Note that: The correctness of these regressor matrices have not checked.

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$$Y_i({}^iV_i, {}^i\tilde{V}_i) \in \mathbb{R}^{6\times13} \quad \tilde{Y}_i({}^iV_i, {}^i\tilde{V}_i, {}^i\tilde{\tilde{V}}_i) \in \mathbb{R}^{6\times13} \quad \tilde{\tilde{Y}}_i({}^iV_i, {}^i\tilde{V}_i, {}^i\tilde{\tilde{V}}_i, {}^i\tilde{\tilde{\tilde{V}}}_i) \in \mathbb{R}^{6\times13} ;$$

Define: $\omega_x = {}^i\omega_i(1) \quad \omega_y = {}^i\omega_i(2) \quad \omega_z = {}^i\omega_i(3)$

$\dot{\omega}_x = {}^i\dot{\omega}_i(1) \quad \dot{\omega}_y = {}^i\dot{\omega}_i(2) \quad \dot{\omega}_z = {}^i\dot{\omega}_i(3)$

$\ddot{\omega}_x = {}^i\ddot{\omega}_i(1) \quad \ddot{\omega}_y = {}^i\ddot{\omega}_i(2) \quad \ddot{\omega}_z = {}^i\ddot{\omega}_i(3)$

$v_1 = {}^iV_i(1); v_2 = {}^iV_i(2); v_3 = {}^iV_i(3); v_4 = {}^iV_i(4); v_5 = {}^iV_i(5); v_6 = {}^iV_i(6)$

$\dot{v}_1 = {}^i\tilde{V}_i(1); \dot{v}_2 = {}^i\tilde{V}_i(2); \dot{v}_3 = {}^i\tilde{V}_i(3); \dot{v}_4 = {}^i\tilde{V}_i(4); \dot{v}_5 = {}^i\tilde{V}_i(5); \dot{v}_6 = {}^i\tilde{V}_i(6)$

$\ddot{v}_1 = {}^i\tilde{\tilde{V}}_i(1); \ddot{v}_2 = {}^i\tilde{\tilde{V}}_i(2); \ddot{v}_3 = {}^i\tilde{\tilde{V}}_i(3); \ddot{v}_4 = {}^i\tilde{\tilde{V}}_i(4); \ddot{v}_5 = {}^i\tilde{\tilde{V}}_i(5); \ddot{v}_6 = {}^i\tilde{\tilde{V}}_i(6)$

$\dddot{v}_1 = {}^i\tilde{\tilde{\tilde{V}}}_i(1); \dddot{v}_2 = {}^i\tilde{\tilde{\tilde{V}}}_i(2); \dddot{v}_3 = {}^i\tilde{\tilde{\tilde{V}}}_i(3); \dddot{v}_4 = {}^i\tilde{\tilde{\tilde{V}}}_i(4); \dddot{v}_5 = {}^i\tilde{\tilde{\tilde{V}}}_i(5); \dddot{v}_6 = {}^i\tilde{\tilde{\tilde{V}}}_i(6)$

The non-zero elements in $\tilde{Y}_i$ are listed as:

$\tilde{Y}_i(1,1) = \ddot{v}_1 - 2\omega_z\dot{v}_2 + 2\omega_y\dot{v}_3 - \dot{\omega}_z v_2 + \dot{\omega}_y v_3 - (\omega_z^2 + \omega_y^2)v_1 + \omega_x\omega_y v_2 + \omega_z\omega_x v_3$

$\tilde{Y}_i(2,1) = \ddot{v}_2 + 2\omega_z\dot{v}_1 - 2\omega_x\dot{v}_3 + \dot{\omega}_z v_2 - \dot{\omega}_x v_3 - (\omega_z^2 + \omega_x^2)v_2 + \omega_x\omega_y v_1 + \omega_z\omega_y v_3$

$\tilde{Y}_i(3,1) = \ddot{v}_3 - 2\omega_y\dot{v}_1 + 2\omega_x\dot{v}_2 - \dot{\omega}_z v_1 + \dot{\omega}_x v_2 - (\omega_y^2 + \omega_x^2)v_3 + \omega_x\omega_z v_1 + \omega_z\omega_y v_2$

$\tilde{Y}_i(1,2) = -2\omega_y\dot{v}_5 - 2\omega_z\dot{v}_6 - \dot{\omega}_y v_5 - \dot{\omega}_z v_6 - \omega_z\omega_y v_5 + \omega_y\omega_x v_6$

$\tilde{Y}_i(2,2) = \ddot{v}_6 + 2\omega_x\dot{v}_5 + \dot{\omega}_x v_5 - \omega_z\omega_y v_5 - \omega_z\omega_z v_6 - \omega_x\omega_x v_6$

