

Why is 50Hz GPS Speed Noisy?

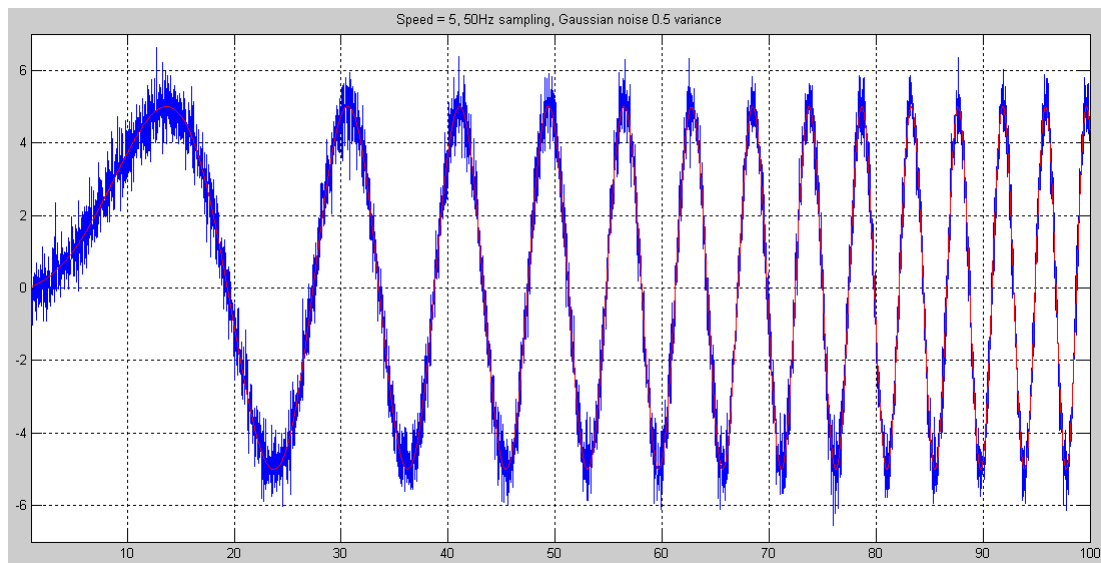
GPS output speed is derived from integrated carrier phase data of internal carrier tracking loop. 1Hz uses 1000msec accumulated carrier phase data; 50Hz uses only 20msec data. As GPS result is a measurement process with noise, 20msec data is only 2% of 1000msec summed data, the 50Hz speed measurement will be noisier than 1Hz, as longer length of 1Hz summed measurement data average out the noise.

Although 50Hz speed is noisier, it is more instantaneous, as 1Hz 1000msec accumulated data averaging out noise but also averages out changing speed, thus introducing more lag.

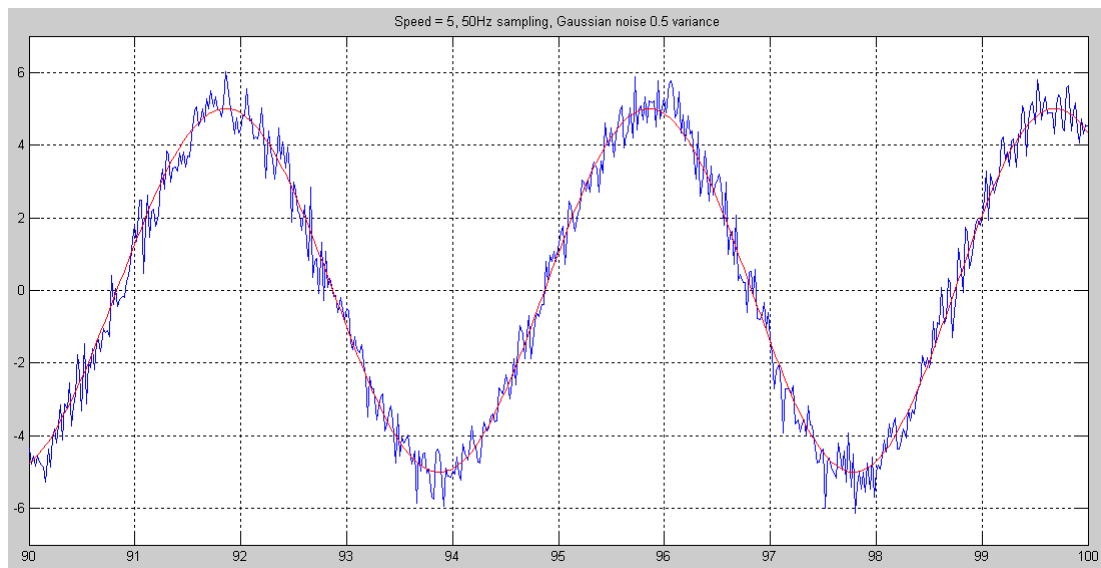
Below figures show 100sec Matlab simulation example of changing speed with magnitude of 5 and 50, having Gaussian noise of 0.5 variance. Blue curve is measured speed. Red curve is true speed without noise.

