Summary of symmetry calculations

October 29, 2021

Contents

1 DBH_model **5**

Chapter 1

DBH_model

Run 01_58PM_29_October-2021

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

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

The calculated generators are:

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

$$\begin{aligned}X_2 = {} & (t+2)\,\partial t + (1-2tw_1)\,\partial w_1 + (1-2tw_2)\,\partial w_2\\ & + (1-2tw_3)\,\partial w_3\end{aligned}$$

$$X_3 = (-1+t)\,\partial t + (w_1)\,\partial w_1 + (w_2)\,\partial w_2 + (w_3)\,\partial w_3,$$

$$X_4 = (1)\,\partial t,$$

$$\begin{aligned}X_5 = {} & (t)\,\partial t + (w_2w_3\,\mathrm{f}_1(t) - w_1w_2\,\mathrm{f}_1(t) - w_1w_3\,\mathrm{f}_1(t))\,\partial w_1 + (w_1w_3\,\mathrm{f}_1(t) - w_1w_2\,\mathrm{f}_1(t)\\ & + -w_2w_3\,\mathrm{f}_1(t))\,\partial w_2 + (w_1w_2\,\mathrm{f}_1(t) - w_1w_3\,\mathrm{f}_1(t) - w_2w_3\,\mathrm{f}_1(t))\,\partial w_3\end{aligned}$$

Some of the generators might contain the following arbitrary functions:

$$f_1$$

Equation $-C_3$:

$$C_3 = 0$$

Equation $-C_2t - C_4t - C_5 + C_7t$:

$$C_2 = -C_4 + C_7$$
$$C_5 = 0$$

Equation $-C_6$:

$$C_6 = 0$$

Equation $2C_4t - 2C_7t - C_8$:

$$C_4 = C_7$$
$$C_8 = 0$$

Equation $-2C_7t - C_9$:

$$C_7 = 0$$
$$C_9 = 0$$

Equation $-C_{10}$:

$$C_{10} = 0$$

Equation $-C_{11}t^2 + C_{12}t - C_{13} + C_{21}t^2 - C_{22}t$:

$$C_{12} = C_{22}$$
$$C_{11} = C_{21}$$
$$C_{13} = 0$$

Equation $-C_{15} + 2C_{17}t + C_{21}t^2 - C_{31}t^2 - 2C_{32}t + C_{40}$:

$$C_{17} = C_{32}$$
$$C_{21} = C_{31}$$
$$C_{15} = C_{40}$$

Equation $C_{14}t - C_{16} - C_{34}t$:

$$C_{14} = C_{34}$$
$$C_{16} = 0$$

Equation $-C_{18} - C_{24}t - C_{27}t + C_{32}t + C_{34}t - C_{40}$:

$$C_{24} = -C_{27} + C_{32} + C_{34}$$
$$C_{18} = -C_{40}$$

Equation $-C_{19} + C_{22}t - C_{37}t - C_{40}$:

$$C_{22} = C_{37}$$
$$C_{19} = -C_{40}$$

Equation $-C_{20} + C_{27}t + C_{37}t$:

$$C_{27} = -C_{37}$$
$$C_{20} = 0$$

Equation $-C_{23}$:

$$C_{23} = 0$$

Equation $-C_{25} - 2C_{34}t - 2C_{37}t - C_{40}$:

$$C_{34} = -C_{37}$$
$$C_{25} = -C_{40}$$

Equation $-C_{26} - 2C_{37}t$:

$$C_{37} = 0$$
$$C_{26} = 0$$

Equation $-C_{28} + C_{40}$:

$$C_{28} = C_{40}$$

Equation $-C_{29} - C_{40}$:

$$C_{29} = -C_{40}$$

Equation $-C_{30}$:

$$C_{30} = 0$$

Equation $-C_{33}$:

$$C_{33} = 0$$

Equation $-C_{35} - C_{40}$:

$$C_{35} = -C_{40}$$

Equation $-C_{36}$:

$$C_{36} = 0$$

Equation $-C_{38} - C_{40}$:

$$C_{38} = -C_{40}$$

Equation $-C_{39}$:

$$C_{39} = 0$$

The execution time of the script was:

0 hours 5 minutes 7 seconds.