$\tilde{Y}_i(3,2) = -\ddot{v}_5 + 2\omega_x\dot{v}_6 + \dot{\omega}_x v_6 + \omega_x\omega_x v_5 + \omega_y\omega_y v_5 + \omega_y\omega_z v_6$

$$\tilde{Y}_i(5,2) = -\tilde{Y}_i(3,1)$$

$$\tilde{Y}_i(6,2) = \tilde{Y}_i(2,1)$$

$$\tilde{Y}_i(1,3) = -\ddot{v}_6 + 2\omega_y\dot{v}_4 + \dot{\omega}_y v_4 + \omega_z\omega_x v_4 + \omega_y\omega_y v_6 + \omega_z\omega_z v_6$$

$$\tilde{Y}_i(2,3) = -2\omega_x\dot{v}_4 - 2\omega_z\dot{v}_6 - \dot{\omega}_x v_4 - \dot{\omega}_z v_6 + \omega_z\omega_y v_4 - \omega_y\omega_x v_6$$

$$\tilde{Y}_i(3,3) = \ddot{v}_4 + 2\omega_y\dot{v}_6 + \dot{\omega}_y v_6 - \omega_y\omega_y v_4 - \omega_x\omega_x v_4 - \omega_x\omega_z v_6$$

$$\tilde{Y}_i(4,3) = \tilde{Y}_i(3,1)$$

$$\tilde{Y}_i(6,3) = -\tilde{Y}_i(1,1)$$

$$\tilde{Y}_i(1,4) = \ddot{v}_5 + 2\omega_z\dot{v}_4 + \dot{\omega}_z v_4 - \omega_y\omega_x v_4 - \omega_z\omega_z v_5 - \omega_y\omega_y v_5$$

$$\tilde{Y}_i(2,4) = -\ddot{v}_4 + 2\omega_z\dot{v}_5 + \dot{\omega}_z v_5 + \omega_z\omega_z v_4 + \omega_x\omega_x v_4 + \omega_x\omega_y v_5$$

$$\tilde{Y}_i(3,4) = -2\omega_x\dot{v}_4 - 2\omega_y\dot{v}_5 - \dot{\omega}_x v_4 - \dot{\omega}_y v_5 - \omega_z\omega_y v_4 + \omega_x\omega_z v_5$$

$$\tilde{Y}_i(4,4) = -\tilde{Y}_i(2,1)$$

$$\tilde{Y}_i(5,4) = \tilde{Y}_i(1,1)$$

$$\tilde{Y}_i(5,5) = -\tilde{Y}_i(3,2)$$

$$\tilde{Y}_i(6,5) = \tilde{Y}_i(2,2)$$

$$\tilde{Y}_i(4,6) = \tilde{Y}_i(3,3)$$

$$\tilde{Y}_i(6,6) = -\tilde{Y}_i(1,3)$$

$$\tilde{Y}_i(4,7) = -\tilde{Y}_i(2,4)$$

$$\tilde{Y}_i(5,7) = \tilde{Y}_i(1,4)$$

$$\tilde{Y}_i(4,8) = \tilde{Y}_i(3,2)$$

$$\tilde{Y}_i(5,8) = -\tilde{Y}_i(3,3)$$

$$\tilde{Y}_i(6,8) = -2\omega_x\dot{v}_4 + 2\omega_y\dot{v}_5 - \dot{\omega}_x v_4 + \dot{\omega}_y v_5 + \omega_z\omega_y v_4 + \omega_x\omega_z v_5 - 2\omega_x\omega_y v_6$$

$$\tilde{Y}_i(4,9) = -\tilde{Y}_i(2,2)$$

$$\tilde{Y}_i(5,9) = 2\omega_x\dot{v}_4 - 2\omega_z\dot{v}_6 + \dot{\omega}_x v_4 - \dot{\omega}_z v_6 + \omega_z\omega_y v_4 + 2\omega_x\omega_z v_5 + \omega_y\omega_x v_6$$

$$\tilde{Y}_i(6,9) = \tilde{Y}_i(2,4)$$

$$\tilde{Y}_i(4,10) = -2\omega_y\dot{v}_5 + 2\omega_z\dot{v}_6 - \dot{\omega}_y v_5 + \dot{\omega}_z v_6 - 2\omega_z\omega_y v_4 + \omega_x\omega_z v_5 + \omega_y\omega_x v_6$$

$$\tilde{Y}_i(5,10) = \tilde{Y}_i(2,4)$$

$$\tilde{Y}_i(6,10) = -\tilde{Y}_i(2,2)$$

$$\tilde{Y}_i(4,11) = \ddot{v}_4 - \omega_z\dot{v}_5 + \omega_y\dot{v}_6 - \dot{\omega}_z v_5 + \dot{\omega}_y v_6 - 2(\omega_z^2 + \omega_y^2)v_4 + \omega_x\omega_y v_5 + \omega_z\omega_x v_6$$

$$\tilde{Y}_i(5,11) = 2\omega_z\dot{v}_4 + \dot{\omega}_z v_4 + \omega_x\omega_y v_4 + \omega_z\omega_z v_5 - \omega_z\omega_y v_6$$

$$\tilde{Y}_i(6,11) = -2\omega_y\dot{v}_4 - \dot{\omega}_y v_4 + \omega_x\omega_z v_4 - \omega_y\omega_z v_5 + \omega_y\omega_y v_6$$

$$\tilde{Y}_i(4,12) = -2\omega_z\dot{v}_5 - \dot{\omega}_z v_5 + \omega_x\omega_y v_5 + \omega_z\omega_z v_4 - \omega_z\omega_x v_6$$