$\text{Speed} * \sin(2 * \pi * t / 10 * t / 75) + 0.5 * \text{randn}()$,

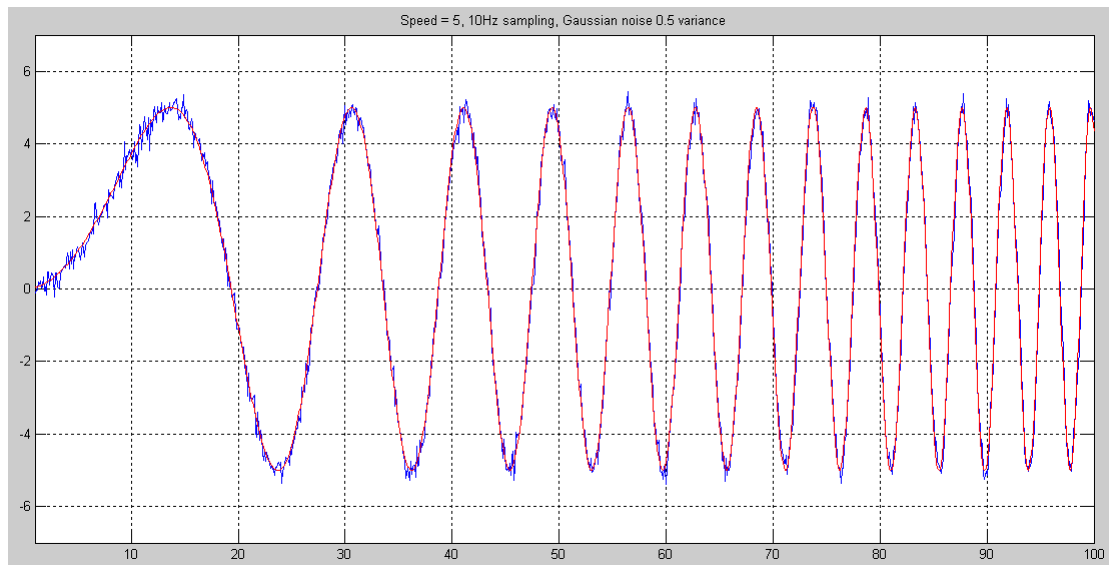
Speed = 5, 50Hz, Gaussian noise 0.5 variance (noisy, no lag)



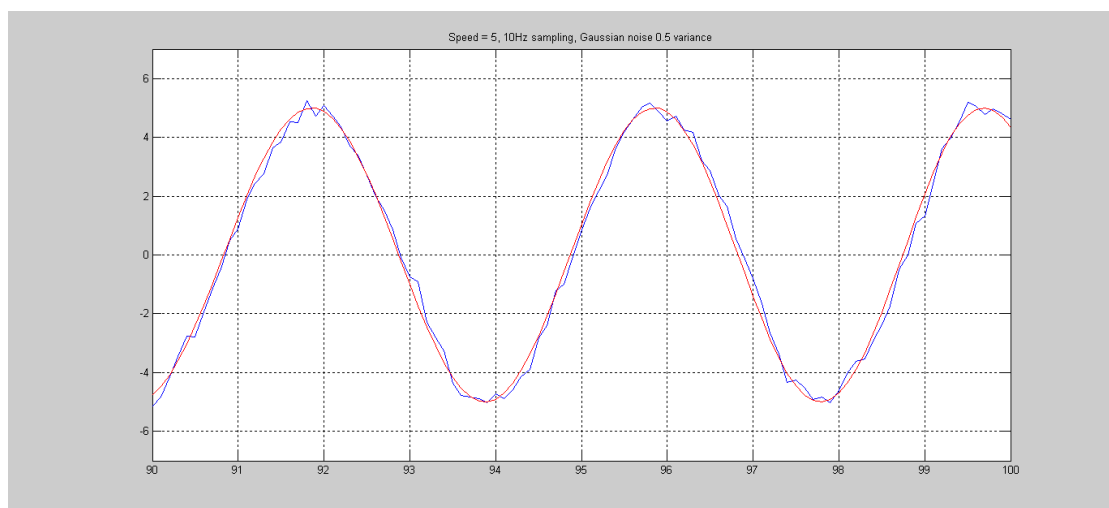
Zoomed in view (noisy, no lag)



