Vehicle Heading Estimation Using Low Cost Yaw Gyro and GPS

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February 11, 2002

Assume the gyro measurement has a DC offset and a scale factor bias,

$$\hat{r} = ar + b \tag{1}$$

$$\Rightarrow r = \frac{\hat{r} - b}{a} \tag{2}$$

$$= \dot{\phi} \tag{3}$$

Plug this into a time varying Kalman filter by letting

$$x = \begin{bmatrix} \phi \\ 1/a \\ b/a \end{bmatrix} \tag{4}$$

then,

$$\dot{x} = \begin{bmatrix} 0 & \hat{r} & -1 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} x + Q \tag{5}$$

with measurement update

$$[\phi] = Cx \tag{6}$$

where

$$C = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \tag{7}$$

when GPS is available, and

$$C = \begin{bmatrix} 0 & 0 & 0 \end{bmatrix} \tag{8}$$

when it is not.

This can lead to some very low drift over long times of GPS dropout. Figure 1 shows the heading traversed by the van during the test. Figure 2 shows the heading error of the van. The Kalman filter is clicked off at 200 seconds and clicked back on at 1000 seconds.

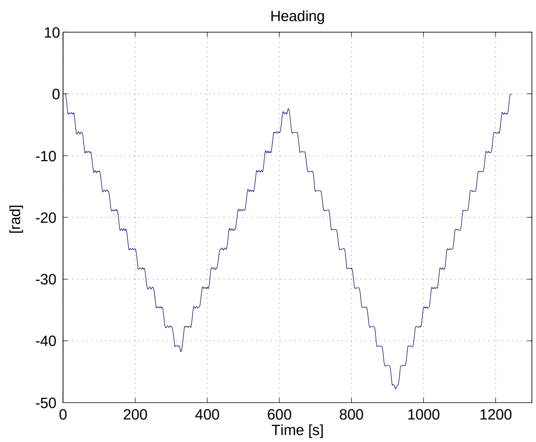

Figure 1: GPSMeasured Heading

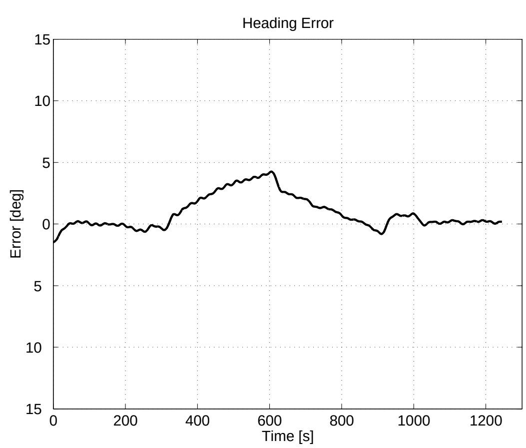

Figure 2: Kalman Filter Estimated Heading