Summary of symmetry calculations

October 24, 2021

Contents

1 DBH_model 5

4 CONTENTS

Chapter 1

$\mathbf{DBH}_{\mathbf{model}}$

$Run~01_10PM_24_October-2021$

Degree in tangential ansätze: 2. The system of ODEs is given by:

$$\begin{split} \frac{\mathrm{d}w_1}{\mathrm{d}t} &= -w_1w_2 - w_1w_3 + w_2w_3, \\ \frac{\mathrm{d}w_2}{\mathrm{d}t} &= -w_1w_2 + w_1w_3 - w_2w_3, \\ \frac{\mathrm{d}w_3}{\mathrm{d}t} &= w_1w_2 - w_1w_3 - w_2w_3. \end{split}$$

The calculated generators are:

```
C_1 - C_{17}t - C_{24}t + C_{31}t^2 + C_{32}t - C_{40} + c_{32}(t)
                                                            C_2t + C_4t + C_5 - C_7t
                                                            C_2t - C_4t + C_7t + C_8
                                                           -C_2t + C_4t + C_7t + C_9
                                                                           C_{10}
                                                                           C_{11}
                                                              -C_{11}t + C_{12} + C_{21}t
                                                  C_{11}t^2 - C_{12}t + C_{13} - C_{21}t^2 + C_{22}t
                                                              -C_{11}t + C_{14} + C_{31}t
                                   -C_{11}t^{2} + C_{15} - 2C_{17}t + C_{31}t^{2} + 2C_{32}t - C_{40} + c_{32}(t)
-C_{11}t^{2} - C_{14}t + C_{16} - C_{31}t^{2} + C_{34}t
                                                               C_{17} - C_{21}t - C_{31}t
         C_{12}t - C_{14}t + C_{17}t + C_{18} + C_{21}t^2 - C_{22}t + C_{24}t + C_{27}t - C_{31}t^2 - 2C_{32}t + C_{40} - c_{32}(t)
                            -C_{12}t + C_{14}t + C_{17}t + C_{19} - C_{32}t - C_{34}t + C_{37}t + C_{40} - c_{32}(t)
\mathbf{c} =
                                                               C_{20} - C_{27}t - C_{37}t
                                                 C_{21}
C_{11}t - C_{21}t + C_{22}
-C_{11}t^2 + C_{12}t + C_{21}t^2 - C_{22}t + C_{23}
                                                              -C_{11}t + C_{24} - C_{31}t
         C_{11}t^{2} - C_{12}t + C_{14}t + C_{17}t + C_{22}t + C_{24}t + C_{25} - C_{27}t - C_{31}t^{2} - 2C_{32}t + C_{40} - c_{32}(t)
                                                              -C_{14}t + C_{26} - C_{34}t
                                                              -C_{21}t + C_{27} + C_{31}t
                                   -C_{21}t^2 - 2C_{24}t + C_{28} + C_{31}t^2 + 2C_{32}t - C_{40} + c_{32}(t)
                           -C_{22}t + C_{24}t + C_{27}t + C_{29} - C_{32}t + C_{34}t - C_{37}t + C_{40} - c_{32}(t)
                                                  C_{21}t^2 - C_{27}t + C_{30} - C_{31}t^2 + C_{37}t
                                                              -C_{11}t - C_{21}t + C_{32}
                                                              -C_{12}t - C_{22}t + C_{33}
               C_{11}t - C_{31}t + C_{34} \\ C_{11}t^2 + C_{12}t - C_{14}t + C_{17}t - C_{31}t^2 - C_{32}t + C_{34}t + C_{35} - C_{37}t + C_{40} - c_{32}(t)
                                                 -C_{11}t^2 + C_{14}t + C_{31}t^2 - C_{34}t + C_{36}
                                                               C_{21}t - C_{31}t + C_{37}
               C_{21}t^{2} + C_{22}t + C_{24}t - C_{27}t - C_{31}t^{2} - C_{32}t - C_{34}t + C_{37}t + C_{38} + C_{40} - c_{32}(t) - C_{21}t^{2} + C_{27}t + C_{31}t^{2} - C_{37}t + C_{39}
```

