Motion Model of Maneuvering Target

Due to space constraints, this section is placed in supplementary material. The main content is about the combination of the maneuvering target into 9 basic actions proposed in the paper. The basic control maneuvers are shown in the Figure 1 in the main text. Next, the motion equations of 9 basic actions are given.

(1): Level flight

$$F(k)=\begin{bmatrix} 1 & T & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & T & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & T \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \tag{S1}$$

(2): Left turn

$$F(k)=\begin{bmatrix} 1 & \omega^{-1}\sin(\omega T) & 0 & \omega^{-1}(\cos(\omega T)-1) & 0 & 0 \\ 0 & \cos(\omega T) & 0 & -\sin(\omega T) & 0 & 0 \\ 0 & \omega^{-1}(\cos(\omega T)-1) & 1 & \omega^{-1}\sin(\omega T) & 0 & 0 \\ 0 & \sin(\omega T) & 0 & \cos(\omega T) & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & T \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \tag{S2}$$

(3): Right turn

$$F(k)=\begin{bmatrix} 1 & \omega^{-1}\sin(\omega T) & 0 & \omega^{-1}(1-\cos(\omega T)) & 0 & 0 \\ 0 & \cos(\omega T) & 0 & \sin(\omega T) & 0 & 0 \\ 0 & \omega^{-1}(\cos(\omega T)-1) & 1 & \omega^{-1}\sin(\omega T) & 0 & 0 \\ 0 & -\sin(\omega T) & 0 & \cos(\omega T) & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & T \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \tag{S3}$$

(4): Climb

$$F(k)=\begin{bmatrix} 1 & T & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & \omega^{-1}\sin(\omega T) & 0 & \omega^{-1}(1-\cos(\omega T)) \\ 0 & 0 & 0 & \cos(\omega T) & 0 & \sin(\omega T) \\ 0 & 0 & 0 & \omega^{-1}(\cos(\omega T)-1) & 1 & \omega^{-1}\sin(\omega T) \\ 0 & 0 & 0 & -\sin(\omega T) & 0 & \cos(\omega T) \end{bmatrix} \tag{S4}$$

(5): Dive

$$F(k)=\begin{bmatrix} 1 & T & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & \omega^{-1}\sin(\omega T) & 0 & \omega^{-1}(\cos(\omega T)-1) \\ 0 & 0 & 0 & \cos(\omega T) & 0 & -\sin(\omega T) \\ 0 & 0 & 0 & \omega^{-1}(1-\cos(\omega T)) & 1 & \omega^{-1}\sin(\omega T) \\ 0 & 0 & 0 & \sin(\omega T) & 0 & \cos(\omega T) \end{bmatrix} \tag{S5}$$

(6): Left climb

$$F(k)=\begin{bmatrix} 1 & \omega^{-1}\sin(\omega T) & 0 & \omega^{-1}(\cos(\omega T)-1) & 0 & 0 \\ 0 & \cos(\omega T) & 0 & -\sin(\omega T) & 0 & 0 \\ 0 & \omega^{-1}(\cos(\omega T)-1) & 1 & -\omega^{-1}\sin(\omega T) & 0 & \omega^{-1}(\cos(\omega T)-1) \\ 0 & \sin(\omega T) & 0 & -\cos(\omega T) & 0 & -\sin(\omega T) \\ 0 & 0 & 0 & \omega^{-1}(1-\cos(\omega T)) & 1 & \omega^{-1}\sin(\omega T) \\ 0 & 0 & 0 & \sin(\omega T) & 0 & \cos(\omega T) \end{bmatrix} \tag{S6}$$

(7): Right climb

$$F(k)=\begin{bmatrix} 1 & \omega^{-1}\sin(\omega T) & 0 & -\omega^{-1}(\cos(\omega T)-1) & 0 & 0 \\ 0 & \cos(\omega T) & 0 & \sin(\omega T) & 0 & 0 \\ 0 & -\omega^{-1}(\cos(\omega T)-1) & 1 & -\omega^{-1}\sin(\omega T) & 0 & \omega^{-1}(\cos(\omega T)-1) \\ 0 & -\sin(\omega T) & 0 & -\cos(\omega T) & 0 & -\sin(\omega T) \\ 0 & 0 & 0 & \omega^{-1}(1-\cos(\omega T)) & 1 & \omega^{-1}\sin(\omega T) \\ 0 & 0 & 0 & \sin(\omega T) & 0 & \cos(\omega T) \end{bmatrix} \tag{S7}$$

(8): Left dive

$$F(k)=\begin{bmatrix} 1 & \omega^{-1}\sin(\omega T) & 0 & \omega^{-1}(\cos(\omega T)-1) & 0 & 0 \\ 0 & \cos(\omega T) & 0 & -\sin(\omega T) & 0 & 0 \\ 0 & \omega^{-1}(\cos(\omega T)-1) & 1 & -\omega^{-1}\sin(\omega T) & 0 & \omega^{-1}(\cos(\omega T)-1) \\ 0 & \sin(\omega T) & 0 & -\cos(\omega T) & 0 & \sin(\omega T) \\ 0 & 0 & 0 & \omega^{-1}(1-\cos(\omega T)) & 1 & \omega^{-1}\sin(\omega T) \\ 0 & 0 & 0 & \sin(\omega T) & 0 & \cos(\omega T) \end{bmatrix} \tag{S8}$$

(9): Right dive

$$F(k)=\begin{bmatrix} 1 & \omega^{-1}\sin(\omega T) & 0 & -\omega^{-1}(\cos(\omega T)-1) & 0 & 0 \\ 0 & \cos(\omega T) & 0 & \sin(\omega T) & 0 & 0 \\ 0 & -\omega^{-1}(\cos(\omega T)-1) & 1 & -\omega^{-1}\sin(\omega T) & 0 & \omega^{-1}(\cos(\omega T)-1) \\ 0 & -\sin(\omega T) & 0 & -\cos(\omega T) & 0 & \sin(\omega T) \\ 0 & 0 & 0 & \omega^{-1}(1-\cos(\omega T)) & 1 & \omega^{-1}\sin(\omega T) \\ 0 & 0 & 0 & \sin(\omega T) & 0 & \cos(\omega T) \end{bmatrix} \tag{S9}$$

where, ω is the turning rate and T is sampling period.