$$\tilde{Y}_i(5,12) = \ddot{v}_5 + \omega_z\dot{v}_4 - \omega_x\dot{v}_6 + \dot{\omega}_z v_4 - \dot{\omega}_x v_6 - 2(\omega_z^2 + \omega_x^2)v_4 + \omega_x\omega_y v_4 + \omega_z\omega_x v_6$$

$$\tilde{Y}_i(6,12) = 2\omega_x\dot{v}_5 + \dot{\omega}_x v_5 + \omega_y\omega_z v_5 - \omega_x\omega_z v_4 + \omega_x\omega_x v_6$$

$$\tilde{Y}_i(4,13) = 2\omega_y\dot{v}_6 + \dot{\omega}_y v_6 + \omega_z\omega_x v_6 + \omega_y\omega_y v_4 - \omega_y\omega_x v_5$$

$$\tilde{Y}_i(5,13) = -2\omega_x\dot{v}_6 - \dot{\omega}_x v_6 + \omega_y\omega_z v_6 - \omega_x\omega_y v_4 + \omega_x\omega_x v_5$$

$$\tilde{Y}_i(6,13) = \ddot{v}_6 - \omega_y\dot{v}_4 + \omega_x\dot{v}_5 - \dot{\omega}_y v_4 + \dot{\omega}_x v_5 - 2(\omega_y^2 + \omega_x^2)v_4 + \omega_x\omega_z v_4 + \omega_y\omega_z v_5$$

Setting $kk = 1.5$, $ff = 3$, $cc = 2$, and $\tilde{\tilde{Y}}_i = \tilde{\tilde{Y}}_{i-A} + \tilde{\tilde{Y}}_{i-B}$, non-zero elements in $\tilde{\tilde{Y}}_{i-A} \in \mathbb{R}^{6\times 13}$ and $\tilde{\tilde{Y}}_{i-B} \in \mathbb{R}^{6\times 13}$ are listed as follows:

$$\tilde{\tilde{Y}}_{i-A}(1,1) = \ddot{v}_1 + (-2\omega_z\ddot{v}_2 + 2\omega_y\ddot{v}_3)\bullet kk + [-\dot{\omega}_z\dot{v}_2 + \dot{\omega}_y\dot{v}_3 - (\omega_z^2 + \omega_y^2)\dot{v}_1 + \omega_x\omega_y\dot{v}_2 + \omega_z\omega_x\dot{v}_3]\bullet ff$$

$$\tilde{\tilde{Y}}_{i-A}(2,1) = \ddot{v}_2 + (2\omega_z\ddot{v}_1 - 2\omega_x\ddot{v}_3)\bullet kk + [\dot{\omega}_z\dot{v}_2 - \dot{\omega}_x\dot{v}_3 - (\omega_z^2 + \omega_x^2)\dot{v}_2 + \omega_x\omega_y\dot{v}_1 + \omega_z\omega_y\dot{v}_3]\bullet ff$$

$$\tilde{\tilde{Y}}_{i-A}(3,1) = \ddot{v}_3 + (-2\omega_y\ddot{v}_1 + 2\omega_x\ddot{v}_2)\bullet kk + [-\dot{\omega}_z\dot{v}_1 + \dot{\omega}_x\dot{v}_2 - (\omega_y^2 + \omega_x^2)\dot{v}_3 + \omega_x\omega_z\dot{v}_1 + \omega_z\omega_y\dot{v}_2]\bullet ff$$

$$\tilde{\tilde{Y}}_{i-A}(1,2) = (-2\omega_y\ddot{v}_5 - 2\omega_z\ddot{v}_6)\bullet kk + (-\dot{\omega}_y\dot{v}_5 - \dot{\omega}_z\dot{v}_6 - \omega_z\omega_y\dot{v}_5 + \omega_y\omega_x\dot{v}_6)\bullet ff$$

$$\tilde{\tilde{Y}}_{i-A}(2,2) = \ddot{v}_6 + 2\omega_x\ddot{v}_5\bullet kk + (\dot{\omega}_x\dot{v}_5 - \omega_z\omega_y\dot{v}_5 - \omega_z\omega_z\dot{v}_6 - \omega_x\omega_x\dot{v}_6)\bullet ff$$

$$\tilde{\tilde{Y}}_{i-A}(3,2) = -\ddot{v}_5 + 2\omega_x\ddot{v}_6\bullet kk + (\dot{\omega}_x\ddot{v}_6 + \omega_x\omega_x\dot{v}_5 + \omega_y\omega_y\dot{v}_5 + \omega_y\omega_z\dot{v}_6)\bullet ff$$

$$\tilde{\tilde{Y}}_{i-A}(5,2) = -\tilde{\tilde{Y}}_{i-A}(3,1)$$

$$\tilde{\tilde{Y}}_{i-A}(6,2) = \tilde{\tilde{Y}}_{i-A}(2,1)$$

$$\tilde{\tilde{Y}}_{i-A}(1,3) = -\ddot{v}_6 + 2\omega_y\ddot{v}_4\bullet kk + (\dot{\omega}_y\dot{v}_4 + \omega_z\omega_x\dot{v}_4 + \omega_y\omega_y\dot{v}_6 + \omega_z\omega_z\dot{v}_6)\bullet ff$$

