

@comment *OpenXM* : *OpenXM/src/asir-contrib/packages/doc/todo_parametrize/todo_parametrize-*
ja.texi, v1.22017/03/3006 : 16 : 37*takayamaExp* @comment Copyright (c) 2005, Shuhei Todo, @comment
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Risa/Asir 篁 f 井牙茫 宴若梧

1.0
2004 総 8

by Shuhei Todo

1 亥亜ヤ

1.1 网荀

宴若吾 篁 f 井牙 蟹茯帥鴻 違 箏祉 純 篁 f 井牙 臂 篁ヤ 荅 < 荐膊
鏢

- 2 牙 困鴻 婚罔
- 合亥鴻 婚罔
- neighborhood graph 鏢篁電 c 合亥鴻 茹 c 茵 tree 鏢
- 牙
- 篁匱牙 (adjoint curves)
- 篁電 牙箏
- 牙鏢腮 逸 牙鏢 < ヤ冴

紊縋 違荐膊 c 亥召 若吟若 ュ篁 f 井牙 臂 縋 違箏 x,y,z 電紊縋
違

1.2 Notation

吾 荐激 ヤ 電 <

- $[x,y,z]$ 綵怨抗 鴻 電 婚罔 $(x:y:z)$ 渦鴻 違 $z=0$ $z=1$ 荀
- Q 遣 \overline{Q} 撮亥医 箵渦

1.3 箏祉

1.3.1 intersect

`intersect(F,G)`
:: 2 牙 $F=0, G=0$ 困鴻 婚罔 鴻菴.

`return` 鴻

F, G 紊 x,y,z 電 縋

- 2 牙 $F=0, G=0$ 困 $[x,y,z]$ 鴻菴
- F, G 演続 c


```
[1] intersect(y^2-x*z,(x^2+y^2)^3-4*x^2*y^2*z^2);
[[0,0,1],[(#4),(#5),1]]
[2] defpoly(alg(4));
t#4^3+3*t#4^2+3*t#4-3
[3] defpoly(alg(5));
t#5^2-t#4
[4] intersect(x^2-y^2,x^3+y*x^2+(y^2-z^2)*x+y^3-z^2*y);
***two curve have common components***
```

1.3.2 sing

$\text{sing}(F)$:: 牙 $F=0$ 合亥鴻 婚罔 鴻菴.

return 鴻

F 素 x,y,z 電 絛

- 牙 $F=0$ 合亥 $[x,y,z]$ 鋸 $F_x(x,y,z) = F_y(x,y,z) = F_z(x,y,z) = 0$ 羣刻 鴻菴
- F 茲絛 c 鋸絛臂 茲絛 句鴻 鴻 合亥鴻 鋸

```
[1] sing(16*x^6-24*z^2*x^4+9*z^4*x^2+4*z^2*y^4-4*z^4*y^2);
[[0,0,1],[(#4),0,1],[1/2,(#3),1],[-1/2,(#3),1],[0,1,0]]
[2] depoly(alg(3));
2*t#3^2-1
[3] depoly(alg(4));
4*t#4^2-3
[4] sing((x-y)*(y^2-x*z));
[[1,1,1],[0,0,1]]
[5] sing((x-y)^2*(y^2-x*z));
***Argument has multiple divisor***
```

Section 1.3.3 [nbh], page 2 Section 1.4.4 [multia], page 6

1.3.3 nbh

$\text{nbh}(F)$:: 牙 $F=0$ neighborhood graph 菴

return 鴻

F 素 x,y,z 電 絛

- 牙 $F=0$ neighborhood graph 茵 鴻菴 neighborhood graph 電 c 合亥鴻 茹
 c 茵 tree 茹 c 障鴻 $f \ni$ 鴻 若吟合亥鴻 $f \ni$ 鴻 宴 電 $<$ c ;

合亥 [鴻, 鴻 婚罔, [茲絛, 紹悟合亥 (=1) (= -1)], [合亥鴻牙 $f \ni$ 鴻 (篁
 ヤ $f \ni$ 鴻障 翫"terminal")]

$f \ni$ [鴻, [茲絛, 紹悟合亥 (=1) (= -1)], [$f \ni$ 鴻牙 $f \ni$ 鴻 (篁ヤ $f \ni$ 鴻障
 翫"terminal")]

