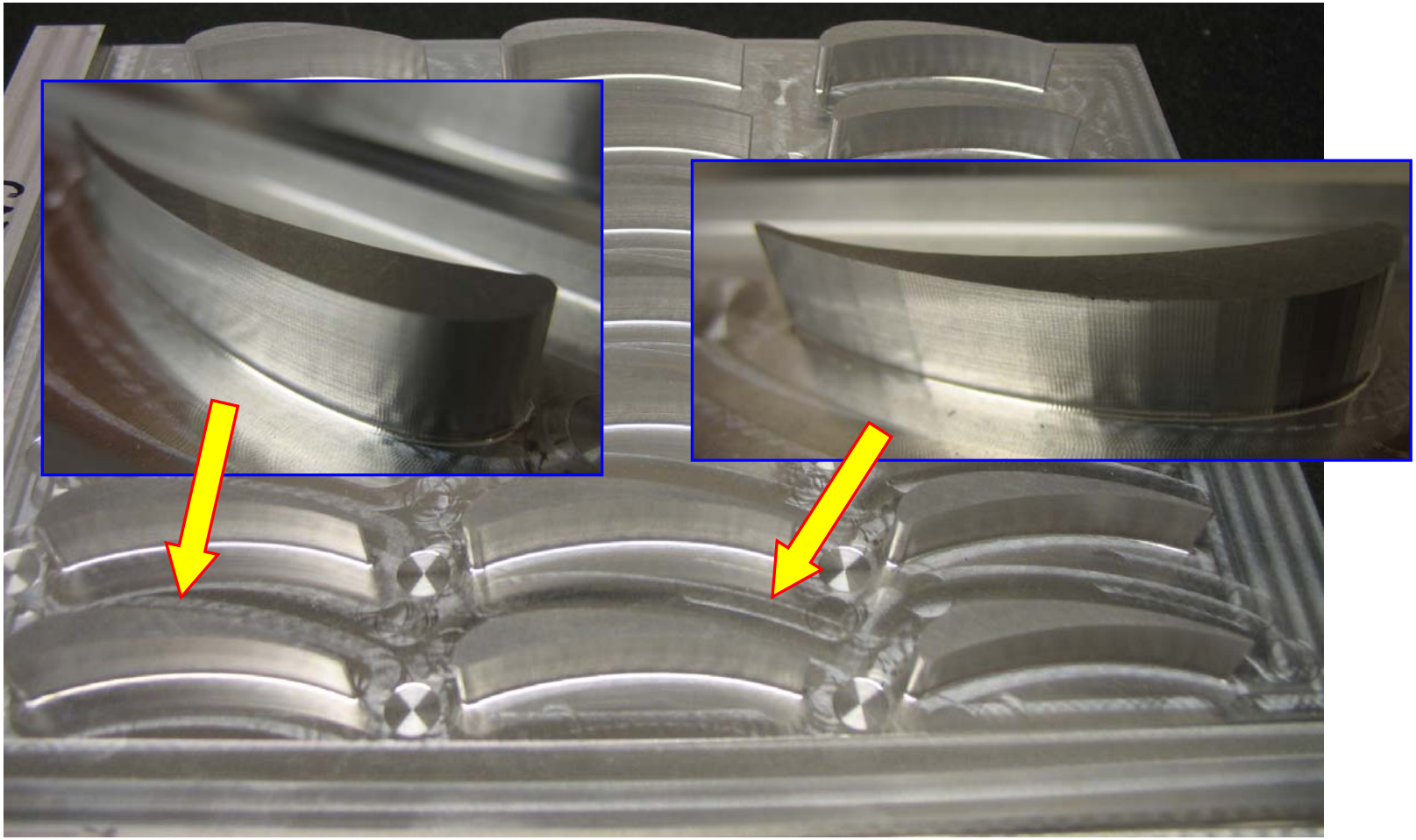


Number of NC blocks and machining time

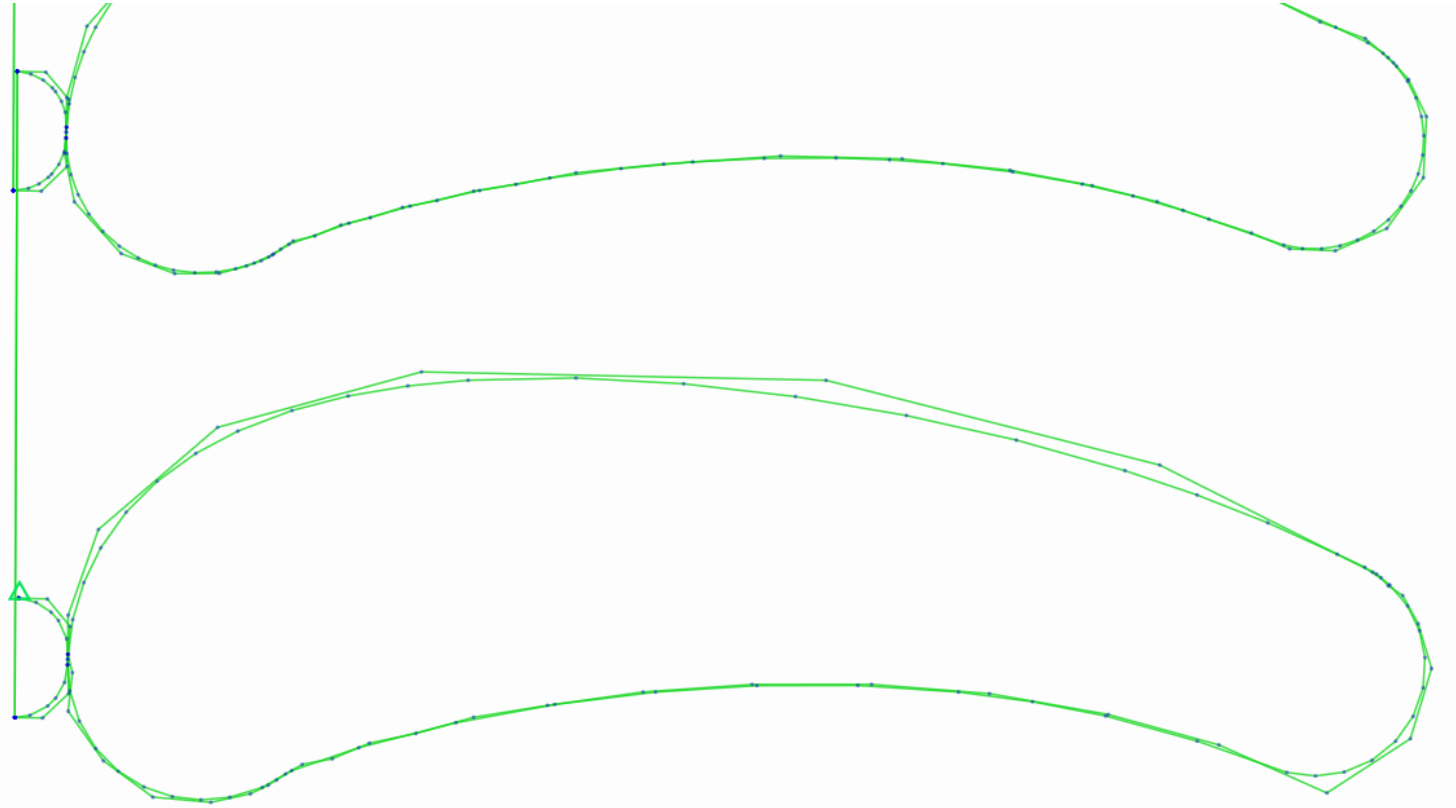
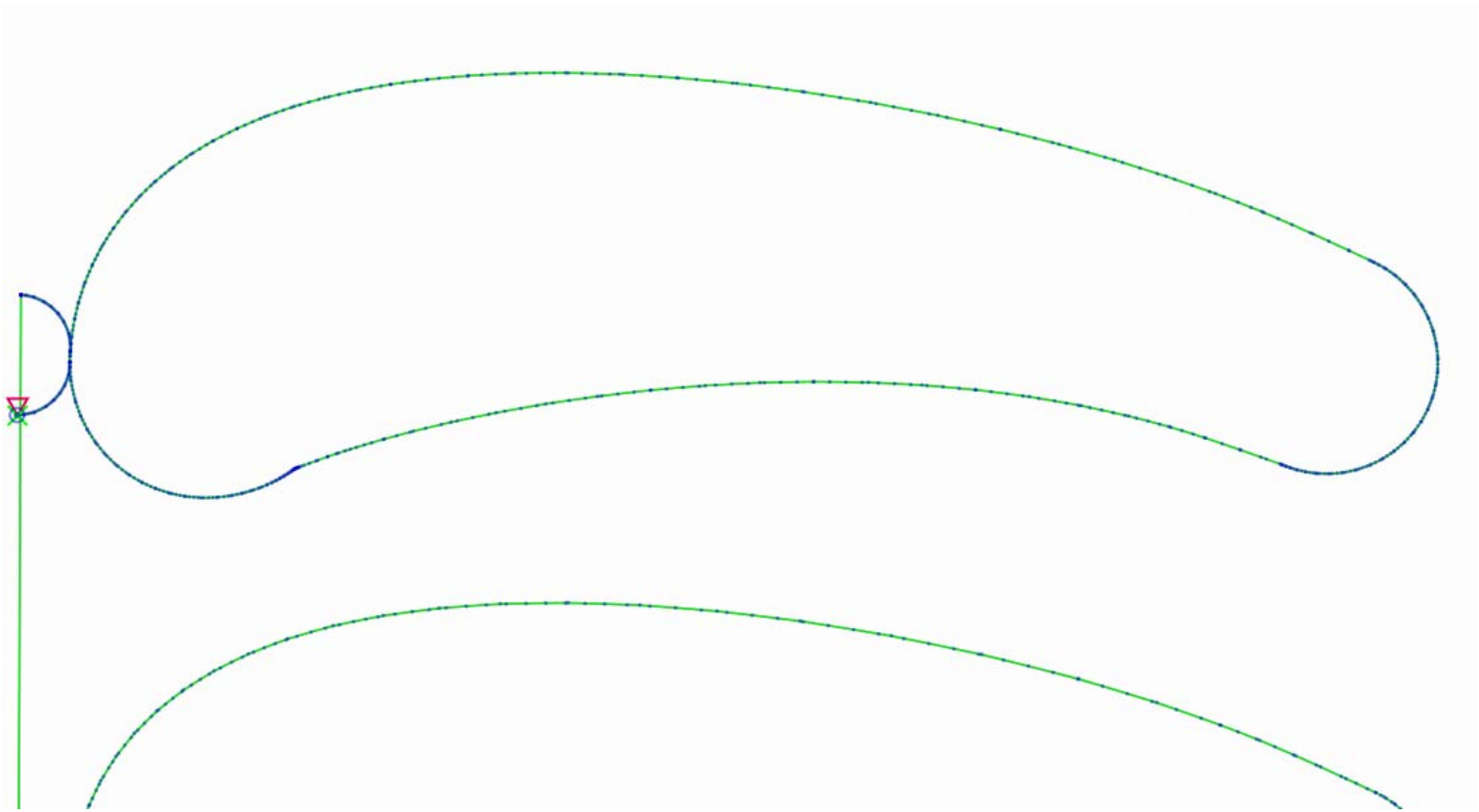
number of NC blocks [-]	toolpath computation tolerance value [mm]						
	0,002	0,004	0,008	0,016	0,02	0,04	0,08
linear interpolation	393	283	199	140	129	91	65
linear and circular interpolation	276 (209+67)	185 (132+53)	119 (76+43)	69 (29+40)	61 (27+34)	39 (8+31)	29 (4+25)
spline interpolation	163	124	92	72	73	60	49

machining time [ms]	toolpath computation tolerance value [mm]						
	0,002	0,004	0,008	0,016	0,02	0,04	0,08
linear interpolation	2200	2070	2000	1960	1930	1940	1940
linear and circular interpolation	1950	1940	1900	1920	1930	1900	1910
spline interpolation	2060	2030	1980	1970	1960	1940	1940

Testing part



Conclusion

- Typical profile of a blade has been chosen for testing
- Comparison betweeen toolpaths based on different interpolation type and different toolpath computation tollerance value has been made
- Measurement of feed-rate along the toolpath in NC programs has been applied
- Analysis of the minimal machining time and quality of machined surface has been made

Thank you for your attention