LAGA_chapter07.02.wxm (LAGA examples)

A test document for Geometric Algebra with wxMaxima
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

Rotate in the geometric algebra, G4

Reference book...Linear and Geometric Algebra (LAGA)
by Alan Macdonald

Initialization

```
(%i26) 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,e4}$
      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,e4]

(%i9) batchload("initialize_lsts")$

 (%t9) lstblds=[[{e1},{e2},{e3},{e4}],[{e1,e2},{e1,e3},{e1,e4},{e2,e3},{e2,e4},{
e3,e4}],[{e1,e2,e3},{e1,e2,e4},{e1,e3,e4},{e2,e3,e4}],[{e1,e2,e3,e4}]]
 (%t10) allblds=[{e1},{e2},{e3},{e4},{e1,e2},{e1,e3},{e1,e4},{e2,e3},{e2,e4},{e3,
e4},{e1,e2,e3},{e1,e2,e4},{e1,e3,e4},{e2,e3,e4},{e1,e2,e3,e4}]
 (%t11) invblds=[{e1},{e2},{e3},{e4},-{e1,e2},-{e1,e3},-{e1,e4},-{e2,e3},-{e2,e4}
,-{e3,e4},-{e1,e2,e3},-{e1,e2,e4},-{e1,e3,e4},-{e2,e3,e4},{e1,e2,e3,e4}]
```

end of Initialization

Exercise 7.12.
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rotation by angle {e1,e2}*pi

```
(%i12) lstgu:[1]$
       nameu:"u"$
       makelistgrademv(nameu,lstgu)$
       ub:u$
       ldisplay(ub)$
       ib:{e1,e2}$
       ldisplay(ib)$
       Z:bldexp(-ib*%pi/2)$
       ldisplay(Z)$
       Zi:bldexp(+ib*%pi/2)$
       ldisplay(Zi)$
       vb:Z&*ub&*Zi$
       ldisplay(vb)$

 (%t16) ub=u_{1,4}*{e4}+u_{1,3}*{e3}+u_{1,2}*{e2}+u_{1,1}*{e1}
 (%t18) ib={e1,e2}
 (%t20) Z=-{e1,e2}
 (%t22) Zi={e1,e2}
 (%t24)/R/ vb=u_{1,4}*{e4}+u_{1,3}*{e3}-u_{1,2}*{e2}-u_{1,1}*{e1}
```

now apply the rotation by angle {e3,e4}*pi giving the negation of ub
so there is no possible equivalent rotation by any angle i*theta

```
(%i25) ib:{e3,e4}$
       ldisplay(ib)$
       Z:bldexp(-ib*%pi/2)$
       ldisplay(Z)$
       Zi:bldexp(+ib*%pi/2)$
       ldisplay(Zi)$
       wb:Z&*vb&*Zi$
       ldisplay(wb)$

 (%t26) ib={e3,e4}
 (%t28) Z=-{e3,e4}
 (%t30) Zi={e3,e4}
 (%t32)/R/ wb=-u_{1,4}*{e4}-u_{1,3}*{e3}-u_{1,2}*{e2}-u_{1,1}*{e1}

(%i33) is(equal(wb,-ub));

 (%o33) true
```

Exercise 7.14.
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rotate a plane, Bp by a bivector angle using both geometric and blade operators
ref. Exercise 5.24. page 89
N.B. Exercise 7.14 is specified in G3 but completed below in G4

```
(%i34) Bp:{e2}&*({e1}+sqrt(3)*{e3})$
       ib:{e3}~*{e1}$
       theta:%pi/3$
       Z:bldexp(-ib*theta/2)$
       ldisplay(Z)$
       Zi:bldexp(+ib*theta/2)$
       ldisplay(Zi)$
       Br:Z&*Bp&*Zi$
       ev(Br)$
       ldisplay(Br,%)$

 (%t38) Z=-{e1,e3}/2+sqrt(3)/2
 (%t40) Zi=sqrt(3)/2-{e1,e3}/2
 (%t43)/R/ Br=({e2,e3}*sqrt(3)^3-2*{e1,e2}*sqrt(3)^2-3*{e2,e3}*sqrt(3)-2*{e1,e2})/4
 (%t44)/R/ %=-2*{e1,e2}
```