箏 合亥鴻 婚罔 撮亥違 翫篁 f 亥違怨醜 撮亥違 舟 鴻障合亥鴻 蟹
 違 合亥鴻箏絛 ; 腓牙 合亥鴻 違鴻 違 ; 腓牙 c や 合亥鴻茵 腓
 牙 c 合亥鴻鴻 違鴻 =1 $f \ni$ 鴻 違鴻 違 ; 鴻 違帥や $f \ni$ 鴻牙
 淵

- neighborhood graph ヤ絛 鴻 c ; 障

```
[1] F=x^6+3*y^2*x^4+(3*y^4-4*z^2*y^2)*x^2+y^6;
x^6+3*y^2*x^4+(3*y^4-4*z^2*y^2)*x^2+y^6
[2] sing(F);
[[0,0,1],[(#0),1,0]]
[3] nbh(F);
[ 1 [0,0,1] [4,-1] [[ 1 [2,1] [terminal] ],[ 1 [2,1] [terminal] ]]]
[ 2 [(#0),1,0] [2,-1] [[ 1 [1,1] [terminal] ]]] ]
```

合亥 $[0,0,1]$ 茲絛 4 紹吾 合亥鴻 2や $f \ni$ 鴻や $<$ 茲絛 2 紹悟合亥 合亥
 $[(#0),1,0]$ $f \ni$ 鴻 腔鴻

- F 茲紕 c

Section 1.3.2 [sing], page 2

1.3.4 genus

$\text{genus}(F) ::$ 牙 $F=0$ 合亥鴻 婚罔 鴻菴.

return 0 簞ヤ 贗

F 素 x,y,z 電 縷

- 牙 $F=0$ 違菴
- $F \overline{Q}[x,y,z]$ 違 $>$ 散 單 g や菴篆荐若 $Q[x,y,z]$ c
 $\overline{Q}[x,y,z]$ 絵荀コ $>$ 散羣
- [1] $\text{genus}(x^6+3y^2x^4+(3y^4-4z^2y^2)x^2+y^6);$
0
- [2] $\text{genus}(y^2z-x^3-z^3);$
1
- [3] $\text{genus}(x^2+y^2+z^2-xy-yz-zx);$
-1
- [4] $\text{fctr}(x^2+y^2+z^2-xy-yz-zx);$
[[1,1],[x^2+(-y-z)*x+y^2-z*y+z^2,1]]
- [5] $\text{irr_conic}(x^2+y^2+z^2-xy-yz-zx);$
reducible

Section 1.4.5 [irr_conic], page 6

1.3.5 adjoint1,adjoint2

$\text{adjoint1}(F)$

$\text{adjoint2}(F)$

$::$ 牙 $F=0$ $n-1$ 菴, $n-2$ 菴 $<$ 篋贗牙 (adjoint curve) 菴 ($n=\deg(F)$)

return 膩綵 $<$ 若帥若 素 x,y,z 電 縷

F 素 x,y,z 電 縷

- $n-2$ 菴 $<$ 牙 $G=0$ 牙 $F=0$ 茲綺 r 鴻絨 茲綺 $r-1$ や 牙 $G=0$ 牙 $F=0$ $n-2$ 菴 $<$ 篋贗牙 (adjoint curve) 若吟 $n-1$ 篋贗牙 $G_0=0, G_1=0, \dots, G_{n-2}=0$ 紕 $n-2$ 菴 $<$ 篋贗牙 臂 縷 $c_0G_0 + c_1G_1 + \dots + c_{n-2}G_{n-2}$ (c_i 遺) ; $\text{adjoint2}(F)$ $n-1$ 綵 $<$ 若帥若 菴 縷菴 $n-1$ 菴 $<$ 篋贗牙罕 臂 $n-1$ 菴 $<$ 篋贗牙 臂 縷 箏 罕 $2n-1$ 綵 $<$ 若帥若 $n-1$ 菴 $<$ 菴 縷 ; $\text{adjoint1}(F)$ 縷菴
- $<$ 若帥若 鴻 激茵 ず
- F 茲紕 c

```
[1] adjoint2(x^6+3*y^2*x^4+(3*y^4-4*z^2*y^2)*x^2+y^6);
[c2,c3,c4,c6,c7] 5
(c2-c4)*x^4+c3*y*x^3+(c2*y^2+c6*z*y)*x^2+(c3*y^3+c7*z*y^2)*x+c4*y^4
[2] adjoint1(F);
[c1,c7,c11,c12,c13,c15,c16,c17,c18,c19,c20] 11
(c1*y+(c11-c15+c18-c20)*z)*x^4+(c13*y^2+c7*z*y+c11*z^2)*x^3+(c17*z*y^2+c12*z^2*y
+c15*z^3)*x^2+(c13*z^2*y^2+c16*z^3*y+c18*z^4)*x+c17*z^3*y^2+c19*z^4*y+c20*z^5
```

