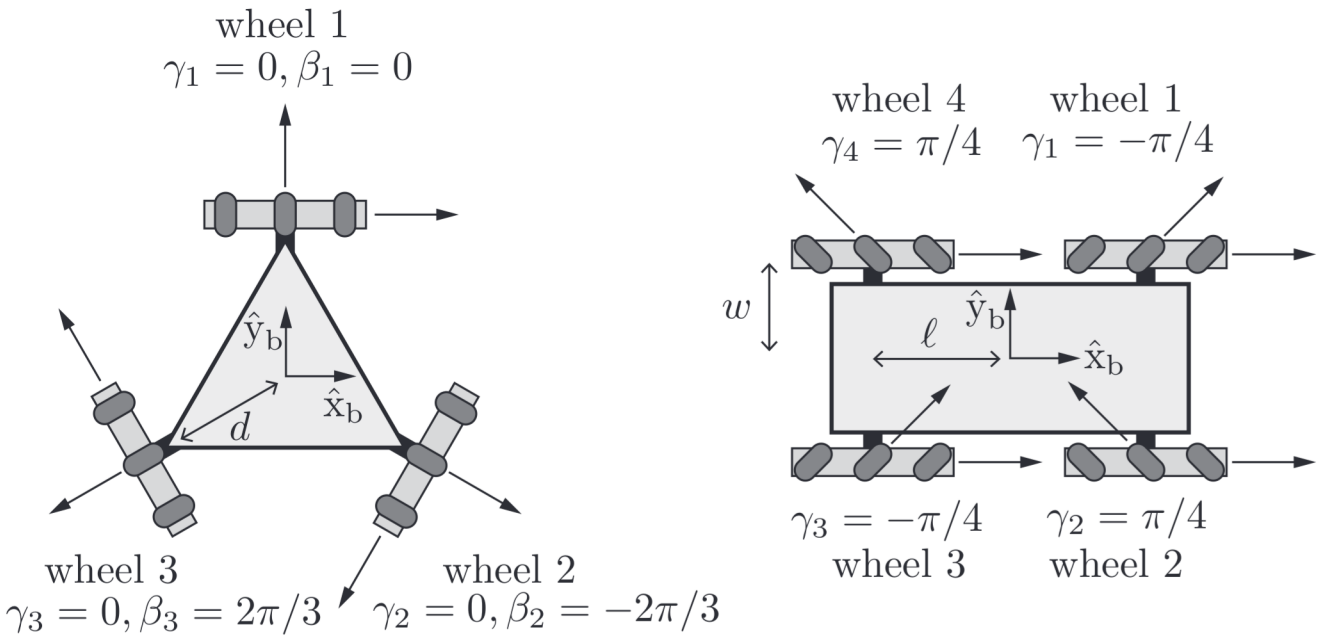

Figure 13.5: Kinematic models for mobile robots with three omniwheels and four mecanum wheels. The radius of all wheels is r and the driving direction for each of the mecanum wheels is $\beta_i = 0$.

In the case $m > 3$, as for the four-wheeled youBot of Figure 13.2, choosing u such that Equation (13.8) is not satisfied for any $\mathcal{V}_b \in \mathbb{R}^3$ implies that the wheels must skid in their driving directions.

Using the notation in Figure 13.5, the kinematic model of the mobile robot with three omniwheels is

$$u = \begin{bmatrix} u_1 \\ u_2 \\ u_3 \end{bmatrix} = H(0)\mathcal{V}_b = \frac{1}{r}\begin{bmatrix} -d & 1 & 0 \\ -d & -1/2 & -\sin(\pi/3) \\ -d & -1/2 & \sin(\pi/3) \end{bmatrix}\begin{bmatrix} \omega_{bz} \\ v_{bx} \\ v_{by} \end{bmatrix} \tag{13.9}$$

and the kinematic model of the mobile robot with four mecanum wheels is

$$u = \begin{bmatrix} u_1 \\ u_2 \\ u_3 \\ u_4 \end{bmatrix} = H(0)\mathcal{V}_b = \frac{1}{r}\begin{bmatrix} -\ell - w & 1 & -1 \\ \ell + w & 1 & 1 \\ \ell + w & 1 & -1 \\ -\ell - w & 1 & 1 \end{bmatrix}\begin{bmatrix} \omega_{bz} \\ v_{bx} \\ v_{by} \end{bmatrix}. \tag{13.10}$$

For the mecanum robot, to move in the direction $+\hat{x}_b$, all wheels drive forward at the same speed; to move in the direction $+\hat{y}_b$, wheels 1 and 3 drive backward and wheels 2 and 4 drive forward at the same speed; and to rotate in the counterclockwise direction, wheels 1 and 4 drive backward and wheels 2 and 3 drive forward at the same speed. Note that the robot chassis is capable of the same speeds in the forward and sideways directions.