Run 02_03PM_29_October-2021

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

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

The calculated generators are:

$$\begin{aligned}
X_1 = &(t+2)\,\partial t + (1-2tw_1)\,\partial w_1 + (1-2tw_2)\,\partial w_2\\
&+ (1-2tw_3)\,\partial w_3
\end{aligned}$$

$$X_2 = (-1+t)\,\partial t + (w_1)\,\partial w_1 + (w_2)\,\partial w_2 + (w_3)\,\partial w_3,$$

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

$$X_4 = (1)\,\partial t,$$

$$\begin{aligned} X_5 = {} & (t)\,\partial t + (w_2 w_3\,\mathrm{f}_1(t) - w_1 w_2\,\mathrm{f}_1(t) - w_1 w_3\,\mathrm{f}_1(t))\,\partial w_1 + (w_1 w_3\,\mathrm{f}_1(t) - w_1 w_2\,\mathrm{f}_1(t) \\ & + -w_2 w_3\,\mathrm{f}_1(t))\,\partial w_2 + (w_1 w_2\,\mathrm{f}_1(t) - w_1 w_3\,\mathrm{f}_1(t) - w_2 w_3\,\mathrm{f}_1(t))\,\partial w_3 \end{aligned}$$

Some of the generators might contain the following arbitrary functions:

$$\mathrm{f}_1$$

Equation $-C_3$:

$$C_3 = 0$$

Equation $-C_2 t - C_4 t - C_5 + C_7 t$:

$$\begin{aligned} C_2 &= -C_4 + C_7 \\ C_5 &= 0 \end{aligned}$$

Equation $-C_6$:

$$C_6 = 0$$

Equation $2C_4 t - 2C_7 t - C_8$:

$$\begin{aligned} C_4 &= C_7 \\ C_8 &= 0 \end{aligned}$$

Equation $-2C_7 t - C_9$:

$$\begin{aligned} C_7 &= 0 \\ C_9 &= 0 \end{aligned}$$

Equation $-C_{10}$:

$$C_{10} = 0$$

Equation $-C_{11} t^2 + C_{12} t - C_{13} + C_{21} t^2 - C_{22} t$:

$$\begin{aligned} C_{11} &= C_{21} \\ C_{12} &= C_{22} \\ C_{13} &= 0 \end{aligned}$$

Equation $-C_{15} + 2C_{17}t + C_{21}t^2 - C_{31}t^2 - 2C_{32}t + C_{40}$:

$$C_{21} = C_{31}$$
$$C_{17} = C_{32}$$
$$C_{15} = C_{40}$$

Equation $C_{14}t - C_{16} - C_{34}t$:

$$C_{14} = C_{34}$$
$$C_{16} = 0$$

Equation $-C_{18} - C_{24}t - C_{27}t + C_{32}t + C_{34}t - C_{40}$:

$$C_{24} = -C_{27} + C_{32} + C_{34}$$
$$C_{18} = -C_{40}$$

Equation $-C_{19} + C_{22}t - C_{37}t - C_{40}$:

$$C_{22} = C_{37}$$
$$C_{19} = -C_{40}$$

Equation $-C_{20} + C_{27}t + C_{37}t$:

$$C_{27} = -C_{37}$$
$$C_{20} = 0$$

Equation $-C_{23}$:

$$C_{23} = 0$$

Equation $-C_{25} - 2C_{34}t - 2C_{37}t - C_{40}$:

$$C_{34} = -C_{37}$$
$$C_{25} = -C_{40}$$

Equation $-C_{26} - 2C_{37}t$:

$$C_{37} = 0$$
$$C_{26} = 0$$

Equation $-C_{28} + C_{40}$:

$$C_{28} = C_{40}$$

Equation $-C_{29} - C_{40}$:

$$C_{29} = -C_{40}$$

Equation $-C_{30}$:

$$C_{30} = 0$$

Equation $-C_{33}$:

$$C_{33} = 0$$

Equation $-C_{35} - C_{40}$:

$$C_{35} = -C_{40}$$

Equation $-C_{36}$:

$$C_{36} = 0$$

Equation $-C_{38} - C_{40}$:

$$C_{38} = -C_{40}$$

Equation $-C_{39}$:

$$C_{39} = 0$$

The execution time of the script was:

0 hours 5 minutes 1 seconds.