Section 1.4.7 [restriction], page 7

1.3.6 intpt

intpt(F) :: 篋電 牙 $F=0$ 箏 贗亥 $[x,y,z]$ 蚊 よや 贗亥鴻続 違続 no integer solution

return 鴻 続 no integer solution.

F 素 x,y,z 電 < 電 続

- 篋電 牙 $F=0$ 箏 贗亥 (affine) 違 婚罔 $[x,y,z]$ 電 x,y,z 鴻 贗違 贗亥鴻続 続 no integer solution 電
- 箏篋電 就続 贗域 罷ゆ悟 Legendre 号 泣 若渦 電 < 合続茹 c 綵羈 F 違素 紹吾

```
[1] intpt(22*x^2-10*y^2+z^2+5*x*y+13*y*x-z*x);
[71,-121,473]
[2] intpt(22*x^2-10*y^2+z^2+5*x*y+12*y*x-z*x);
no integer solution
```

1.3.7 parametrize

parametrize(F)
:: 牙 $F=0$ < ヤ冴素続 電

return 鴻

F 牙 臂 続鋸素 x,y,z 電 続鋸

- 牙 $F=0$ 鋸腮 違 0 牙鋸 素 t 続 $P(t), Q(t), R(t)$ x,y,z 電 続 $S(x,y,z), T(x,y,z)$
($x:y:z$)=($P(t):Q(t):R(t)$), $t=T(x,y,z)/S(x,y,z)$ < 若帥取; 腓冴 parametrize(F)
続 鴻 $[P(t), Q(t), R(t), T(x,y,z)/S(x,y,z)]$ 電鋸 $\text{GCD}(P(t), Q(t), R(t))=1$ 鋸
箏 $P(t), Q(t), R(t)$ 違 違 抗号鴻 素続 違違 続 牙 < ヤ冴 酖 紹吾違違
続 電鋸箴并牙 違網違 酖鋸

- $F \overline{Q}[x,y,z]$ よ 違 0 違 > 散羣
[1] parametrize($x^4+(2*y^2-z^2)*x^2+y^4+z^2*y^2$);
[- $t^3-t, t^3-t, t^4+1, (-x^2-y^2)/(z*x+z*y)$]
[2] parametrize($(x^2+y^2)^3-4*x^2*y^2*z^2$);
heuristic2 failed...
heuristic3 succeed
[32256*t^6-133120*t^5-129024*t^4+1064960*t^3-516096*t^2
-2129920*t+2064384, -127008*t^6+1048320*t^5-2671232*t^4
+10684928*t^2-16773120*t+8128512, 274625*t^6-3194100*t^5
+15678780*t^4-41555808*t^3+62715120*t^2-51105600*t+17576000,
(-126*x^4+1040*y*x^3-382*y^2*x^2+1040*y^3*x-256*y^4)
/((-65*x^4+520*y*x^3+(-65*y^2-32*z*y)*x^2+(520*y^3+256*z*y^2)*x)]
[3] parametrize(22*x^2-10*y^2+z^2+5*x*y+12*y*x-z*x);
[(220*#6-10)*t^2+(-22*#6+1), (374*#6-17)*t^2+(-22*#6-43)*t,
(220*#6+210)*t^2+(-374*#6+17)*t+22, (-y)/((22*#6-1)*x+z)]

1.4

1.4.1 tdeg

```
tdeg(Poly)
    :: 素綫 Poly      違菴
return    0 簞ヤ 贗
Poly      素綫
    • 素綫 Poly      違菴
      [1] tdeg(u^3+v^3-x*y*z*w);
      4
      [956] tdeg((x^3+y^2+z)*(a^2+b+1));
      5
```

