





If we sample for  $N$  times, then the square sum of error is:

$$J = \sum_{k=1}^N [a(k) - bP(k) - c - dV(k)^2]^2 \quad (14)$$

We can try to get the differential coefficient of  $J$  if we want the minimum of  $J$ , and make them zero, then:

$$\frac{\partial J}{\partial b} = 0 \quad (15)$$

$$\frac{\partial J}{\partial c} = 0 \quad (16)$$

We can estimate  $b$  and  $c$  as  $\hat{b}$  and  $\hat{c}$  from the above equations (15) and (16), so equations (11) and (12) can be written as:

$$C_x = -\hat{c}m \quad (17)$$

$$\hat{R} = -\hat{b}/\hat{c} \quad (18)$$

#### IV. SIMULATION AND ANALYSIS

The Matlab is the software of strong function which is developed by the Math Work company in the United States, and simulink toolbar can be used to simulate system model in real time. Here we simulate the established model by the simulink toolbar. Figure 3 shows the setting of the velocity and the angular velocity of the tire and the acceleration, and we can get the result of simulation  $C_x$  and  $R$  as Figure 4. From figure 4 we can see that the estimated value of tire radius has a good consistency with the true value, so the change of estimated tire radius can reflect better the change of tire pressure.

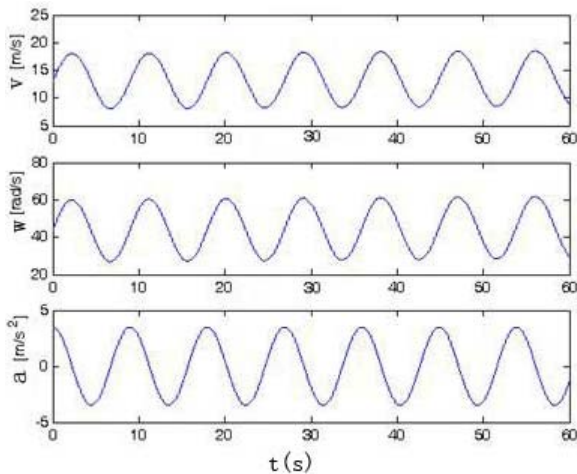


Figure 3: The setting of the velocity and the angular velocity of the tire and the acceleration

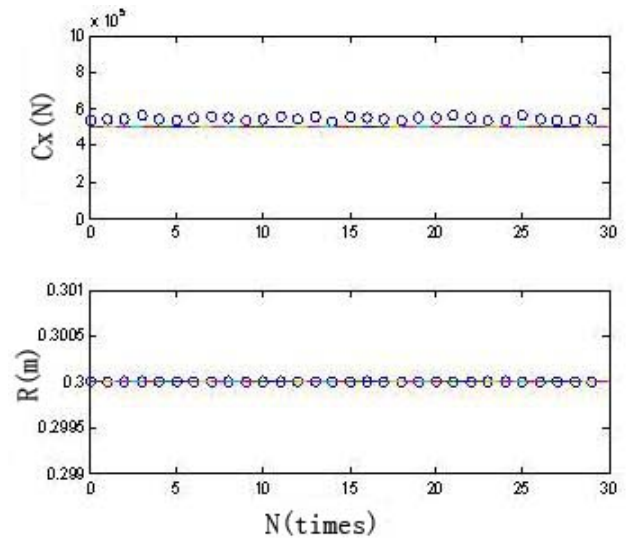


Figure 4: The result of simulation of  $C_x$  and  $R$

#### V. CONCLUSIONS

The slip of tire has not only a close connection with longitudinal force, but also a direct connection with tire radius. We can get the force-slip model of low slip from the Magic Formula Model, estimate the tire radius through least square, and the result of the simulation about this method is perfect. It is an effective method for indirect tire pressure monitoring by only ABS wheel speed sensors.

#### REFERENCES

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