$$\tilde{\tilde{Y}}_{i-A}(2,3) = (-2\omega_x\ddot{v}_4 - 2\omega_z\ddot{v}_6)\bullet kk + (-\dot{\omega}_x\dot{v}_4 - \dot{\omega}_z\dot{v}_6 + \omega_z\omega_y\dot{v}_4 - \omega_y\omega_x\dot{v}_6)\bullet ff$$

$$\tilde{\tilde{Y}}_{i-A}(3,3) = \ddot{v}_4 + 2\omega_y\ddot{v}_6\bullet kk + (\dot{\omega}_y\dot{v}_6 - \omega_y\omega_y\dot{v}_4 - \omega_x\omega_x\dot{v}_4 - \omega_x\omega_z\dot{v}_6)\bullet ff$$

$$\tilde{\tilde{Y}}_{i-A}(4,3) = \tilde{\tilde{Y}}_{i-A}(3,1)$$

$$\tilde{\tilde{Y}}_{i-A}(6,3) = -\tilde{\tilde{Y}}_{i-A}(1,1)$$

$$\tilde{\tilde{Y}}_{i-A}(1,4) = \ddot{v}_5 + 2\omega_z\ddot{v}_4\bullet kk + (\dot{\omega}_z\dot{v}_4 - \omega_y\omega_x\dot{v}_4 - \omega_z\omega_z\dot{v}_5 - \omega_y\omega_y\dot{v}_5)\bullet ff$$

$$\tilde{\tilde{Y}}_{i-A}(2,4) = -\ddot{v}_4 + 2\omega_z\ddot{v}_5\bullet kk + (\dot{\omega}_z\dot{v}_5 + \omega_z\omega_z\dot{v}_4 + \omega_x\omega_x\dot{v}_4 + \omega_x\omega_y\dot{v}_5)\bullet ff$$

$$\tilde{\tilde{Y}}_{i-A}(3,4) = (-2\omega_x\ddot{v}_4 - 2\omega_y\ddot{v}_5)\bullet kk + (-\dot{\omega}_x\dot{v}_4 - \dot{\omega}_y\dot{v}_5 - \omega_z\omega_y\dot{v}_4 + \omega_x\omega_z\dot{v}_5)\bullet ff$$

$$\tilde{\tilde{Y}}_{i-A}(4,4) = -\tilde{\tilde{Y}}_{i-A}(2,1)$$

$$\tilde{\tilde{Y}}_{i-A}(5,4) = \tilde{\tilde{Y}}_{i-A}(1,1)$$

$$\tilde{\tilde{Y}}_{i-A}(5,5) = -\tilde{\tilde{Y}}_{i-A}(3,2)$$

$$\tilde{\tilde{Y}}_{i-A}(6,5) = \tilde{\tilde{Y}}_{i-A}(2,2)$$

$$\tilde{\tilde{Y}}_{i-A}(4,6) = \tilde{\tilde{Y}}_{i-A}(3,3)$$

$$\tilde{\tilde{Y}}_{i-A}(6,6) = -\tilde{\tilde{Y}}_{i-A}(1,3)$$

$$\tilde{\tilde{Y}}_{i-A}(4,7) = -\tilde{\tilde{Y}}_{i-A}(2,4)$$

$$\tilde{\tilde{Y}}_{i-A}(5,7) = \tilde{\tilde{Y}}_{i-A}(1,4)$$

$$\tilde{\tilde{Y}}_{i-A}(4,8) = \tilde{\tilde{Y}}_{i-A}(3,2)$$

$$\tilde{\tilde{Y}}_{i-A}(5,8) = -\tilde{\tilde{Y}}_{i-A}(3,3)$$

$$\tilde{\tilde{Y}}_{i-A}(6,8) = (-2\omega_x\ddot{v}_4 + 2\omega_y\ddot{v}_5)\cdot kk + (-\dot{\omega}_x\dot{v}_4 + \dot{\omega}_y\dot{v}_5 + \omega_z\omega_y\dot{v}_4 + \omega_x\omega_z\dot{v}_5 - 2\omega_x\omega_y\dot{v}_6)\cdot ff$$

$$\tilde{\tilde{Y}}_{i-A}(4,9) = -\tilde{\tilde{Y}}_{i-A}(2,2)$$

$$\tilde{\tilde{Y}}_{i-A}(5,9) = (2\omega_x\ddot{v}_4 - 2\omega_z\ddot{v}_6)\cdot kk + (\dot{\omega}_x\dot{v}_4 - \dot{\omega}_z\dot{v}_6 + \omega_z\omega_y\dot{v}_4 + 2\omega_x\omega_z\dot{v}_5 + \omega_y\omega_x\dot{v}_6)\cdot ff$$

$$\tilde{\tilde{Y}}_{i-A}(6,9) = \tilde{\tilde{Y}}_{i-A}(2,4)$$

$$\tilde{\tilde{Y}}_{i-A}(4,10) = (-2\omega_y\ddot{v}_5 + 2\omega_z\ddot{v}_6)\cdot kk + (-\dot{\omega}_y\dot{v}_5 + \dot{\omega}_z\dot{v}_6 - 2\omega_z\omega_y\dot{v}_4 + \omega_x\omega_z\dot{v}_5 + \omega_y\omega_x\dot{v}_6)\cdot ff$$