1.4.2 homzation

```
homzation(AF)
    :: 素 x,y 綫電 x,y,z 電 綫
return    素 x,y,z 電 綫
F          素 x,y 綫
    • 素 x,y 綫電 x,y,z 電 綫 ⊃素綫 違 x,y 違
      [1] homzation((x^2+4*x^3+6*x^4)-4*x^4*y
      +(-2*x-4*x^2-2*x^3)*y^2+y^4);
      (-4*y+6*z)*x^4+(-2*y^2+4*z^2)*x^3
      +(-4*z*y^2+z^3)*x^2-2*z^2*y^2*x+z*y^4
      [958] homzation(u*v+1);
      Input must be polynomial of variable x,y
```

1.4.3 random_line

```
random_line(Pt,B[,Seed])
    :: Pt(=[x,y,z]) 雁蚊 や 渦菴
return    素 x,y,z 電
Pt         鴻茵 鴻
B          俱
Seed       俱
    • Pt(=[x,y,z]) 雁 合綫 篆違 や-B 簞ヤ B 蚊 や 渦
    • Seed 泣 若渦 random([Seed]) 戎
      [1] random_line([0,0,1],1);
      x-8*y
```

1.4.4 multia

```

multia(F,Pt)
    :: 牙  $F=0$     $Pt(=[x,y,z])$    茲綺 菴
return      0 簞ヤ   俱
F           紊  $x,y,z$    菴  縹
Pt          鴻茵   鴻
    • 牙  $F=0$     $Pt(=[x,y,z])$    茲綺 菴 FN 縹   紊縹    $Pt\ 0$    膺 N 牙  $F=0$     $Pt$ 
      茲綺
      [1] multia((4*y^2+4*z^2)*x^4+8*z^3*x^3+8*z^2*y^2*x^2-8*z^5*x+
      4*z^4*y^2-4*z^6,[0,0,1]);
      0
      [2] multia((4*y^2+4*z^2)*x^4+8*z^3*x^3+8*z^2*y^2*x^2-8*z^5*x+
      4*z^4*y^2-4*z^6,[0,1,0]);
      4
      [3] multia((4*y^2+4*z^2)*x^4+8*z^3*x^3+8*z^2*y^2*x^2-8*z^5*x+
      4*z^4*y^2-4*z^6,[1,0,0]);
      2

```

Section 1.3.2 [sing], page 2 Section 1.3.3 [nbh], page 2

1.4.5 irr_conic

```

irr_conic(F)
    :: 箒篋菴   就縹  $F\ \overline{Q}[x,y,z]$    𠂇
return      縹
F           紊  $x,y,z$    菴 <   菴  縹
    • 箒篋菴   就縹  $F\ \overline{Q}[x,y,z]$    irreducible   reducible 菴
      [1] irr_conic(x^2+y^2+z^2-x*y-y*z-z*x);
      reducible
      [2] fctr(x^2+y^2+z^2-x*y-y*z-z*x);
      [[1,1],[x^2+(-y-z)*x+y^2-z*y+z^2,1]]

```

1.4.6 lissajou

```

lissajou(M,N)
    ::  $x = \sin(M\theta), y = \cos(N\theta)$    c   臂   泣若吾ㄣ牙   育   域 ; 腓
return      紊  $x,y,z$    菴  縹
M N         篋   俱
    •  $x = \sin(M\theta), y = \cos(N\theta)$    c   臂   泣若吾ㄣ牙   育   域 ; 腓 削紊  $x,y,z$    菴   縹 鋸菴
      [984] lissajou(3,4);
      64*x^8-128*z^2*x^6+80*z^4*x^4-16*z^6*x^2+16*z^2*y^6
      -24*z^4*y^4+9*z^6*y^2
      [985] lissajou(2,7);
      4096*x^14-14336*z^2*x^12+19712*z^4*x^10-13440*z^6*x^8
      +4704*z^8*x^6-784*z^10*x^4+49*z^12*x^2+4*z^10*y^4-4*z^12*y^2

```


1.4.7 restriction

```
restriction(A,List)
  :: 劫 鴻篋贗牙 臂 縊荐膊
return      膩綵      <若帥若  x,y,z  黽  縊
A          adjoint1,adjoint2菴綵  罕  膩綵  <若帥 や  x,y,z  黽  縊
List       [x,y,z]  鴻
  • adjoint1,adjoint2菴膩綵  <若帥寂 黽  縊 List  障鴻句鴻  や  膩綵  <若帥若
    や  Q 箏  箏黽  縊腴 違  > 散渦  違  綵  <若帥寂  黽  紊縊箴
  • List  障鴻  intersectsing 菴鴻箴帥  喝
    <undefined> [adjoint1], page <undefined>
```

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