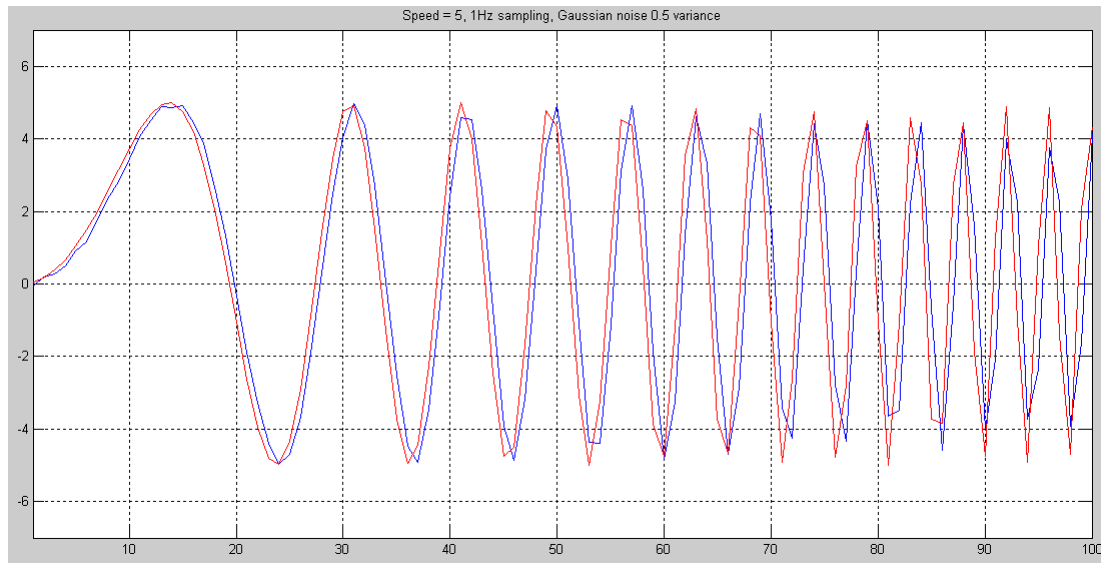
Speed = 5, 10Hz, Gaussian noise 0.5 variance (less noisy, slight lag)



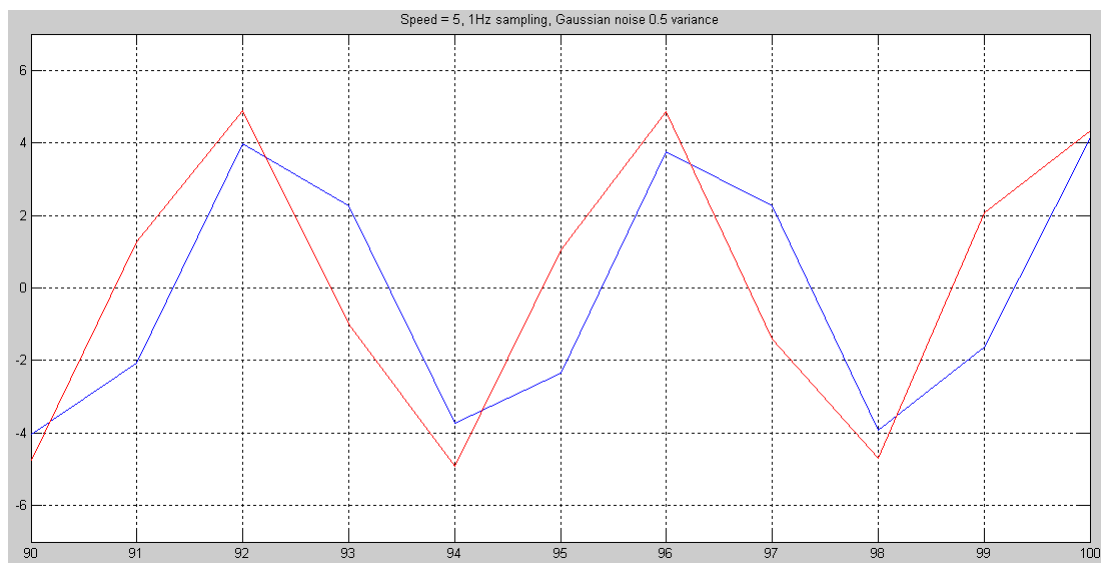
Zoomed in view (less noisy, slight lag)



