(%i1) load(cliffordan);

package name: clifford.mac
author: Dimiter Prodanov
version: v24
Recommended location: share/contrib
last update: 20 Feb 2019
warning: redefining @
package name: cliffordan.mac
author: Dimiter Prodanov
version: v18
Recommended location: share/contrib
last update: 04 Feb 2018

(%o1) "C:/Dropbox/maxima/cliffordan.mac"

pseudo differential forms

Reference: K. Roebenack: Nichtlineare Regelungssysteme, p.101.
https://doi.org/10.1007/978-3-662-444091-9_3.
Roebenack uses the cartan package of Maxima to solve this problem.

(%i2) clifford(dx,3);

(%o2) $[1,1,1]$

(%i3) xx:[x_1,x_2, x_3];

(xx) $[x_1,x_2,x_3]$

(%i4) ww:[omega_1, omega_2, omega_3];

(ww) $[\omega_1,\omega_2,\omega_3]$

(%i5) nn:[eta_1, eta_2, eta_3];

(nn) $[\eta_1,\eta_2,\eta_3]$

implictly declares components to be scalar

(%i6) x:cvect(xx);

(x) $dx_1\, x_1+dx_2\, x_2+dx_3\, x_3$

(%i7) depends(ww, xx);

(%o7) $[\omega_1(x_1,x_2,x_3),\omega_2(x_1,x_2,x_3),\omega_3(x_1,x_2,x_3)]$

(%i8) omega: cvect(ww);

(omega) $dx_1\, \omega_1+dx_2\, \omega_2+dx_3\, \omega_3$

Exterior derivative of 1-form

(%i9) domega: extvectdiff(omega, x);

(domega) $$(dx_1\ .\ dx_2)\left(-\frac{d}{d\, x_2}\omega_1+\frac{d}{d\, x_1}\omega_2\right)+(dx_1\ .\ dx_3)\left(-\frac{d}{d\, x_3}\omega_1+\frac{d}{d\, x_1}\omega_3\right)+(dx_2\ .\ dx_3)\left(-\frac{d}{d\, x_3}\omega_2+\frac{d}{d\, x_2}\omega_3\right)$$

(%i10) extvectdiff(domega,x);

(%o10) 0

(%i11) nn1:cvect(nn);

(nn1) $dx_1\,\eta_1+dx_2\,\eta_2+dx_3\,\eta_3$

(%i12) depends(nn, xx);

(%o12) $[\eta_1(x_1,x_2,x_3),\eta_2(x_1,x_2,x_3),\eta_3(x_1,x_2,x_3)]$

this is the algebraical but not the Clifford dual

(%i13) eta:dual(nn1);

(eta) $(dx_2\;.\;dx_3)\,\eta_1+(dx_1\;.\;dx_3)\,\eta_2+(dx_1\;.\;dx_2)\,\eta_3$

Exterior derivative of 2-form

(%i14) deta:extvectdiff(eta, x);

(deta) $(dx_1\;.\;dx_2\;.\;dx_3)\left(\frac{d}{d\,x_1}\eta_1-\frac{d}{d\,x_2}\eta_2+\frac{d}{d\,x_3}\eta_3\right)$

(%i15) extvectdiff(deta,x);

(%o15) 0