$$\begin{bmatrix} -C_3 \\ -C_2t - C_4t - C_5 + C_7t \\ -C_6 \\ -C_2t + C_4t - C_7t - C_8 \\ C_2t - C_4t - C_7t - C_9 \\ -C_{10} \\ -C_{11}t^2 + C_{12}t - C_{13} + C_{21}t^2 - C_{22}t \\ -C_{11}t^2 - C_{15} + 2C_{17}t - C_{31}t^2 - 2C_{32}t + C_{40} \\ -C_{11}t^2 + C_{12}t - C_{13}t^2 - C_{34}t \\ -C_{12}t + C_{14}t - C_{17}t - C_{19} + C_{32}t + C_{34}t \\ -C_{12}t + C_{14}t - C_{17}t - C_{19} + C_{32}t + C_{34}t - C_{37}t - C_{40} \\ -C_{12}t + C_{14}t - C_{17}t - C_{19} + C_{32}t + C_{34}t - C_{37}t - C_{40} \\ -C_{20} + C_{27}t + C_{37}t \\ -C_{11}t^2 + C_{12}t - C_{12}t - C_{21}t^2 + C_{22}t - C_{23} - C_{40} \\ C_{11}t^2 - C_{12}t - C_{21}t^2 - C_{21}t^2 + C_{22}t - C_{23} \\ -C_{11}t^2 + C_{12}t - C_{14}t - C_{17}t - C_{21}t^2 + C_{22}t - C_{23} \\ -C_{11}t^2 - C_{12}t - C_{24}t - C_{25}t - C_{34}t + C_{37}t - C_{40} \\ C_{21}t^2 + 2C_{24}t - C_{28} - C_{31}t^2 - 2C_{32}t + C_{40} \\ C_{21}t^2 + 2C_{24}t - C_{29}t - C_{32}t - C_{40}t + C_{37}t - C_{40} \\ -C_{21}t^2 + C_{24}t - C_{29}t - C_{34}t + C_{37}t - C_{40} \\ C_{21}t^2 + C_{24}t - C_{29}t - C_{34}t + C_{37}t - C_{40} \\ C_{12}t + C_{22}t - C_{33} \\ -C_{11}t^2 - C_{12}t + C_{14}t - C_{17}t + C_{31}t^2 + C_{32}t - C_{34}t - C_{35}t - C_{40} \\ C_{12}t^2 + C_{22}t - C_{33} + C_{31}t^2 - C_{37}t \\ C_{12}t^2 - C_{21}t^2 + C_{24}t - C_{25}t - C_{34}t - C_{35}t - C_{40} \\ C_{11}t^2 - C_{14}t - C_{31}t^2 + C_{32}t - C_{34}t - C_{35}t - C_{40} \\ C_{11}t^2 - C_{12}t + C_{14}t - C_{17}t + C_{31}t^2 + C_{32}t - C_{34}t - C_{35}t - C_{40} \\ C_{11}t^2 - C_{12}t + C_{21}t - C_{31}t^2 + C_{32}t - C_{34}t - C_{35}t - C_{40} \\ C_{11}t^2 - C_{12}t + C_{21}t - C_{31}t^2 + C_{32}t - C_{34}t - C_{35}t - C_{36}t - C_{36}t$$

$$X_1 = (1) \partial t$$
,

$$X_2 = (-1) \partial t$$
,

$$X_3 = (t+2) \partial t + (1 - 2tw_1) \partial w_1 + (1 - 2tw_2) \partial w_2 + (1 - 2tw_3) \partial w_3$$

$$X_4 = (-1+t) \partial t + (w_1) \partial w_1 + (w_2) \partial w_2 + (w_3) \partial w_3$$

$$X_{5} = (t) \partial t + (w_{2}w_{3} f_{1}(t) - w_{1}w_{2} f_{1}(t) - w_{1}w_{3} f_{1}(t)) \partial w_{1} + (w_{1}w_{3} f_{1}(t) - w_{1}w_{2} f_{1}(t) + -w_{2}w_{3} f_{1}(t)) \partial w_{2} + (w_{1}w_{2} f_{1}(t) - w_{1}w_{3} f_{1}(t) - w_{2}w_{3} f_{1}(t)) \partial w_{3}$$

Some of the generators might contain the following arbitrary functions:

WARNING: Some of the calculated generators did not satisfy the linearised symmetry conditions. Thus, the presented list here is not complete and consists exclusively of the calculated generators that satisfy the linearised symmetry conditions.