Run 02_08PM_29_October-2021

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

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

The calculated generators are:

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

$$X_2 = (-1+t)\,\partial t + (w_1)\,\partial w_1 + (w_2)\,\partial w_2 + (w_3)\,\partial w_3,$$

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

$$X_4 = (-1)\,\partial t,$$

$$X_5 = (t)\,\partial t + (w_2 w_3\,\mathrm{f}_1(t) - w_1 w_2\,\mathrm{f}_1(t) - w_1 w_3\,\mathrm{f}_1(t))\,\partial w_1 + (w_1 w_3\,\mathrm{f}_1(t) - w_1 w_2\,\mathrm{f}_1(t) + -w_2 w_3\,\mathrm{f}_1(t))\,\partial w_2 + (w_1 w_2\,\mathrm{f}_1(t) - w_1 w_3\,\mathrm{f}_1(t) - w_2 w_3\,\mathrm{f}_1(t))\,\partial w_3$$

Some of the generators might contain the following arbitrary functions:

$$\mathrm{f}_1$$

Equation $-C_3$:

$$C_3 = 0$$

Equation $-C_2 t - C_4 t - C_5 + C_7 t$:

$$C_2 = -C_4 + C_7$$
$$C_5 = 0$$

Equation $-C_6$:

$$C_6 = 0$$

Equation $2C_4 t - 2C_7 t - C_8$:

$$C_4 = C_7$$
$$C_8 = 0$$

Equation $-2C_7 t - C_9$:

$$C_7 = 0$$
$$C_9 = 0$$

Equation $-C_{10}$:

$$C_{10} = 0$$

Equation $-C_{11}t^2 + C_{12}t - C_{13} + C_{21}t^2 - C_{22}t$:

$$C_{12} = C_{22}$$
$$C_{11} = C_{21}$$
$$C_{13} = 0$$

Equation $-C_{15} + 2C_{17}t + C_{21}t^2 - C_{31}t^2 - 2C_{32}t + C_{40}$:

$$C_{17} = C_{32}$$
$$C_{21} = C_{31}$$
$$C_{15} = C_{40}$$

Equation $C_{14}t - C_{16} - C_{34}t$:

$$C_{14} = C_{34}$$
$$C_{16} = 0$$

Equation $-C_{18} - C_{24}t - C_{27}t + C_{32}t + C_{34}t - C_{40}$:

$$C_{24} = -C_{27} + C_{32} + C_{34}$$
$$C_{18} = -C_{40}$$

Equation $-C_{19} + C_{22}t - C_{37}t - C_{40}$:

$$C_{22} = C_{37}$$
$$C_{19} = -C_{40}$$

Equation $-C_{20} + C_{27}t + C_{37}t$:

$$C_{27} = -C_{37}$$
$$C_{20} = 0$$

Equation $-C_{23}$:

$$C_{23} = 0$$

Equation $-C_{25} - 2C_{34}t - 2C_{37}t - C_{40}$:

$$C_{34} = -C_{37}$$
$$C_{25} = -C_{40}$$

Equation $-C_{26} - 2C_{37}t$:

$$C_{37} = 0$$
$$C_{26} = 0$$

Equation $-C_{28} + C_{40}$:

$$C_{28} = C_{40}$$

Equation $-C_{29} - C_{40}$:

$$C_{29} = -C_{40}$$

Equation $-C_{30}$:

$$C_{30} = 0$$

Equation $-C_{33}$:

$$C_{33} = 0$$

Equation $-C_{35} - C_{40}$:

$$C_{35} = -C_{40}$$

Equation $-C_{36}$:

$$C_{36} = 0$$

Equation $-C_{38} - C_{40}$:

$$C_{38} = -C_{40}$$

Equation $-C_{39}$:

$$C_{39} = 0$$

The execution time of the script was:

0 hours 5 minutes 4 seconds.

