

```
load('clifford');
package name: clifford.mac
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version: v24
Recommended location: share/contrib
last update: 20 Feb 2019
"C:/Users/prodanov/Dropbox/maxima/clifford.mac"
```

General multivector inverse in 4 dimensions

```
clifford(e,3,1);
```

General element

```
A:celem(b);
```

(A)

$$b_1 + e_1 b_2 + e_2 b_3 + e_3 b_4 + e_4 b_5 + b_6 (e_1 \cdot e_2) + b_{12} (e_1 \cdot e_2 \cdot e_3) + b_{16} (e_1 \cdot e_2 \cdot e_3 \cdot e_4) + b_{13} (e_1 \cdot e_2 \cdot e_4) + b_7 (e_1 \cdot e_3)$$

Hitzer-Sangwine automorphism

```
hautom(vv, lst):=block ([gr, v:0, k, ulst],
  if not listp(lst) then error("list required"),
  if lmax(lst)>ndim then error("illegal argument"),
  if not freeof(".", vv) then
    gr: grade(vv, true)
  else
    gr: grade(vv),
    ulst: makelist(0, ndim+1),
    for i in lst do ulst[i+1]:1,
    for i:1 thru ndim+1 do (
      if ulst[i]=1 then k:-1 else k:1,
      v:v + k * gr[i]
    ),
    v
);
```

```
hautom(vv, lst):=block ([gr, v:0, k, ulst], if not listp(lst) then error("list required"), if lmax(lst)>ndim then error("illegal argument"), if not
error("list required"), if lmax(lst)>ndim then error("illegal argument"), if not
freeof(".", vv) then gr: grade(vv, true) else gr: grade(vv), ulst: makelist(0, ndim+1),
for i in lst do ulst[i+1]:1, for i thru ndim+1 do
(if ulst[i]=1 then k:-1 else k:1, v:v + k gr[i], v)
```

```
ndim;
```

```
4
```

```
C: cconjugate(A);
```

(C)

$$b_1 - e_1 b_2 - e_2 b_3 - e_3 b_4 - e_4 b_5 - b_6 (e_1 \cdot e_2) + b_{12} (e_1 \cdot e_2 \cdot e_3) + b_{16} (e_1 \cdot e_2 \cdot e_3 \cdot e_4) + b_{13} (e_1 \cdot e_2 \cdot e_4) - b_7 (e_1 \cdot e_3)$$

```
D:A.C, expand, dotsimp;
```

(D)

$$b_1^2 - b_2^2 - b_3^2 - b_4^2 + b_5^2 + b_6^2 + b_7^2 - b_8^2 + b_9^2 - b_{10}^2 - b_{11}^2 - b_{12}^2 + b_{13}^2 + b_{14}^2 + b_{15}^2 - b_{16}^2 - 2 b_4 b_6 (e_1 \cdot e_2 \cdot e_3) + 2 b_3 b_7 (e_1 \cdot e_2 \cdot e_3)$$

Hitzer-Sangwine automorphism

```
E:hautom(D, [3,4]);
```

(E)

$$b_1^2 - b_2^2 - b_3^2 - b_4^2 + b_5^2 + b_6^2 + b_7^2 - b_8^2 + b_9^2 - b_{10}^2 - b_{11}^2 - b_{12}^2 + b_{13}^2 + b_{14}^2 + b_{15}^2 - b_{16}^2 + 2 b_4 b_6 (e_1 \cdot e_2 \cdot e_3) - 2 b_3 b_7 (e_1 \cdot e_2 \cdot e_3)$$

(F)

$$b_1^4 - 2 b_1^2 b_2^2 + b_2^4 - 2 b_1^2 b_3^2 + 2 b_2^2 b_3^2 + b_3^4 - 2 b_1^2 b_4^2 + 2 b_2^2 b_4^2 + 2 b_3^2 b_4^2 + b_4^4 + 2 b_1^2 b_5^2 - 2 b_2^2 b_5^2 - 2 b_3^2 b_5^2 - 2 b_4^2 b_5^2 + b_5^4 + 2 b_1^2 b_6^2 - 2 b_2^2 b_6^2 - 2 b_3^2 b_6^2 - 2 b_4^2 b_6^2 + b_6^4$$

(B)

$$b_1^3 - b_1^2 e_1 b_2 - b_1 b_2^2 + e_1 b_2^3 - b_1^2 e_2 b_3 + b_1^2 e_2 b_3 - b_1 b_3^2 + e_1 b_2 b_3^2 + e_2 b_3^3 - b_1^2 e_3 b_4 + b_1^2 e_3 b_4 + b_2^2 e_3 b_4 - b_1 b_4^2 + e_1 b_2 b_4^2$$

(Q)

$$b_1^4 - 2 b_1^2 b_2^2 + b_2^4 - 2 b_1^2 b_3^2 + 2 b_2^2 b_3^2 + b_3^4 - 2 b_1^2 b_4^2 + 2 b_2^2 b_4^2 + 2 b_3^2 b_4^2 + b_4^4 + 2 b_1^2 b_5^2 - 2 b_2^2 b_5^2 - 2 b_3^2 b_5^2 - 2 b_4^2 b_5^2 + b_5^4 + 2 b_1^2 b_6^2$$

0

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