VAGC_deriv_Problem3.5.2_xh.wxm

A short development document for Geometric Algebra with wxMaxima
just to test some calculus functions within the GAwxM environment,
contains...
Initialization
Loading of functions (intrinsic and GA specific)
Pseudoscalar definition (specifies the space dimension) and
Calculation of the inverse pseudoscalar used to generate the dual of a multivector
Enumeration of the standard basis for the specified dimension

Problem 3.5.2, VAGC page 40 for the directional derivative of vector x^-1
using the vector notation in the text for the direction, h and the coordinate, x

Initialization

```
(%i35) ext:["wxm"]$
       file_type_maxima:append(ext,file_type_maxima)$
       batchload("initialize_fns")$
```

the pseudoscalar and its inverse
the lowest useable dimension pseudoscalar should be {e1,e2} i.e. Plen = 2
e.g. for four dimensions edit Pseudos:{e1,e2,e3}$ to Pseudos:{e1,e2,e3,e4}$

```
(%i1) Pseudos:{e1,e2,e3}$
      Pvar:listofvars(Pseudos)$
      Plen:length(Pvar)$
      I:Pseudos$
      ni:(Plen-1)*Plen/2$
      Ii:(-1)^ni*I$
      kill(ni)$
      ldisplay(Pvar)$
```

(%t8) Pvar = [e1, e2, e3]

```
(%i9) batchload("initialize_lsts")$
```

(%t9) lstblds = [[{e1},{e2},{e3}],[{e1,e2},{e1,e3},{e2,e3}],[{e1,e2,e3}]]
(%t10) allblds = [{e1},{e2},{e3},{e1,e2},{e1,e3},{e2,e3},{e1,e2,e3}]
(%t11) invblds = [{e1},{e2},{e3},-{e1,e2},-{e1,e3},-{e2,e3},-{e1,e2,e3}]

end of Initialization

set derivabbrev:false$

```
(%i12) derivabbrev:false$
```

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coefficients of the vector, h

```
(%i13) hlst:[h1,h2,h3,0,0,0,0]$
```

coefficients of the vector, x

```
(%i14) xlst:[x1,x2,x3,0,0,0,0]$
```

form the coordinate and direction vectors from the lists of coefficients

```
(%i15) eJ:allblds$
       lenlst:2^Plen-1$
       x:0$
       h:0$
       for j:1 thru lenlst do
       block(x:x+xlst[j]*eJ[j],
       h:h+hlst[j]*eJ[j])$
       ldisplay(x,h)$
```

(%t20) x = {e3}*x3+{e2}*x2+{e1}*x1
(%t21) h = {e3}*h3+{e2}*h2+{e1}*h1

form the function, F(x) from the Hint in the problem

```
(%i22) F(x):=x*normod(x)^-2$
       Fx:ev(F(x))$
       ldisplay(Fx)$
```

(%t24) $Fx=\dfrac{\{e3\}*x3+\{e2\}*x2+\{e1\}*x1}{x3^2+x2^2+x1^2}$

show the function mvderiv() in action and form DdF!

```
(%i25) Fstr:"F"$
       derivF:mvderiv(Fstr,xlst,hlst)$
       ldisplay(derivF)$
```

(%t27) $derivF=h3*\left(\dfrac{d}{d*x3}*F\right)+h2*\left(\dfrac{d}{d*x2}*F\right)+h1*\left(\dfrac{d}{d*x1}*F\right)$

```
(%i28) F:Fx$
       DdF:ev(derivF,diff)$
       ldisplay(DdF)$
```

(%t30) $DdF=h3*\left(\dfrac{\{e3\}}{x3^2+x2^2+x1^2}-\dfrac{2*x3*(\{e3\}*x3+\{e2\}*x2+\{e1\}*x1)}{(x3^2+x2^2+x1^2)^2}\right)+h2*\left(\dfrac{\{e2\}}{x3^2+x2^2+x1^2}-\dfrac{2*x2*(\{e3\}*x3+\{e2\}*x2+\{e1\}*x1)}{(x3^2+x2^2+x1^2)^2}\right)+h1*\left(\dfrac{\{e1\}}{x3^2+x2^2+x1^2}-\dfrac{2*x1*(\{e3\}*x3+\{e2\}*x2+\{e1\}*x1)}{(x3^2+x2^2+x1^2)^2}\right)$

confirm that the calculated DdF is the same as the formula given in the Problem

```
(%i31) n2:normod(x)^2$
       Q1:h/n2;
```

(%o32) $\dfrac{\{e3\}*h3+\{e2\}*h2+\{e1\}*h1}{x3^2+x2^2+x1^2}$

```
(%i33) Q2:-2*h&.x/n2^2;
```

(%o33)/R/ $-\dfrac{2*x3*h3+2*x2*h2+2*x1*h1}{x3^4+(2*x2^2+2*x1^2)*x3^2+x2^4+2*x1^2*x2^2+x1^4}$

```
(%i34) rhs:Q1+Q2*x$
       is(equal(DdF,rhs));
```

(%o35) true

Created with wxMaxima.