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And $\big(d(g_1)d(g_2) - d(g_2)d(g_1)\big)x - x\big(d(g_1)d(g_2) - d(g_2)d(g_1)\big)$

$$= \begin{pmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & c_2d_1 - c_1d_2 & b_1d_2 - b_2d_1 \\ 0 & -(c_2d_1 - c_1d_2) & 0 & b_2c_1 - b_1c_2 \\ 0 & -(b_1d_2 - b_2d_1) & -(b_2c_1 - b_1c_2) & 0 \end{pmatrix} \begin{pmatrix} x_0 \\ x_1 \\ x_2 \\ x_3 \end{pmatrix}$$

$$- (x_0\ x_1\ x_2\ x_3) \begin{pmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & c_2d_1 - c_1d_2 & b_1d_2 - b_2d_1 \\ 0 & -(c_2d_1 - c_1d_2) & 0 & b_2c_1 - b_1c_2 \\ 0 & -(b_1d_2 - b_2d_1) & -(b_2c_1 - b_1c_2) & 0 \end{pmatrix}$$

$$= \begin{pmatrix} 0 \\ x_2(c_2d_1 - c_1d_2) + x_3(b_1d_2 - b_2d_1) \\ -x_1(c_2d_1 - c_1d_2) + x_3(b_2c_1 - b_1c_2) \\ -x_1(b_1d_2 - b_2d_1) - x_2(b_2c_1 - b_1c_2) \end{pmatrix} - \begin{pmatrix} 0 \\ -x_2(c_2d_1 - c_1d_2) - x_3(b_1d_2 - b_2d_1) \\ x_1(c_2d_1 - c_1d_2) - x_3(b_2c_1 - b_1c_2) \\ x_1(b_1d_2 - b_2d_1) + x_2(b_2c_1 - b_1c_2) \end{pmatrix}$$

$$= \begin{pmatrix} 0 \\ 2x_2(c_2d_1 - c_1d_2) + 2x_3(b_1d_2 - b_2d_1) \\ -2x_1(c_2d_1 - c_1d_2) + 2x_3(b_2c_1 - b_1c_2) \\ -2x_1(b_1d_2 - b_2d_1) - 2x_2(b_2c_1 - b_1c_2) \end{pmatrix}$$

$$= (x_0, x_1, x_2, x_3) \begin{pmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 2(c_1d_2 - c_2d_1) & 2(b_2d_1 - b_1d_2) \\ 0 & -2(c_1d_2 - c_2d_1) & 0 & 2(b_1c_2 - b_2c_1) \\ 0 & -2(b_2d_1 - b_1d_2) & -2(b_1c_2 - b_2c_1) & 0 \end{pmatrix}$$

The transformation matrix is exactly that on bottom of p10.
If g_1 and g_2 are as usual then in this represent.

$$\mathrm{ad}\, g_1(g_2) = \begin{pmatrix} 0 \\ 2(c_1d_2 - d_1c_2) \\ 2(d_1b_2 - b_1d_2) \\ 2(b_1c_2 - c_1b_2) \end{pmatrix}^T = (a_2, b_2, c_2, d_2) \begin{pmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 2d_1 & -2c_1 \\ 0 & -2d_1 & 0 & 2b_1 \\ 0 & +2c_1 & -2b_1 & 0 \end{pmatrix}$$

I'd done this already - You see how tired I was.

Although the result is (quasi) correct — you have started on the wrong premise, viz. that $g \in Sp(1)$ group. g is given as an element of the algebra $sp(1)$, & has only 3 parameters —

(i) 2/2
(ii) 2/3
(iii) 3/5

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