space_time_para_4.1.2.wxm

An application document for Geometric Algebra using wxMaxima

Ref: The Survey, para.4.1.2,

investigate the use of the fourth axis, g4 = e4 to imitate G(1,3)

Initialization

```
(%i42) 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

set derivabbrev:false$

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

The Survey, ref. para 4.1.2
investigate the use of the fourth axis with g4 = e4

in order to imitate G(1,3) use these gammas

```
(%i13) g1:%i*{e1}$
       g2:%i*{e2}$
       g3:%i*{e3}$
       g4:{e4}$
```

allocate the inner products to definite axes for G(1,3) using g4 as the time axis

```
(%i17) g1&.g1;
       g2&.g2;
       g3&.g3;
       g4&.g4;
```

(%o17)/R/ -1
(%o18)/R/ -1
(%o19)/R/ -1
(%o20)/R/ 1

the spacetime coordinate vector using these gammas

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

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

examine a spacetime split using g4 = e4

```
(%i22) x&^g4$
       space:collectterms(%,%i);
```

(%o23) %i*({e3,e4}*x3+{e2,e4}*x2+{e1,e4}*x1)

```
(%i24) time:x&.g4;
```

(%o24)/R/ t

now specify some "sigma" bivectors (printed bold although they are bivectors)

```
(%i25) s1:g1&^g4;
       s2:g2&^g4;
       s3:g3&^g4;
```

(%o25)/R/ {e1,e4}*%i
(%o26)/R/ {e2,e4}*%i
(%o27)/R/ {e3,e4}*%i

b(old)x space using the sigmas

```
(%i28) x1*s1+x2*s2+x3*s3$
       bx:collectterms(%,%i)$
       is(equal(bx,space))$
       ldisplay(%,bx)$
```

(%t31) %=true
(%t32) bx=%i*({e3,e4}*x3+{e2,e4}*x2+{e1,e4}*x1)

typical sigma products

```
(%i33) s1&*s1;
       s2&.s3;
```

(%o33)/R/ 1
(%o34) 0

```
(%i35) s1&*s3;
       s3&*s1;
```

(%o35)/R/ {e1,e3}
(%o36)/R/ -{e1,e3}

using the spacetime coordinate vector, x from above;
compute...to find the spacetime interval used in para.4.1.2;

```
(%i37) x&*x;
```

(%o37)/R/ $-x3^2-x2^2-x1^2+t^2$

so the above coordinate vector, x could be used to imitate G(1,3)
with g4 as the worldline tangent vector