The execution time of the script was:

0 hours 3 minutes 30 seconds.

Run $01_14PM_24_October-2021$

Degree in tangential ansätze: 2. The system of ODEs is given by:

$$\begin{split} \frac{\mathrm{d}w_1}{\mathrm{d}t} &= -w_1w_2 - w_1w_3 + w_2w_3, \\ \frac{\mathrm{d}w_2}{\mathrm{d}t} &= -w_1w_2 + w_1w_3 - w_2w_3, \\ \frac{\mathrm{d}w_3}{\mathrm{d}t} &= w_1w_2 - w_1w_3 - w_2w_3. \end{split}$$

The calculated generators are:

```
C_1 - C_{17}t - C_{24}t + C_{31}t^2 + C_{32}t - C_{40} + c_{32}(t)
                                                           C_2t + C_4t + C_5 - C_7t
                                                           C_2t - C_4t + C_7t + C_8
                                                          -C_2t + C_4t + C_7t + C_9
                                                                         C_{10}
                                                                         C_{11}
                                                             -C_{11}t + C_{12} + C_{21}t
                                                 C_{11}t^2 - C_{12}t + C_{13} - C_{21}t^2 + C_{22}t
                                                             -C_{11}t + C_{14} + C_{31}t
                                  -C_{11}t^{2} + C_{15} - 2C_{17}t + C_{31}t^{2} + 2C_{32}t - C_{40} + c_{32}(t)
-C_{11}t^{2} - C_{14}t + C_{16} - C_{31}t^{2} + C_{34}t
                                                              C_{17} - C_{21}t - C_{31}t
         C_{12}t - C_{14}t + C_{17}t + C_{18} + C_{21}t^2 - C_{22}t + C_{24}t + C_{27}t - C_{31}t^2 - 2C_{32}t + C_{40} - c_{32}(t)
                           -C_{12}t + C_{14}t + C_{17}t + C_{19} - C_{32}t - C_{34}t + C_{37}t + C_{40} - c_{32}(t)
                                                              C_{20} - C_{27}t - C_{37}t
\mathbf{c} =
                                                C_{21}
C_{11}t - C_{21}t + C_{22}
-C_{11}t^2 + C_{12}t + C_{21}t^2 - C_{22}t + C_{23}
                                                             -C_{11}t + C_{24} - C_{31}t
         C_{11}t^{2} - C_{12}t + C_{14}t + C_{17}t + C_{22}t + C_{24}t + C_{25} - C_{27}t - C_{31}t^{2} - 2C_{32}t + C_{40} - c_{32}(t)
                                                             -C_{14}t + C_{26} - C_{34}t
                                                             -C_{21}t + C_{27} + C_{31}t
                                  -C_{21}t^2 - 2C_{24}t + C_{28} + C_{31}t^2 + 2C_{32}t - C_{40} + c_{32}(t)
                          -C_{22}t+C_{24}t+C_{27}t+C_{29}-C_{32}t+C_{34}t-C_{37}t+C_{40}-\mathbf{c}_{32}\left(t\right)
                                                 C_{21}t^2 - C_{27}t + C_{30} - C_{31}t^2 + C_{37}t
                                                             -C_{11}t - C_{21}t + C_{32}
                                                             -C_{12}t - C_{22}t + C_{33}
                                                              C_{11}t - C_{31}t + C_{34}
               C_{11}t^{2} + C_{12}t - C_{14}t + C_{17}t - C_{31}t^{2} - C_{32}t + C_{34}t + C_{35} - C_{37}t + C_{40} - c_{32}(t)
                                                -C_{11}t^2 + C_{14}t + C_{31}t^2 - C_{34}t + C_{36}
                                                              C_{21}t - C_{31}t + C_{37}
               C_{21}t^{2} + C_{22}t + C_{24}t - C_{27}t - C_{31}t^{2} - C_{32}t - C_{34}t + C_{37}t + C_{38} + C_{40} - c_{32}(t) - C_{21}t^{2} + C_{27}t + C_{31}t^{2} - C_{37}t + C_{39}
```

