

# Ok\_diff (Okutani )

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# 1 Differential equations (library by Okutani)

gr, ok\_matrix.rr, ok\_diff.rr .

Yukio Okutani Risa/Asir . odiff\_ .

..

$$[[f_\alpha, [\alpha_1, \dots, \alpha_n]], \dots]$$

$$\sum_{\alpha} f_{\alpha} \partial^{\alpha}$$

.

$$\left(\sum_{\alpha^{(i)}} f_{\alpha^{(i)}} \partial^{\alpha^{(i)}}\right) \bullet u = 0 \quad (i = 1, \dots, s)$$

.

$$[[[f_{\alpha^{(1)}}, [\alpha_1^{(1)}, \dots, \alpha_n^{(1)}]], \dots], \dots, [[f_{\alpha^{(s)}}, [\alpha_1^{(s)}, \dots, \alpha_n^{(s)}]], \dots]]$$

$x\partial_x + y\partial_y + 1$

$$[[x, [1, 0]], [y, [0, 1]], [1, [0, 0]]]$$

$x\partial_x + y\partial_y + 1, \partial_x^2 + \partial_y^2$

$$[[[x, [1, 0]], [y, [0, 1]], [1, [0, 0]], [[1, [2, 0]], [1, [0, 2]]]]$$

$\dots xdx. x\partial_x + y\partial_y + 1$

$$x * dx + y * dy + 1$$

.

## 1.0.1 odiff\_op\_appell4

odiff\_op\_appell4(a,b,c1,c2,V)

:: appell F\_4 .

return

a, b, c1, c2

V

- odiff\_op\_appell4.

```
[298] odiff_op_appell4(a,b,c1,c2,[x,y]);
[ [ [-x^2+x, [2,0]], [-2*y*x, [1,1]], [-y^2, [0,2]],
  [(-a-b-1)*x+c1, [1,0]], [(-a-b-1)*y, [0,1]], [-b*a, [0,0]] ],
  [ [-y^2+y, [0,2]], [-2*y*x, [1,1]], [-x^2, [2,0]],
  [(-a-b-1)*y+c2, [0,1]], [(-a-b-1)*x, [1,0]], [-b*a, [0,0]] ] ]
```

**1.0.2 odiff\_op\_tosm1**

```
odiff_op_tosm1(LL,V)
  :: sm1 .
```

```
return
```

```
LL
```

```
V
```

```
• .
```

```
• odiff_op_tosm1
```

```
[299] odiff_op_tosm1([[x,[2,0]],[-1,[0,0]]],
                    [[y,[0,2]],[-1,[0,0]]],[x,y]);
[ + ( + (1) x) dx^2 + ( + (-1)), + ( + (1) y) dy^2 + ( + (-1))]
```

```
[300] odiff_op_tosm1([[x,[1,0]],[y,[0,1]],[1,[0,0]]],
                    [[1,[2,0]],[1,[0,2]]],[x,y]);
[ + ( + (1) x) dx + ( + (1) y) dy + ( + (1)), + ( + (1)) dx^2 + ( + (1)) dy^2]
```

```
[301] odiff_op_tosm1([[1/2,[1,0]],[1,[0,0]]],
                    [[1/3,[0,1]],[1/4,[0,0]]],[x,y]);
[ + ( + (6)) dx + ( + (12)), + ( + (4)) dy + ( + (3))]
```

```
[302] odiff_op_tosm1([[1/2*x,[1,0]],[1,[0,0]]],
                    [[1/3*y,[0,1]],[1/4,[0,0]]],[x,y]);
[ + ( + (6) x) dx + ( + (12)), + ( + (4) y) dy + ( + (3))]
```

**1.0.3 odiff\_op\_toasir**

```
odiff_op_toasir(LL,V)
  :: LL asir .
```

```
return
```

```
LL
```

```
V
```

```
• odiff_op_toasir
```

```
[303] odiff_op_toasir([[1/2*x,[1,0]],[1,[0,0]]],
                    [[1/3*y,[0,1]],[1/4,[0,0]]],[x,y]);
[1/2*x*dx+1,1/3*y*dy+1/4]
```

```
[304] odiff_op_toasir([[x,[1,0]],[y,[0,1]],[1,[0,0]]],
                    [[1,[2,0]],[1,[0,2]]],[x,y]);
[x*dx+y*dy+1,dx^2+dy^2]
```