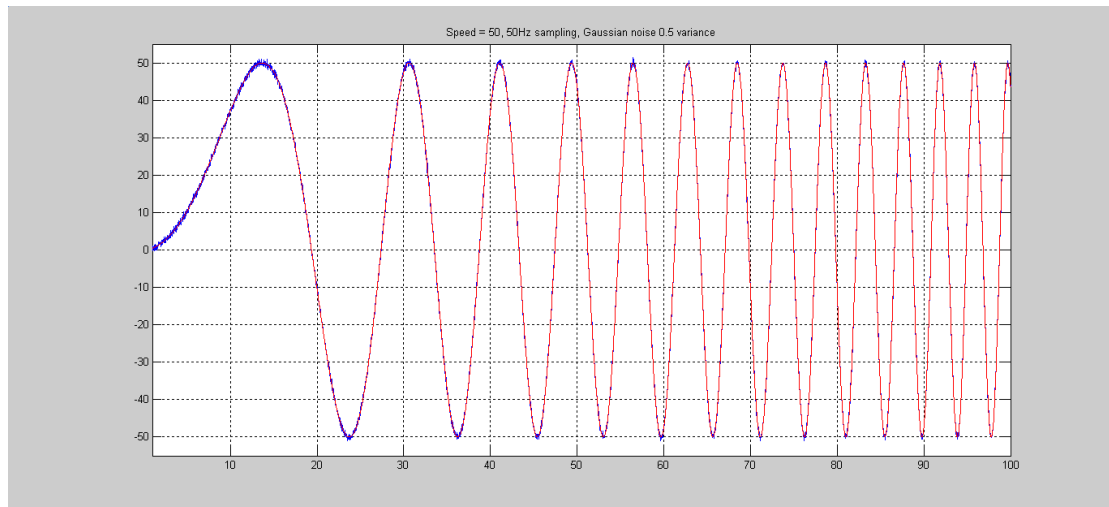
Speed = 5, 1Hz sampling, Gaussian noise 0.5 variance (least noisy, severe lag, reduced amplitude)



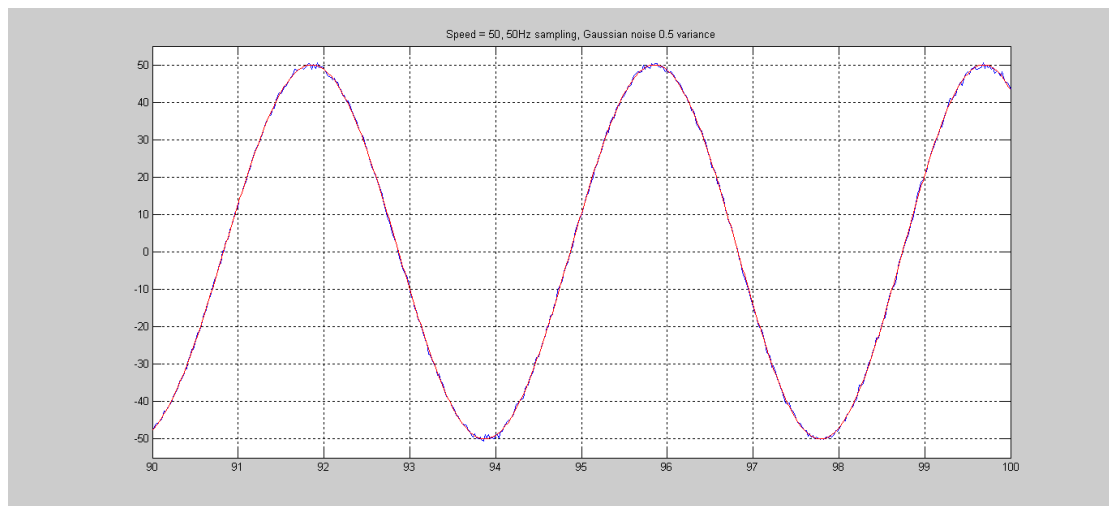
Zoomed in view (least noisy, severe lag, reduced amplitude)



Speed = 50, 50Hz, Gaussian noise 0.5 variance (noise insignificant, no lag)



Zoomed in view (noise insignificant, no lag)



SUMMARY

At low speed, noise level of speed measurement at 50Hz will be prominent.

At high speed, noise level of speed measurement at 50Hz will be insignificant.

N-Hz generates N speed measurements per second, each with $1/N$ -sec duration of accumulated data to compute. Larger the N is, shorter the accumulation duration, noisier the measured speed will be, but it will be more instantaneous with less lag.

At given N-Hz, higher the speed less significant the noise factor.

So higher update rate should be used for faster speed higher dynamics application that requires true instantaneous speed measurement. It's less suitable for low speed application as it becomes noisier. Also, at low speed, there isn't the need for high update rate, since 1Hz already gives speed without lag!