$$\begin{bmatrix} -C_3 \\ -C_2t - C_4t - C_5 + C_7t \\ -C_6 \\ -C_2t + C_4t - C_7t - C_8 \\ C_2t - C_4t - C_7t - C_9 \\ -C_{11}t^2 + C_{12}t - C_{13} + C_{21}t^2 - C_{22}t \\ -C_{11}t^2 + C_{15} + 2C_{17}t - C_{31}t^2 - 2C_{32}t + C_{40} \\ -C_{11}t^2 + C_{15} + 2C_{17}t - C_{31}t^2 - 2C_{32}t + C_{40} \\ -C_{11}t^2 + C_{15} + 2C_{17}t - C_{31}t^2 - 2C_{32}t + C_{40} \\ -C_{12}t + C_{14}t - C_{16} + C_{21}t^2 + C_{24}t - C_{27}t + C_{31}t^2 + 2C_{32}t - C_{40} \\ C_{12}t - C_{14}t - C_{17}t - C_{19} + C_{32}t + C_{34}t - C_{37}t - C_{40} \\ -C_{20} + C_{27}t + C_{37}t \\ -C_{11}t^2 - C_{12}t - C_{21}t^2 + C_{22}t - C_{23} \\ -C_{11}t^2 - C_{12}t - C_{21}t^2 + C_{22}t - C_{23} \\ -C_{11}t^2 - C_{12}t - C_{21}t^2 - C_{21}t - C_{21}t + C_{31}t^2 + 2C_{32}t - C_{40} \\ C_{12}t^2 + 2C_{24}t - C_{27}t - C_{29}t + C_{31}t^2 - 2C_{32}t + C_{40} \\ C_{21}t^2 + 2C_{24}t - C_{27}t - C_{31}t^2 - 2C_{32}t + C_{40} \\ C_{21}t^2 + 2C_{24}t - C_{27}t - C_{31}t^2 - 2C_{32}t + C_{40} \\ C_{21}t^2 + C_{21}t - C_{31}t^2 - C_{31}t^2 - C_{37}t - C_{40} \\ C_{12}t^2 - C_{21}t - C_{31}t^2 - C_{31}t^2 - C_{31}t - C_{31}t - C_{40} \\ C_{11}t^2 - C_{12}t - C_{21}t - C_{21}t - C_{31}t - C_$$

$$X_1 = (1) \partial t$$
,

$$X_2 = (-1) \partial t$$
,

$$X_3 = (t+2) \partial t + (1 - 2tw_1) \partial w_1 + (1 - 2tw_2) \partial w_2 + (1 - 2tw_3) \partial w_3$$

$$X_4 = (t) \partial t + (w_2 w_3 f_1(t) - w_1 w_2 f_1(t) - w_1 w_3 f_1(t)) \partial w_1 + (w_1 w_3 f_1(t) - w_1 w_2 f_1(t) + -w_2 w_3 f_1(t)) \partial w_2 + (w_1 w_2 f_1(t) - w_1 w_3 f_1(t) - w_2 w_3 f_1(t)) \partial w_3$$

Some of the generators might contain the following arbitrary functions:

 f_1

WARNING:

Some of the calculated generators did not satisfy the linearised symmetry conditions. Thus, the presented list here is not complete and consists exclusively of the calculated generators that satisfy the linearised symmetry conditions.

The execution time of the script was:

0 hours 3 minutes 30 seconds.

$Run~01_17PM_24_October-2021$

Degree in tangential ansätze: 2. The system of ODEs is given by:

$$\frac{\mathrm{d}w_1}{\mathrm{d}t} = -w_1w_2 - w_1w_3 + w_2w_3,$$

$$\frac{\mathrm{d}w_2}{\mathrm{d}t} = -w_1w_2 + w_1w_3 - w_2w_3,$$

$$\frac{\mathrm{d}w_3}{\mathrm{d}t} = w_1w_2 - w_1w_3 - w_2w_3.$$

The calculated generators are:

```
C_1 - C_{17}t - C_{24}t + C_{31}t^2 + C_{32}t - C_{40} + c_{32}(t)
                                                            C_2t + C_4t + C_5 - C_7t
                                                            C_2t - C_4t + C_7t + C_8
                                                           -C_2t + C_4t + C_7t + C_9
                                                                          C_{10}
                                                                          C_{11}
                                                              -C_{11}t + C_{12} + C_{21}t
                                                  C_{11}t^2 - C_{12}t + C_{13} - C_{21}t^2 + C_{22}t
                                                             -C_{11}t + C_{14} + C_{31}t
                                   -C_{11}t^{2} + C_{15} - 2C_{17}t + C_{31}t^{2} + 2C_{32}t - C_{40} + c_{32}(t)
-C_{11}t^{2} - C_{14}t + C_{16} - C_{31}t^{2} + C_{34}t
                                                               C_{17} - C_{21}t - C_{31}t
         C_{12}t - C_{14}t + C_{17}t + C_{18} + C_{21}t^2 - C_{22}t + C_{24}t + C_{27}t - C_{31}t^2 - 2C_{32}t + C_{40} - c_{32}(t)
                           -C_{12}t + C_{14}t + C_{17}t + C_{19} - C_{32}t - C_{34}t + C_{37}t + C_{40} - c_{32}(t)
\mathbf{c} =
                                                               C_{20} - C_{27}t - C_{37}t
                                                C_{21}
C_{11}t - C_{21}t + C_{22}
-C_{11}t^2 + C_{12}t + C_{21}t^2 - C_{22}t + C_{23}
                                                              -C_{11}t + C_{24} - C_{31}t
         C_{11}t^{2} - C_{12}t + C_{14}t + C_{17}t + C_{22}t + C_{24}t + C_{25} - C_{27}t - C_{31}t^{2} - 2C_{32}t + C_{40} - c_{32}(t)
                                                              -C_{14}t + C_{26} - C_{34}t
                                                              -C_{21}t + C_{27} + C_{31}t
                                   -C_{21}t^2 - 2C_{24}t + C_{28} + C_{31}t^2 + 2C_{32}t - C_{40} + c_{32}(t)
                           -C_{22}t+C_{24}t+C_{27}t+C_{29}-C_{32}t+C_{34}t-C_{37}t+C_{40}-c_{32}\left(t\right)
                                                  C_{21}t^2 - C_{27}t + C_{30} - C_{31}t^2 + C_{37}t
                                                              -C_{11}t - C_{21}t + C_{32}
                                                              -C_{12}t - C_{22}t + C_{33}
               C_{11}t - C_{31}t + C_{34} \\ C_{11}t^2 + C_{12}t - C_{14}t + C_{17}t - C_{31}t^2 - C_{32}t + C_{34}t + C_{35} - C_{37}t + C_{40} - c_{32}(t)
                                                -C_{11}t^2 + C_{14}t + C_{31}t^2 - C_{34}t + C_{36}
                                                               C_{21}t - C_{31}t + C_{37}
               C_{21}t^{2} + C_{22}t + C_{24}t - C_{27}t - C_{31}t^{2} - C_{32}t - C_{34}t + C_{37}t + C_{38} + C_{40} - c_{32}(t) - C_{21}t^{2} + C_{27}t + C_{31}t^{2} - C_{37}t + C_{39}
```