$$\tilde{\tilde{Y}}_{i-A}(5,10) = \tilde{\tilde{Y}}_{i-A}(1,3)$$

$$\tilde{\tilde{Y}}_{i-A}(6,10) = -\tilde{\tilde{Y}}_{i-A}(1,4)$$

$$\tilde{\tilde{Y}}_{i-A}(4,11) = \ddot{v}_4 - \omega_z\ddot{v}_5 + \omega_y\ddot{v}_6 + [-\dot{\omega}_z\dot{v}_5 + \dot{\omega}_y\dot{v}_6 - 2(\omega_z^2 + \omega_y^2)\dot{v}_4 + \omega_x\omega_y\dot{v}_5 + \omega_z\omega_x\dot{v}_6]\cdot cc$$

$$\tilde{\tilde{Y}}_{i-A}(5,11) = 2\omega_z\ddot{v}_4 + (\dot{\omega}_z\dot{v}_4 + \omega_x\omega_y\dot{v}_4 + \omega_z\omega_z\dot{v}_5 - \omega_z\omega_y\dot{v}_6)\cdot cc$$

$$\tilde{\tilde{Y}}_{i-A}(6,11) = -2\omega_y\ddot{v}_4 + (-\dot{\omega}_y\dot{v}_4 + \omega_x\omega_z\dot{v}_4 - \omega_y\omega_z\dot{v}_5 + \omega_y\omega_y\dot{v}_6)\cdot cc$$

$$\tilde{\tilde{Y}}_{i-A}(4,12) = -2\omega_z\ddot{v}_5 + (-\dot{\omega}_z\dot{v}_5 + \omega_x\omega_y\dot{v}_5 + \omega_z\omega_z\dot{v}_4 - \omega_z\omega_x\dot{v}_6)\cdot cc$$

$$\tilde{\tilde{Y}}_{i-A}(5,12) = \ddot{v}_5 + \omega_z\ddot{v}_4 - \omega_x\ddot{v}_6 + [\dot{\omega}_z\dot{v}_4 - \dot{\omega}_x\dot{v}_6 - 2(\omega_z^2 + \omega_x^2)\dot{v}_4 + \omega_x\omega_y\dot{v}_4 + \omega_z\omega_x\dot{v}_6]\cdot cc$$

$$\tilde{\tilde{Y}}_{i-A}(6,12) = 2\omega_x\ddot{v}_5 + (\dot{\omega}_x\dot{v}_5 + \omega_y\omega_z\dot{v}_5 - \omega_x\omega_z\dot{v}_4 + \omega_x\omega_x\dot{v}_6)\cdot cc$$

$$\tilde{\tilde{Y}}_{i-A}(4,13) = 2\omega_y\ddot{v}_6 + (\dot{\omega}_y\dot{v}_6 + \omega_z\omega_x\dot{v}_6 + \omega_y\omega_y\dot{v}_4 - \omega_y\omega_x\dot{v}_5)\cdot cc$$

$$\tilde{\tilde{Y}}_{i-A}(5,13) = -2\omega_x\ddot{v}_6 + (-\dot{\omega}_x\dot{v}_6 + \omega_y\omega_z\dot{v}_6 - \omega_x\omega_y\dot{v}_4 + \omega_x\omega_x\dot{v}_5)\cdot cc$$

$$\tilde{\tilde{Y}}_{i-A}(6,13) = \ddot{v}_6 - \omega_y\ddot{v}_4 + \omega_x\ddot{v}_5 + [-\dot{\omega}_y\dot{v}_4 + \dot{\omega}_x\dot{v}_5 - 2(\omega_y^2 + \omega_x^2)\dot{v}_4 + \omega_x\omega_z\dot{v}_4 + \omega_y\omega_z\dot{v}_5]\cdot cc$$

$$\tilde{\tilde{Y}}_{i-B}(1,1) = (-3\dot{\omega}_z\omega_z - 3\dot{\omega}_y\omega_y)v_1 + (-\ddot{\omega}_z + 2\dot{\omega}_y\omega_x + \omega_y\dot{\omega}_x + \omega_z^3 + \omega_x^2\omega_z + \omega_y^2\omega_z)v_2 + (-\ddot{\omega}_y + 2\dot{\omega}_z\omega_x + \omega_z\dot{\omega}_x - \omega_y\omega_z^2 - \omega_y^3 - \omega_x^2\omega_y)v_3$$

$$\tilde{\tilde{Y}}_{i-B}(2,1) = (\ddot{\omega}_z + 2\dot{\omega}_x\omega_y + \omega_x\dot{\omega}_y - \omega_z^3 - \omega_x^2\omega_z - \omega_y^2\omega_z)v_1 + (-3\dot{\omega}_z\omega_z - 3\dot{\omega}_x\omega_x)v_2 + (-\ddot{\omega}_x + 2\dot{\omega}_z\omega_y + \omega_z\dot{\omega}_y + \omega_x\omega_z^2 + \omega_x\omega_y^2 + \omega_x^3)v_3$$