Run 02_13PM_29_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:

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

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

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

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

$$X_5 = (t)\,\partial t + (w_2w_3\,\mathrm{f}_1(t) - w_1w_2\,\mathrm{f}_1(t) - w_1w_3\,\mathrm{f}_1(t))\,\partial w_1 + (w_1w_3\,\mathrm{f}_1(t) - w_1w_2\,\mathrm{f}_1(t) + -w_2w_3\,\mathrm{f}_1(t))\,\partial w_2 + (w_1w_2\,\mathrm{f}_1(t) - w_1w_3\,\mathrm{f}_1(t) - w_2w_3\,\mathrm{f}_1(t))\,\partial w_3$$

Some of the generators might contain the following arbitrary functions:

$$\mathrm{f}_1$$

Equation $-C_3$:

$$C_3 = 0$$

Equation $-C_2t - C_4t - C_5 + C_7t$:

$$C_2 = -C_4 + C_7$$
$$C_5 = 0$$

Equation $-C_6$:

$$C_6 = 0$$

Equation $2C_4t - 2C_7t - C_8$:

$$C_4 = C_7$$
$$C_8 = 0$$

Equation $-2C_7t - C_9$:

$$C_7 = 0$$
$$C_9 = 0$$

Equation $-C_{10}$:

$$C_{10} = 0$$

Equation $-C_{11}t^2 + C_{12}t - C_{13} + C_{21}t^2 - C_{22}t$:

$$C_{12} = C_{22}$$
$$C_{11} = C_{21}$$
$$C_{13} = 0$$

Equation $-C_{15} + 2C_{17}t + C_{21}t^2 - C_{31}t^2 - 2C_{32}t + C_{40}$:

$$C_{17} = C_{32}$$
$$C_{21} = C_{31}$$
$$C_{15} = C_{40}$$

Equation $C_{14}t - C_{16} - C_{34}t$:

$$C_{14} = C_{34}$$
$$C_{16} = 0$$

Equation $-C_{18} - C_{24}t - C_{27}t + C_{32}t + C_{34}t - C_{40}$:

$$C_{24} = -C_{27} + C_{32} + C_{34}$$
$$C_{18} = -C_{40}$$

Equation $-C_{19} + C_{22}t - C_{37}t - C_{40}$:

$$C_{22} = C_{37}$$
$$C_{19} = -C_{40}$$

Equation $-C_{20} + C_{27}t + C_{37}t$:

$$C_{27} = -C_{37}$$
$$C_{20} = 0$$

Equation $-C_{23}$:

$$C_{23} = 0$$

Equation $-C_{25} - 2C_{34}t - 2C_{37}t - C_{40}$:

$$C_{34} = -C_{37}$$
$$C_{25} = -C_{40}$$

Equation $-C_{26} - 2C_{37}t$:

$$C_{37} = 0$$
$$C_{26} = 0$$

Equation $-C_{28} + C_{40}$:

$$C_{28} = C_{40}$$

Equation $-C_{29} - C_{40}$:

$$C_{29} = -C_{40}$$

Equation $-C_{30}$:

$$C_{30} = 0$$

Equation $-C_{33}$:

$$C_{33} = 0$$

Equation $-C_{35} - C_{40}$:

$$C_{35} = -C_{40}$$

Equation $-C_{36}$:

$$C_{36} = 0$$

Equation $-C_{38} - C_{40}$:

$$C_{38} = -C_{40}$$

Equation $-C_{39}$:

$$C_{39} = 0$$

The execution time of the script was:

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