$$\begin{bmatrix} -C_3 \\ -C_2t - C_4t - C_5 + C_7t \\ -C_6 \\ -C_2t + C_4t - C_7t - C_8 \\ C_2t - C_4t - C_7t - C_9 \\ -C_{10} \\ -C_{11}t^2 + C_{12}t - C_{13} + C_{21}t^2 - C_{22}t \\ C_{11}t^2 - C_{15} + 2C_{17}t - C_{31}t^2 - 2C_{32}t + C_{40} \\ -C_{11}t^2 + C_{12}t - C_{13} + C_{21}t^2 - C_{34}t \\ -C_{12}t + C_{14}t - C_{17}t - C_{18} + C_{21}t^2 + C_{22}t - C_{24}t - C_{27}t + C_{31}t^2 + 2C_{32}t - C_{40} \\ C_{12}t - C_{14}t - C_{17}t - C_{19} + C_{32}t + C_{37}t - C_{40} \\ -C_{20} + C_{27}t + C_{37}t \\ C_{11}t^2 - C_{12}t - C_{21}t^2 + C_{22}t - C_{23} \\ -C_{11}t^2 + C_{12}t - C_{14}t - C_{17}t - C_{22}t - C_{24}t - C_{27}t + C_{31}t^2 + 2C_{32}t - C_{40} \\ C_{12}t - C_{14}t - C_{17}t - C_{22}t - C_{24}t - C_{25}t - C_{23} \\ -C_{11}t^2 + C_{12}t - C_{12}t^2 + C_{21}t^2 + C_{22}t - C_{23} \\ -C_{11}t^2 + C_{12}t - C_{12}t - C_{21}t^2 - C_{23}t + C_{40} \\ C_{12}t^2 + 2C_{24}t - C_{28} - C_{31}t^2 - 2C_{32}t + C_{40} \\ C_{21}t^2 + 2C_{24}t - C_{28} - C_{31}t^2 - 2C_{32}t + C_{40} \\ C_{21}t^2 + 2C_{24}t - C_{29}t - C_{34}t + C_{37}t - C_{40} \\ -C_{21}t^2 + C_{27}t - C_{30}t - C_{31}t^2 - C_{37}t \\ C_{12}t + C_{22}t - C_{33} \\ -C_{11}t^2 - C_{12}t + C_{14}t - C_{17}t + C_{31}t^2 + C_{32}t - C_{34}t - C_{35}t - C_{40} \\ C_{11}t^2 - C_{14}t - C_{31}t^2 + C_{34}t - C_{35} \\ -C_{21}t^2 - C_{22}t - C_{24}t + C_{27}t + C_{31}t^2 + C_{32}t - C_{34}t - C_{35}t - C_{40} \\ C_{11}t^2 - C_{14}t - C_{31}t^2 + C_{32}t - C_{34}t - C_{35}t - C_{40} \\ C_{21}t^2 - C_{27}t - C_{31}t^2 + C_{32}t - C_{34}t - C_{35}t - C_{40} \\ C_{21}t^2 - C_{27}t - C_{31}t^2 + C_{32}t - C_{34}t - C_{35}t - C_{40} \\ C_{21}t^2 - C_{27}t - C_{31}t^2 + C_{37}t - C_{39} \\ \end{bmatrix}$$

$$X_1 = (t+2) \partial t + (1 - 2tw_1) \partial w_1 + (1 - 2tw_2) \partial w_2 + (1 - 2tw_3) \partial w_3$$

$$X_2 = (1) \partial t$$
,

$$X_3 = (-1) \partial t$$
,

$$X_4 = (-1+t) \partial t + (w_1) \partial w_1 + (w_2) \partial w_2 + (w_3) \partial w_3$$

$$X_5 = (t) \partial t + (w_2 w_3 f_1(t) - w_1 w_2 f_1(t) - w_1 w_3 f_1(t)) \partial w_1 + (w_1 w_3 f_1(t) - w_1 w_2 f_1(t) + -w_2 w_3 f_1(t)) \partial w_2 + (w_1 w_2 f_1(t) - w_1 w_3 f_1(t) - w_2 w_3 f_1(t)) \partial w_3$$

Some of the generators might contain the following arbitrary functions:

 f_1

The execution time of the script was:

Run 01_21PM_24_October-2021

Degree in tangential ansätze: 2. The system of ODEs is given by:

$$\frac{\mathrm{d}w_1}{\mathrm{d}t} = -w_1w_2 - w_1w_3 + w_2w_3,$$

$$\frac{\mathrm{d}w_2}{\mathrm{d}t} = -w_1w_2 + w_1w_3 - w_2w_3,$$

$$\frac{\mathrm{d}w_3}{\mathrm{d}t} = w_1w_2 - w_1w_3 - w_2w_3.$$

The calculated generators are:

$$\mathbf{c}_{1} = \begin{bmatrix} C_{1} - C_{12}t + C_{31}t^{2} + C_{32}t - C_{40} + c_{32}\left(t\right) \\ C_{2} \\ C_{3} \\ C_{4} \\ C_{2}t + C_{4}t + C_{5} - C_{7}t \\ C_{6} \\ C_{7} \\ C_{2}t - C_{4}t + C_{7}t + C_{8} \\ -C_{2}t + C_{4}t + C_{7}t + C_{9} \\ C_{10} \\ C_{11} \\ C_{11}t^{2} - C_{12}t + C_{13} - C_{21}t^{2} + C_{22}t \\ -C_{11}t + C_{12} + C_{21}t \\ -C_{11}t + C_{12} + C_{31}t \\ -C_{11}t^{2} - C_{12}t + C_{31}t^{2} + C_{32}t - C_{40} + c_{32}\left(t\right) \\ C_{11}t^{2} - C_{12}t + C_{31}t^{2} + C_{31}t \\ -C_{11}t^{2} + C_{13} - C_{21}t - C_{31}t \\ -C_{12}t - C_{14}t + C_{18} - C_{31}t^{2} + C_{34}t \\ -C_{12}t - C_{14}t + C_{18} + C_{21}t^{2} - C_{22}t + C_{24}t + C_{27}t - C_{31}t^{2} - 2C_{32}t + C_{40} - c_{32}\left(t\right) \\ -C_{12}t + C_{14}t + C_{17}t + C_{19} - C_{32}t - C_{34}t + C_{37}t + C_{40} - c_{32}\left(t\right) \\ -C_{12}t + C_{14}t + C_{17}t + C_{21}t - C_{21}t + C_{22}t + C_{23}t \\ -C_{11}t + C_{21}t - C_{21}t + C_{22}t \\ -C_{11}t^{2} - C_{12}t + C_{14}t + C_{17}t + C_{22}t + C_{23}t \\ -C_{11}t + C_{21}t - C_{22}t + C_{23}t \\ -C_{11}t + C_{22}t - C_{31}t \\ -C_{21}t + C_{22}t - C_{31}t \\ -C_{21}t + C_{23}t + C_{31}t \\ -C_{21}t + C_{24}t + C_{25}t - C_{31}t \\ -C_{21}t + C_{24}t + C_{25}t - C_{31}t + C_{37}t + C_{40} - c_{32}\left(t\right) \\ -C_{11}t^{2} - C_{12}t + C_{23}t + C_{23}t + C_{34}t - C_{37}t + C_{40} - c_{32}\left(t\right) \\ -C_{11}t^{2} - C_{27}t + C_{30}t - C_{31}t^{2} + C_{37}t + C_{40} - c_{32}\left(t\right) \\ -C_{21}t^{2} - C_{27}t + C_{30}t - C_{31}t^{2} + C_{37}t + C_{40} - c_{32}\left(t\right) \\ -C_{11}t^{2} - C_{12}t + C_{23}t + C_{34}t - C_{37}t + C_{40} - c_{32}\left(t\right) \\ -C_{11}t^{2} - C_{12}t + C_{23}t + C_{34}t - C_{37}t + C_{40} - c_{32}\left(t\right) \\ -C_{11}t^{2} - C_{12}t + C_{23}t + C_{34}t - C_{37}t + C_{30}t - C_{31}t^{2} + C_{37}t + C_{40} - c_{32}\left(t\right) \\ -C_{11}t^{2} - C_{12}t + C_{23}t + C_{34}t - C_{37}t + C_{30}t - C_{31}t^{2} + C_{34}t + C_{35}t - C_{37}t + C_{40}t - c_{32}\left(t\right) \\ -C_{11}t^{2} - C_{12}t + C_{23}t + C_{34}t + C_{35}t - C_{37}t + C_{40}t - c_{32}\left(t\right) \\ -C_{11}t^{2} + C_{12}t + C_{12}t + C_{13}t + C_{13}t + C_{37}t + C_{30}t - C_{31}t^{$$