$$\tilde{\tilde{Y}}_{i-B}(3,1) = (-\ddot{\omega}_y + 2\dot{\omega}_x\omega_z + \omega_x\dot{\omega}_z + \omega_y\omega_z^2 + \omega_y^3 + \omega_x^2\omega_y)v_1 + (-3\dot{\omega}_y\omega_y - 3\dot{\omega}_x\omega_x)v_3 + (\ddot{\omega}_x + 2\dot{\omega}_y\omega_z + \omega_y\dot{\omega}_z - \omega_x\omega_z^2 - \omega_x\omega_y^2 - \omega_x^3)v_2$$

$$\tilde{\tilde{Y}}_{i-B}(1,2) = (-\ddot{\omega}_y - 2\dot{\omega}_z\omega_x - \omega_z\dot{\omega}_x + \omega_y\omega_z^2 + \omega_y^3 + \omega_x^2\omega_y)v_5 + (-\ddot{\omega}_z + 2\dot{\omega}_y\omega_x + \omega_y\dot{\omega}_x + \omega_z^3 + \omega_x^2\omega_z + \omega_y^2\omega_z)v_6$$

$$\tilde{\tilde{Y}}_{i-B}(2,2) = (\ddot{\omega}_x - 2\dot{\omega}_z\omega_y - \omega_z\dot{\omega}_y - \omega_x\omega_z^2 - \omega_x\omega_y^2 - \omega_y^3)v_5 + (-3\dot{\omega}_z\omega_z - 3\dot{\omega}_x\omega_x)v_6$$

$$\tilde{\tilde{Y}}_{i-B}(3,2) = (3\dot{\omega}_y\omega_y + 3\dot{\omega}_x\omega_x)v_5 + (\ddot{\omega}_x + 2\dot{\omega}_y\omega_z + \omega_y\dot{\omega}_z - \omega_x\omega_z^2 - \omega_x\omega_y^2 - \omega_x^3)v_6$$

$$\tilde{\tilde{Y}}_{i-B}(5,2) = -\tilde{\tilde{Y}}_{i-B}(3,1)$$

$$\tilde{\tilde{Y}}_{i-B}(6,2) = \tilde{\tilde{Y}}_{i-B}(2,1)$$

$$\tilde{\tilde{Y}}_{i-B}(1,3) = (\ddot{\omega}_y + 2\dot{\omega}_z\omega_x + \omega_z\dot{\omega}_x - \omega_y\omega_z^2 - \omega_y^3 - \omega_x^2\omega_y)v_4 + (3\dot{\omega}_z\omega_z + 3\dot{\omega}_y\omega_y)v_6$$

$$\tilde{\tilde{Y}}_{i-B}(2,3) = (-\ddot{\omega}_x + 2\dot{\omega}_z\omega_y + \omega_z\dot{\omega}_y + \omega_x\omega_z^2 + \omega_x\omega_y^2 + \omega_x^3)v_4 + (-\ddot{\omega}_z - 2\dot{\omega}_x\omega_y - \omega_x\dot{\omega}_y + \omega_z^3 + \omega_x^2\omega_z + \omega_y^2\omega_z)v_6$$

$$\tilde{\tilde{Y}}_{i-B}(3,3) = (-3\dot{\omega}_y\omega_y - 3\dot{\omega}_x\omega_x)v_5 + (\ddot{\omega}_y - 2\dot{\omega}_x\omega_z - \omega_x\dot{\omega}_z - \omega_y\omega_z^2 - \omega_y^3 - \omega_x^2\omega_y)v_6$$

$$\tilde{\tilde{Y}}_{i-B}(4,3) = \tilde{\tilde{Y}}_{i-B}(3,1)$$

$$\tilde{\tilde{Y}}_{i-B}(6,3) = -\tilde{\tilde{Y}}_{i-B}(1,1)$$

$$\tilde{\tilde{Y}}_{i-B}(1,4) = (\ddot{\omega}_z - 2\dot{\omega}_y\omega_x - \omega_y\dot{\omega}_x - \omega_z^3 - \omega_x^2\omega_z - \omega_y^2\omega_z)v_4 + (-3\dot{\omega}_z\omega_z - 3\omega_y\dot{\omega}_y)v_5$$

$$\tilde{\tilde{Y}}_{i-B}(2,4) = (3\dot{\omega}_z\omega_z + 3\dot{\omega}_x\omega_x)v_4 + (\ddot{\omega}_z + 2\dot{\omega}_x\omega_y + \omega_x\dot{\omega}_y - \omega_z^3 - \omega_x^2\omega_z - \omega_y^2\omega_z)v_5$$

$$\tilde{\tilde{Y}}_{i-B}(3,4) = (-\ddot{\omega}_x - 2\dot{\omega}_y\omega_z - \omega_y\dot{\omega}_z + \omega_x\omega_z^2 + \omega_x\omega_y^2 + \omega_x^3)v_4 + (-\ddot{\omega}_y + 2\dot{\omega}_x\omega_z + \omega_x\dot{\omega}_z + \omega_y\omega_z^2 + \omega_y^3 + \omega_x^2\omega_y)v_5$$