**1.0.4 odiff\_op\_fromasir**

```
odiff_op_fromasir(D_list,V)
  :: asir .
```

*return*

*D\_list*

*V*

- `odiff_op_fromasir`

```
[305] odiff_op_fromasir([1/2*x*dx+1,1/3*y*dy+1/4],[x,y]);
[[[1/2*x,[1,0]],[1,[0,0]]],[[1/3*y,[0,1]],[1/4,[0,0]]]]

[306] odiff_op_fromasir([x*dx+y*dy+1,dx^2+dy^2],[x,y]);
[[[x,[1,0]],[y,[0,1]],[1,[0,0]]],[[1,[2,0]],[1,[0,2]]]]
```

### 1.0.5 `odiff_act`

`odiff_act(L,F,V)`  
 $:: L F . V .$

*return*

*L*            or

*F*

*V*

- `odiff_act`

```
[302] odiff_act([[1,[2]]],x^3+x^2+x+1,[x]);
6*x+2

[303] odiff_act([[1,[1,0]],[1,[0,1]]],x^2+y^2,[x,y]);
2*x+2*y

[349] odiff_act(x*dx+y*dy, x^2+x*y+y^2, [x,y]);
2*x^2+2*y*x+2*y^2
```

### 1.0.6 `odiff_act_appell4`

`odiff_act_appell4(a,b,c1,c2,F,V)`  
 $:: \text{odiff\_op\_appell4 } F .$

*return*

*a, b, c1, c2*

*F*

*V*

- `odiff_act_appell4`

```
[303] odiff_act_appell4(1,0,1,1,x^2+y^2,[x,y]);
[-6*x^2+4*x-6*y^2,-6*x^2-6*y^2+4*y]

[304] odiff_act_appell4(0,0,1,1,x^2+y^2,[x,y]);
```

```
[-4*x^2+4*x-4*y^2,-4*x^2-4*y^2+4*y]
```

```
[305] odiff_act_appell4(-2,-2,-1,-1,x^2+y^2,[x,y]);
[0,0]
```

### 1.0.7 odiff\_poly\_solve

```
odiff_poly_solve(LL,N,V)
:: N.
```

*return*

*LL*

*N*

*V*

- odiff\_poly\_solve.

```
[297] odiff_poly_solve([[x,[1,0]],[-1,[0,0]]],[[y,[0,1]],[-1,[0,0]]],5,[x,y]);
[_4*y*x,[_4]]
```

```
[298] odiff_poly_solve([[x,[1,0]],[-2,[0,0]]],[[y,[0,1]],[-2,[0,0]]],5,[x,y]);
[_33*y^2*x^2,[_33]]
```

```
[356] odiff_poly_solve([x*dx+y*dy-3,dx+dy],4,[x,y]);
[-_126*x^3+3*_126*y*x^2-3*_126*y^2*x+_126*y^3,[_126]]
```

### 1.0.8 odiff\_poly\_solve\_hg1

```
odiff_poly_solve_hg1(a,b,c,V)
:: .
```

*return*

*a, b, c*

*V*

- odiff\_poly\_solve\_hg1.

```
[334] odiff_poly_solve_hg1(-3,-6,-5,[x]);
[_1*x^6-2*_0*x^3+9/2*_0*x^2-18/5*_0*x+_0,[_0,_1]]
```

```
[335] odiff_poly_solve_hg1(-3,-6,-7,[x]);
[-4/7*_2*x^3+15/7*_2*x^2-18/7*_2*x+_2,[_2]]
```

### 1.0.9 odiff\_poly\_solve\_appell4

```
odiff_poly_solve_appell4(a,b,c1,c2,V)
:: F_4.
```

*return*

*a, b, c1, c2*

V

- `odiff_poly_solve_appell4`.
 

```
[299] odiff_poly_solve_appell4(-3,1,-1,-1,[x,y]);
      [-_26*x^3+(3*_26*y+_26)*x^2+3*_24*y^2*x-_24*y^3+_24*y^2,[_24,_26]]

      [300] odiff_poly_solve_appell4(-3,1,1,-1,[x,y]);
      [-3*_45*y^2*x-_45*y^3+_45*y^2,[_45]]
```

### 1.0.10 `odiff_rat_solve`

`odiff_rat_solve(LL,Dn,N,V)`  
 ::  $D_n, N$ .

*return*

$LL$

$D_n$

$N$

V

- `odiff_rat_solve`.
 

```
[333] odiff_rat_solve([[x,[1]],[1,[0]]],x,1,[x]);
      [(_8)/(x),[_8]]

      [361] odiff_rat_solve([x*(1-x)*dx^2+(1-3*x)*dx-1],1-x,2,[x]);
      [(_180)/(-x+1),[_180]]

      [350] D = odiff_op_appell4(0,0,3,0,[x,y])$
      [351] odiff_rat_solve(D,x^2,2,[x,y]);
      [(_118*x^2-_114*y*x+1/2*_114*y^2+_114*y)/(x^2),[_114,_118]]
```

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