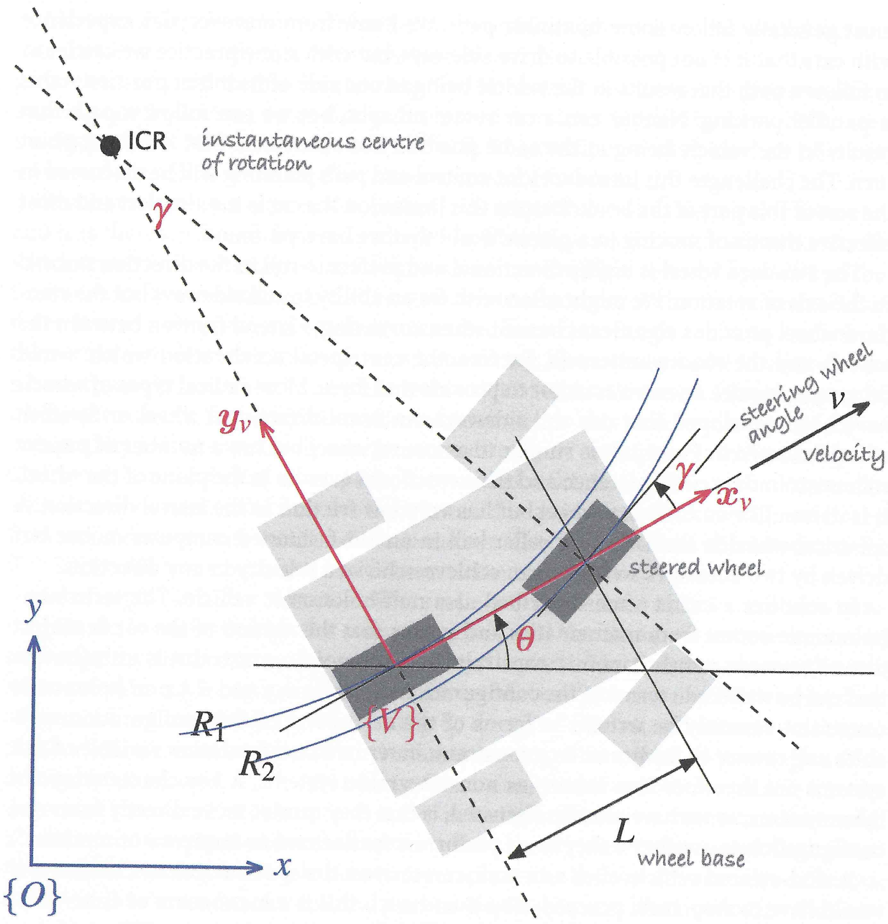

Fig. 4.2. Bicycle model ... is shown in light ... bicycle approx... grey. The vehicle's ... frame is shown in ... world coordinate ... The steering ... and the velocity ... wheel, in the x-direction ... two wheel axes are ... dashed lines and ... Instantaneous Centre ... (ICR) and the ... ICR to the back ... is R_1 and R_2 respect...

A commonly used model for a four-wheeled car-like vehicle is the bicycle model shown in Fig. 4.2. The bicycle has a rear wheel fixed to the body and the plane of the front wheel rotates about the vertical axis to steer the vehicle.

Often incorrectly ... model.

The pose of the vehicle is represented by the coordinate frame $\{V\}$ shown in Fig. 4.2, with its x-axis in the vehicle's forward direction and its origin at the centre of the rear axle. The configuration of the vehicle is represented by the generalized coordinates $q = (x, y, \theta) \in \mathcal{C}$ where $\mathcal{C} \subset SE(2)$. The vehicle's velocity is by definition v in the vehicle's x-direction, and zero in the y-direction since the wheels cannot slip sideways. In the vehicle frame $\{V\}$ this is

Other well known ... Reeds-Shepp model ... three speeds: forward, ... stopped, and the Dubbin... only two speeds: ...

$$^V\dot{x} = v, \quad ^V\dot{y} = 0$$

The dashed lines show the direction along which the wheels cannot move, the lines of no motion, and these intersect at a point known as the Instantaneous Centre of Rotation (ICR). The reference point of the vehicle thus follows a circular path and its angular velocity is

$$\dot{\theta} = \frac{v}{R_1} \tag{4.1}$$

and by simple geometry the turning radius is $R_1 = L / \tan\gamma$ where L is the length of the vehicle or *wheel base*. As we would expect the turning circle increases with vehicle length. The steering angle γ is limited mechanically and its maximum value dictates the minimum value of R_1.