$$\tilde{\tilde{Y}}_{i-B}(4,4) = -\tilde{\tilde{Y}}_{i-B}(2,1)$$

$$\tilde{\tilde{Y}}_{i-B}(5,4) = \tilde{\tilde{Y}}_{i-B}(1,1)$$

$$\tilde{\tilde{Y}}_{i-B}(5,5) = -\tilde{\tilde{Y}}_{i-B}(3,2)$$

$$\tilde{\tilde{Y}}_{i-B}(6,5) = \tilde{\tilde{Y}}_{i-B}(2,2)$$

$$\tilde{\tilde{Y}}_{i-B}(4,6) = \tilde{\tilde{Y}}_{i-B}(3,3)$$

$$\tilde{\tilde{Y}}_{i-B}(6,6) = -\tilde{\tilde{Y}}_{i-B}(1,3)$$

$$\tilde{\tilde{Y}}_{i-B}(4,7) = -\tilde{\tilde{Y}}_{i-B}(2,4)$$

$$\tilde{\tilde{Y}}_{i-B}(5,7) = \tilde{\tilde{Y}}_{i-B}(1,4)$$

$$\tilde{\tilde{Y}}_{i-B}(4,8) = \tilde{\tilde{Y}}_{i-B}(3,2)$$

$$\tilde{\tilde{Y}}_{i-B}(5,8) = -\tilde{\tilde{Y}}_{i-B}(3,3)$$

$$\tilde{\tilde{Y}}_{i-B}(6,8) = (-\ddot{\omega}_x + 2\dot{\omega}_z\omega_y + \omega_z\dot{\omega}_y + \omega_x\omega_z^2 + \omega_x\omega_y^2 + \omega_x^3)v_4 + (\ddot{\omega}_y + 2\dot{\omega}_z\omega_x + \omega_z\dot{\omega}_x - \omega_y\omega_z^2 - \omega_y^3 - \omega_x^2\omega_y)v_5 + (-3\dot{\omega}_y\omega_x - 3\dot{\omega}_x\omega_y)v_6$$

$$\tilde{\tilde{Y}}_{i-B}(4,9) = -\tilde{\tilde{Y}}_{i-B}(2,2)$$

$$\tilde{\tilde{Y}}_{i-B}(5,9) = (\ddot{\omega}_x + 2\dot{\omega}_y\omega_z + \omega_y\dot{\omega}_z - \omega_x\omega_z^2 - \omega_x\omega_y^2 - \omega_x^3)v_4 + (2\dot{\omega}_y\omega_x + \omega_y\dot{\omega}_x + \omega_z^3 + \omega_x^2\omega_z + \omega_y^2\omega_z)v_6 + (-3\dot{\omega}_x\omega_z - 3\dot{\omega}_z\omega_x)v_5$$

$$\tilde{\tilde{Y}}_{i-B}(6,9) = \tilde{\tilde{Y}}_{i-B}(2,4)$$

$$\tilde{\tilde{Y}}_{i-B}(4,10) = (-\ddot{\omega}_y + 2\dot{\omega}_x\omega_z + \omega_x\dot{\omega}_z + \omega_y\omega_z^2 + \omega_y^3 + \omega_x^2\omega_y)v_5 + (\ddot{\omega}_z + 2\dot{\omega}_x\omega_y + \omega_x\dot{\omega}_y - \omega_z^3 - \omega_x^2\omega_z - \omega_y^2\omega_z)v_6 + (-3\dot{\omega}_y\omega_z - 3\dot{\omega}_z\omega_y)v_4$$

$$\tilde{\tilde{Y}}_{i-B}(5,10) = \tilde{\tilde{Y}}_{i-B}(1,3)$$

$$\tilde{\tilde{Y}}_{i-B}(6,10) = -\tilde{\tilde{Y}}_{i-B}(1,4)$$

$$\tilde{\tilde{Y}}_{i-B}(4,11) = (\omega_z^2 + \omega_y^2)\dot{v}_4 - 2\omega_y\omega_x\dot{v}_5 - 2\omega_z\omega_x\dot{v}_6 + (-4\dot{\omega}_z\omega_z - 4\dot{\omega}_y\omega_y)v_4 + (-\ddot{\omega}_z + 2\dot{\omega}_y\omega_x + \omega_x^2\omega_z - \omega_y\dot{\omega}_x - \omega_z^3 - \omega_y^2\omega_z)v_5$$
$$+ (\ddot{\omega}_y + 2\dot{\omega}_z\omega_x + \omega_x^2\omega_y - \omega_z\dot{\omega}_x + \omega_z^2\omega_y + \omega_y^3)v_6$$

$$\tilde{\tilde{Y}}_{i-B}(5,11) = (\omega_z + \omega_x\omega_y)\dot{v}_4 - 4\omega_z^2\dot{v}_5 + 4\omega_z\omega_y\dot{v}_6 + 3\omega_x\omega_y\omega_z v_5 + (\ddot{\omega}_z + 2\dot{\omega}_x\omega_y + \omega_x\dot{\omega}_y - \omega_x^2\omega_z - 2\omega_z^3 - 2\omega_y^2\omega_z)v_4$$
$$+ (-2\dot{\omega}_z\omega_y + 2\omega_z\dot{\omega}_y - 2\omega_x\omega_y^2 + 2\omega_z^2\omega_y)v_6$$