$$\begin{bmatrix} -C_3 \\ -C_2t - C_4t - C_5 + C_7t \\ -C_6 \\ -C_2t + C_4t - C_7t - C_8 \\ C_2t - C_4t - C_7t - C_9 \\ -C_{10} \\ -C_{11}t^2 + C_{12}t - C_{13} + C_{21}t^2 - C_{22}t \\ C_{11}t^2 - C_{15} + 2C_{17}t - C_{31}t^2 - 2C_{32}t + C_{40} \\ -C_{12}t + C_{14}t - C_{17}t - C_{19} + C_{21}t^2 + C_{23}t - C_{40} \\ C_{12}t - C_{14}t - C_{17}t - C_{19}t^2 + C_{24}t - C_{27}t + C_{31}t^2 + 2C_{32}t - C_{40} \\ C_{12}t - C_{14}t - C_{17}t - C_{19}t + C_{32}t + C_{34}t - C_{37}t - C_{40} \\ -C_{20}t - C_{27}t + C_{37}t - C_{21}t - C_{21}t - C_{23}t - C_{40} \\ C_{12}t - C_{14}t - C_{17}t - C_{21}t^2 + C_{22}t - C_{23} \\ -C_{11}t^2 + C_{12}t - C_{12}t - C_{21}t^2 + C_{22}t - C_{23} \\ -C_{11}t^2 + C_{12}t - C_{12}t - C_{21}t^2 - C_{22}t - C_{23} \\ -C_{11}t^2 + C_{12}t - C_{12}t - C_{21}t^2 - C_{23}t - C_{40} \\ C_{12}t^2 + 2C_{24}t - C_{25}t - C_{34}t + C_{37}t - C_{40} \\ C_{12}t^2 + 2C_{24}t - C_{25}t - C_{31}t^2 - 2C_{32}t + C_{40} \\ C_{12}t^2 + 2C_{24}t - C_{25}t - C_{31}t^2 - 2C_{32}t + C_{40} \\ C_{21}t^2 + 2C_{24}t - C_{29}t - C_{34}t + C_{37}t - C_{40} \\ -C_{21}t^2 + C_{27}t - C_{30}t - C_{31}t^2 - C_{37}t \\ C_{12}t + C_{22}t - C_{33} \\ -C_{11}t^2 - C_{12}t + C_{14}t - C_{17}t + C_{31}t^2 + C_{32}t - C_{34}t - C_{35}t - C_{40} \\ C_{11}t^2 - C_{12}t + C_{14}t - C_{17}t + C_{31}t^2 + C_{32}t - C_{34}t - C_{35}t - C_{40} \\ C_{11}t^2 - C_{12}t + C_{14}t - C_{17}t + C_{31}t^2 + C_{32}t - C_{34}t - C_{35}t - C_{40} \\ C_{11}t^2 - C_{12}t + C_{14}t - C_{17}t + C_{31}t^2 + C_{32}t - C_{34}t - C_{35}t - C_{40} \\ C_{11}t^2 - C_{12}t + C_{21}t - C_{31}t^2 + C_{32}t - C_{34}t - C_{35}t - C_{40} \\ C_{11}t^2 - C_{12}t + C_{21}t - C_{21}t^2 + C_{22}t - C_{24}t - C_{25}t - C_{34}t - C_{35}t - C_{35}t - C_{40} \\ C_{11}t^2 - C_{12}t - C_{21}t - C_{21}t^2 + C_{21}t - C_{31}t^2 - C_{31}t - C_{30}t - C_{31}t^2 - C_{31}t - C_{40} \\ C_{11}t^2 - C_{12}t - C_{21}t - C_{21}t^2 + C_{21}t - C_{31}t^2 - C_{31}t - C_{30}t - C_{31}t^2 - C_{31}t - C_{30}t - C_{31}t^2 - C_{31}t - C_{31}t^2 - C_{31}t - C_{3$$

$$X_1 = (t+2) \partial t + (1 - 2tw_1) \partial w_1 + (1 - 2tw_2) \partial w_2 + (1 - 2tw_3) \partial w_3$$

$$X_2 = (1) \partial t$$
,

$$X_3 = (-1) \, \partial t,$$

$$X_4 = (-1+t) \partial t + (w_1) \partial w_1 + (w_2) \partial w_2 + (w_3) \partial w_3$$

$$X_{5} = (t) \partial t + (w_{2}w_{3} f_{1}(t) - w_{1}w_{2} f_{1}(t) - w_{1}w_{3} f_{1}(t)) \partial w_{1} + (w_{1}w_{3} f_{1}(t) - w_{1}w_{2} f_{1}(t) + -w_{2}w_{3} f_{1}(t)) \partial w_{2} + (w_{1}w_{2} f_{1}(t) - w_{1}w_{3} f_{1}(t) - w_{2}w_{3} f_{1}(t)) \partial w_{3}$$

Some of the generators might contain the following arbitrary functions:

 f_1

The execution time of the script was:

0 hours 3 minutes 36 seconds.