The definition of the transition matrices for each motion model in IMMKF corresponds to the constant-velocity, constant-acceleration, and constant turn models, respectively.

$$F_{CV} = \begin{bmatrix} \mathbb{I}_3 & \Delta t * \mathbb{I}_3 & \mathbb{O}_3 & \mathbb{O}_3 & \mathbb{O}_3 \\ \mathbb{O}_3 & \mathbb{I}_3 & \mathbb{O}_3 & \mathbb{O}_3 & \mathbb{O}_3 \\ \mathbb{O}_3 & \mathbb{O}_3 & \mathbb{I}_3 & \mathbb{O}_3 & \mathbb{O}_3 \\ \mathbb{O}_3 & \mathbb{O}_3 & \mathbb{O}_3 & \mathbb{I}_3 & \mathbb{O}_3 \\ \mathbb{O}_3 & \mathbb{O}_3 & \mathbb{O}_3 & \mathbb{O}_3 & \mathbb{I}_3 \end{bmatrix},$$

$$F_{CA} = \begin{bmatrix} \mathbb{I}_3 & \Delta t * \mathbb{I}_3 & \mathbb{O}_3 & \frac{\Delta t^2}{2}\mathbb{I}_3 & \mathbb{O}_3 \\ \mathbb{O}_3 & \mathbb{I}_3 & \mathbb{O}_3 & \Delta t * \mathbb{I}_3 & \mathbb{O}_3 \\ \mathbb{O}_3 & \mathbb{O}_3 & \mathbb{I}_3 & \mathbb{O}_3 & \mathbb{O}_3 \\ \mathbb{O}_3 & \mathbb{O}_3 & \mathbb{O}_3 & \mathbb{I}_3 & \mathbb{O}_3 \\ \mathbb{O}_3 & \mathbb{O}_3 & \mathbb{O}_3 & \mathbb{O}_3 & \mathbb{I}_3 \end{bmatrix},$$

$$F_{CT} = \begin{bmatrix} \mathbb{I}_3 & F_B & \mathbb{O}_3 & \mathbb{O}_3 & \mathbb{O}_3 \\ \mathbb{O}_3 & \mathbb{I}_3 + F_A & \mathbb{O}_3 & \mathbb{O}_3 & \mathbb{O}_3 \\ \mathbb{O}_3 & \mathbb{O}_3 & \mathbb{I}_3 & \mathbb{O}_3 & \mathbb{O}_3 \\ \mathbb{O}_3 & \mathbb{O}_3 & \mathbb{O}_3 & \mathbb{I}_3 & \mathbb{O}_3 \\ \mathbb{O}_3 & \mathbb{O}_3 & \mathbb{O}_3 & \mathbb{O}_3 & \mathbb{I}_3 \end{bmatrix}.$$

We adopt the formulation of F_A, and F_B in [1] to calculate the transition matrix F_{CT}, where

$$F_A = \begin{bmatrix} a_1 b_1 & -a_2 w_z - a_1 w_{xy} & a_2 w_y - a_1 w_{xz} \\ a_2 w_z - a_1 w_{xy} & a_1 b_2 & -a_2 w_x - a_1 w_{yz} \\ -a_2 w_y - a_1 w_{xz} & a_2 w_x - a_1 w_{yz} & a_1 b_3 \end{bmatrix},$$

$$F_B = \begin{bmatrix} a_3 b_1 & a_1 w_z - a_3 w_{xy} & -a_1 w_y - a_3 w_{xz} \\ -a_1 w_z - a_3 w_{xy} & a_3 b_2 & -a_1 w_x - a_3 w_{yz} \\ a_1 w_y - a_3 w_{xz} & -a_1 w_x - a_3 w_{yz} & a_3 b_3 \end{bmatrix},$$

$a_1 = \frac{cos||w||\Delta t - 1}{||w||^2}$, $a_2 = \frac{sin||w||\Delta t}{||w||}$,
$a_3 = \frac{1}{||w||^2}(\frac{sin||w||\Delta t}{||w||} - T)$,
$b_1 = w_y^2 + w_z^2$, $b_2 = w_x^2 + w_z^2$, $b_3 = w_x^2 + w_y^2$,
$w_{xy} = w_x w_y$, $w_{xz} = w_x w_z$, $w_{yz} = w_y w_z$.

The measurement matrices of each model are defined as follow:

$$H_{CV} = H_{CA} \begin{bmatrix} \mathbb{I}_{3\times3} & \mathbb{O}_{3\times3} & \mathbb{O}_{3\times6} \\ \mathbb{O}_{3\times3} & \mathbb{O}_{3\times3} & \mathbb{O}_{3\times6} \\ \mathbb{O}_{6\times3} & \mathbb{O}_{6\times3} & \mathbb{O}_{6\times6} \end{bmatrix}$$

$$H_{CT} = \begin{bmatrix} \mathbb{I}_{3\times3} & \mathbb{O}_{3\times3} & \mathbb{O}_{3\times6} \\ \mathbb{O}_{3\times3} & \mathbb{O}_{3\times3} & \mathbb{O}_{3\times6} \\ \mathbb{O}_{6\times3} & \mathbb{O}_{6\times3} & \mathbb{I}_{6\times6} \end{bmatrix}$$

REFERENCES

[1] Ronghui Zhan and Jianwei Wan, "Passive maneuvering target tracking using 3D constant-turn model," 2006 IEEE Conference on Radar, Verona, NY, USA, 2006, pp. 8 pp.-, doi: 10.1109/RADAR.2006.1631832.