$$\tilde{\tilde{Y}}_{i-B}(6,11) = (-\omega_y + \omega_x\omega_z)\dot{v}_4 + 4\omega_y\omega_z\dot{v}_5 - 4\omega_y^2\dot{v}_6 - 3\omega_x\omega_y\omega_z v_6 + (-\ddot{\omega}_y + 2\dot{\omega}_x\omega_z + \omega_x\dot{\omega}_z + \omega_x^2\omega_y + 2\omega_y^3 + 2\omega_z^2\omega_y)v_4$$
$$+ (-2\dot{\omega}_y\omega_z + 2\omega_y\dot{\omega}_z + 2\omega_x\omega_z^2 - \omega_y^2\omega_x)v_5$$

$$\tilde{\tilde{Y}}_{i-B}(4,12) = -4\omega_z^2\dot{v}_4 + (-\omega_z + \omega_y\omega_x)\dot{v}_5 + 4\omega_z\omega_x\dot{v}_6 - 3\omega_x\omega_y\omega_z v_4 + (\ddot{\omega}_z + 2\dot{\omega}_y\omega_x + \omega_y\dot{\omega}_x + \omega_x^2\omega_z + 2\omega_z^3 + 2\omega_y^2\omega_z)v_5$$
$$+ (-2\dot{\omega}_z\omega_x + 2\omega_z\dot{\omega}_x + 2\omega_y\omega_x^2 - 2\omega_z^2\omega_y)v_6$$

$$\tilde{\tilde{Y}}_{i-B}(5,12) = -2\omega_x\omega_y\dot{v}_4 + (\omega_z^2 + \omega_x^2)\dot{v}_5 - 2\omega_z\omega_y\dot{v}_6 + (-4\dot{\omega}_z\omega_z - 4\dot{\omega}_y\omega_y)v_5 + (\ddot{\omega}_z + 2\dot{\omega}_x\omega_y - \omega_y^2\omega_z - \omega_x\dot{\omega}_y + \omega_z^3 + \omega_x^2\omega_z)v_4$$
$$+ (-\ddot{\omega}_x + 2\dot{\omega}_z\omega_y + \omega_x\omega_y^2 + \omega_z\dot{\omega}_y - \omega_z^2\omega_x - \omega_x^3)v_6$$

$$\tilde{\tilde{Y}}_{i-B}(6,12) = 4\omega_x\omega_z\dot{v}_4 + (\omega_x + \omega_y\omega_z)\dot{v}_5 - 4\omega_x^2\dot{v}_6 + 3\omega_x\omega_y\omega_z v_6 + (-2\dot{\omega}_x\omega_z + 2\omega_x\dot{\omega}_z - 2\omega_y\omega_z^2 + \omega_x^2\omega_y)v_4$$
$$+ (\ddot{\omega}_x + 2\dot{\omega}_y\omega_z + \omega_y\dot{\omega}_z - \omega_x\omega_y^2 - 2\omega_z^3 - 2\omega_z^2\omega_x)v_6$$

$$\tilde{\tilde{Y}}_{i-B}(4,13) = -4\omega_y^2\dot{v}_4 + 4\omega_y\omega_x\dot{v}_5 + (\omega_y + \omega_z\omega_x)\dot{v}_6 + 3\omega_x\omega_y\omega_z v_4 + (-2\dot{\omega}_y\omega_x + 2\omega_y\dot{\omega}_x - 2\omega_z\omega_x^2 + \omega_y^2\omega_z)v_5$$
$$+ (\ddot{\omega}_y + 2\dot{\omega}_z\omega_x + \omega_z\dot{\omega}_x - \omega_y\omega_z^2 - 2\omega_y^3 - 2\omega_x^2\omega_y)v_6$$

$$\tilde{\tilde{Y}}_{i-B}(5,13) = 4\omega_x\omega_y\dot{v}_4 - 4\omega_x^2\dot{v}_5 + (-\omega_x + \omega_z\omega_y)\dot{v}_6 - 3\omega_x\omega_y\omega_z v_5 + (-2\dot{\omega}_x\omega_y + 2\omega_x\dot{\omega}_y + 2\omega_z\omega_y^2 - \omega_x^2\omega_z)v_4$$
$$+ (-\ddot{\omega}_x + 2\dot{\omega}_z\omega_y + \omega_z\dot{\omega}_y + \omega_x\omega_z^2 + 2\omega_x^3 + 2\omega_y^2\omega_x)v_6$$

$$\tilde{\tilde{Y}}_{i-B}(6,13) = -2\omega_x\omega_z\dot{v}_4 - 2\omega_y\omega_z\dot{v}_5 + (\omega_y^2 + \omega_x^2)\dot{v}_6 + (-4\dot{\omega}_y\omega_y - 4\dot{\omega}_x\omega_x)v_6 + (-\ddot{\omega}_y + 2\dot{\omega}_x\omega_z + \omega_y\omega_z^2 - \omega_x\dot{\omega}_z - \omega_y^3 - \omega_x^2\omega_y)v_4$$
$$+ (\ddot{\omega}_x + 2\dot{\omega}_y\omega_z - \omega_x\omega_z^2 - \omega_y\dot{\omega}_z + \omega_y^2\omega_x + \omega_x^3)v_5$$