Intelligent Tracking Trajectory Design of Mobile Robot

ŠUSTER PETER

Dept. of Cybernetics and Artificial Intelligence, FEI TU of Košice, Slovak Republic

E-mail:peter.suster@tuke.sk

MATHEMATICAL - PHYSICAL MODEL OF MOBILE ROBOT

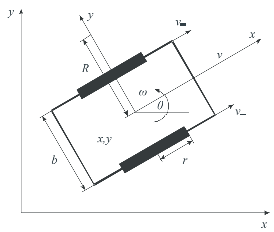

Fig. 1 Kinematic model of mobile robot

$$\dot{x}(t)=v\cos\theta,\quad \dot{y}(t)=v\sin\theta,\quad \dot{\theta}(t)=\omega \quad\Rightarrow\quad v=\frac{v_L+v_R}{2},\quad \omega=\frac{v_L-v_R}{b} \qquad (1)$$

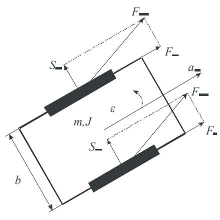

Fig. 2 Dynamic model of mobile robot

$$\left.\begin{aligned} ma_t &= F_L+F_R\\ J\varepsilon &= \frac{(F_L-F_R)b}{2}\\ J\ddot{\theta}_L(t)+F_T\dot{\theta}_L(t)+F_Lr &= U_L\\ J\ddot{\theta}_R(t)+F_T\dot{\theta}_R(t)+F_Rr &= U_R \end{aligned}\right\}\Rightarrow \begin{aligned} \dot{x}(t)&=Ax(t)+Bu(t)\\ y(t)&=Cx(t)\end{aligned} \qquad (2)$$

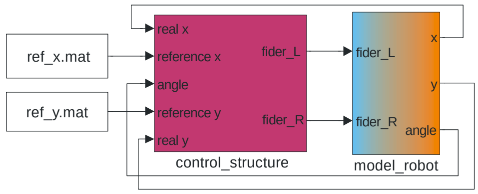

Fig. 3 Simulation scheme is designed for to simulate movements of the mobile robot

$$x(t)=[x_1(t),x_2(t),x_3(t),x_4(t)]=[v(t),\omega(t),\omega_L(t),\omega_R(t)]$$
$$\dot{x}(t)=[\dot{x}_1(t),\dot{x}_2(t),\dot{x}_3(t),\dot{x}_4(t)]=[a_t(t),\varepsilon(t),\varepsilon_L(t),\varepsilon_R(t)]$$
$$u=[u_1(t),u_2(t),u_3(t),u_4(t)]=[F_L,F_R,U_L,U_R]$$
$$y(t)=[y_1(t),y_2(t)]=[x_3(t),x_4(t)]$$

FORWARD NEURAL MODEL OF MOBILE ROBOT

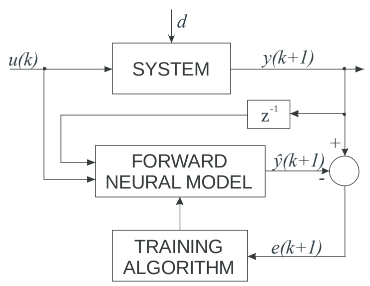

Fig. 4 Identification scheme based on output prediction error

$$\hat{y}(k+1)=\hat{f}\left[y(k),\ldots,(k-n+1),u(k),\ldots,u(k-m+1)\right] \qquad (3)$$

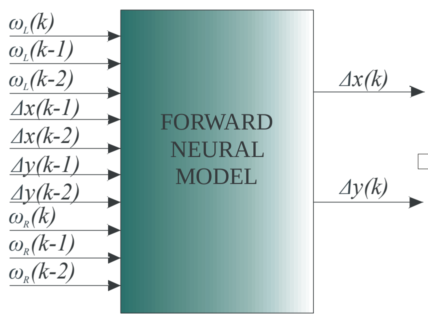

Fig. 5 Forward neural model of the mobile robot

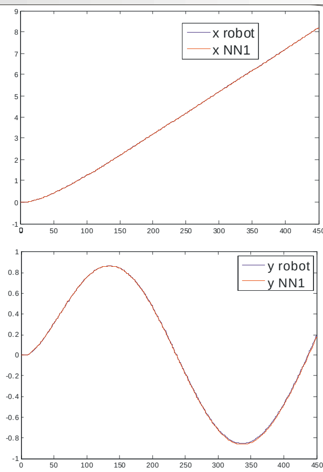

Fig. 6 Comparison outputs of the system and the forward neural model

INVERSE NEURAL MODEL OF MOBILE ROBOT

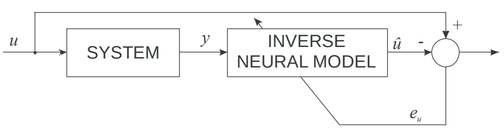

Fig. 7 General training structure

$$u(k)=f^{-1}\begin{bmatrix} r(k+1),y(k),\ldots,y(k-n+1),\ldots\\ \ldots u(k),\ldots,u(k-m+1)\end{bmatrix} \qquad (4)$$

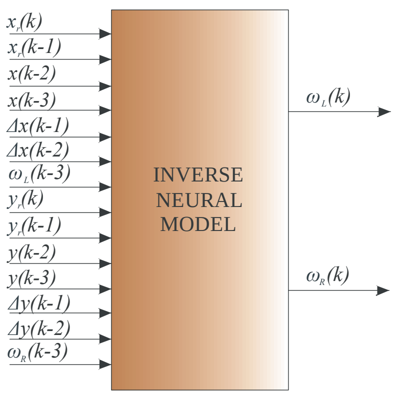

Fig. 8 Inverse neural model of mobile robot

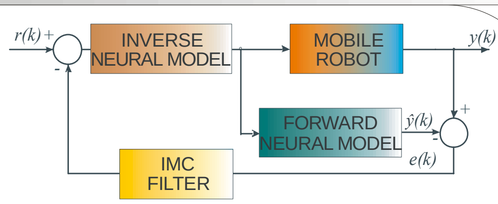

Fig. 9 Control structure Internal Model Control

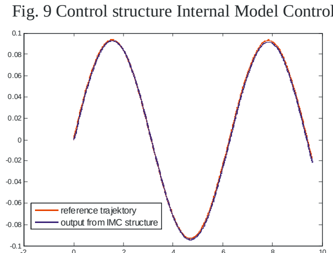

Fig. 10 Comparison the defined reference trajectory and output from IMC structure

This contribution is the results of the Vega project implementation: Multiagent Network Control System with Automatic Reconfiguration (No.1/0617/08), supported by the Scientific Grant Agency of Slovak Republic.