spacetime_rot_split.wxm

An application document for Geometric Algebra using wxMaxima

Ref: The Survey, paragraph 4.1.3

Use of G(1,3) for splitting the rotated vector

Initialization

```
(%i27) 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

floating point print (display) precision

```
(%i12) fpprintprec:6$
       ratprint:false$
       ldisplay(fpprintprec,fpprec,ratprint)$

(%t14) fpprintprec=6
(%t15) fpprec=16
(%t16) ratprint=false
```

The Survey, para.4

show the spacetime gammas required for the imitation of G(1,3), where, to avoid the use
of gamma_zero, we have used the fourth axis, e4, for the time axis and the intrinsic
maxima imaginary, %i, for the space axes

```
(%i17) g1:%i*{e1}$
       g2:%i*{e2}$
       g3:%i*{e3}$
       g4:{e4}$
```

the spacetime coordinate vector using the gammas

```
(%i21) x:x1*g1+x2*g2+x3*g3+t*g4;

(%o21) %i*{e3}*x3+%i*{e2}*x2+%i*{e1}*x1+{e4}*t
```

spacetime vector rotation for a simple velocity, vel*vhat (= vel*g1)

```
(%i22) vel:0.8$
       alpha:atanh(vel)$
       ahalf:alpha/2;

(%o24) 0.5493
```

form the rotation bivector

```
(%i25) vhat:g1$
       B:vhat&*g4*ahalf$
       ev(%,numer,expand);

(%o27) 0.5493*%i*{e1,e4}
```

form the left and right exponential multipliers

```
(%i28) mvexp(-B,13)$
       lexp:ev(%,numer,expand);

(%o29) 1.1547-0.5774*%i*{e1,e4}

(%i30) mvexp(+B,13)$
       rexp:ev(%,numer,expand);

(%o31) 0.5774*%i*{e1,e4}+1.1547
```

find the rotated spacetime vector, xbar, para. 4.1.3;

```
(%i32) lexp&*x&*rexp$
       ev(%,numer,expand)$
       xbar:collectterms(%,e1,e4);

(%o34) 1.0*%i*{e3}*x3+1.0*%i*{e2}*x2+{e1}*(1.66667*%i*x1-1.33333*%i*t)+{e4}*(1.66667*t-1.33333*x1)
```

The Survey, paragraph 4.1.2, suggests a spacetime split using
the geometric product; x&*gamma_zero, thus, using our g's as the gammas, that
is x&*g4; we could call this the split (rotated) spacetime coordinate, splx

```
(%i35) xbar&*g4$
       ev(%,numer,expand)$
       splx:collectterms(%,e1,e4)$
       ldisplay(splx)$

(%t38) splx=1.0*%i*{e3,e4}*x3+1.0*%i*{e2,e4}*x2+{e1,e4}*(1.66667*%i*x1-1.33333*%i*t)-1.33333*x1+1.66667*t
```

for this imitation of G(1,3), the split of the rotated spacetime coordinate
into time and space (using the sigma bivectors as the G(3) basis) is...

```
(%i39) realpart(splx);
       imagpart(splx);

(%o39) 1.66667*t-1.33333*x1
(%o40) 1.0*{e3,e4}*x3+1.0*{e2,e4}*x2+{e1,e4}*(1.66667*x1-1.33333*t)
```