

# Re: Q about noise in time interval measurement averaging

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*Source:* <http://sci.tech-archive.net/Archive/sci.electronics.design/2007-04/msg01216.html>

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- *From:* "colin" <[colin.rowe1@xxxxxxxxxxxxxxxxxxxxx](mailto:colin.rowe1@xxxxxxxxxxxxxxxxxxxxx)>
  - *Date:* Sat, 07 Apr 2007 00:44:46 GMT
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<[bill.sloman@xxxxxxxx](mailto:bill.sloman@xxxxxxxx)> wrote in message  
[news:1175902280.854739.222930@xx](mailto:news:1175902280.854739.222930@xx)

On Apr 6, 8:42 pm, "colin" <[colin.ro...@xxxxxxxxxxxxxxxxxxxxx](mailto:colin.ro...@xxxxxxxxxxxxxxxxxxxxx)> wrote:

Hi,  
I have a PIC measuring a time interval to 25ns resolution,  
the interval is totally asynchronous to the PIC clock.

So say if I average over 25000 measurements that will give me a limit of  
1ps  
resolution.

Im trying to do a system noise analysis and im wondering how to work this  
out,  
I cant seem to recall how the noise reduces with increasing samples,  
is it 1/samples ? this would be too good to be true,  
or 1/sqrt(samples) this seems rather low.

Noise decreases as one over the square root of the number of samples,  
if the noise on successive samples is uncorrelated.

The square root of 25000 is 158.1, so you'd reduce your 25nsec  
quantisation error to 158psec rather than 1psec, if you averaged 25000  
independent samples.

Ah yes ofc I must of forgoton how to think for a while,  
I was getting mixed up with the number of available bits for resolution.

there is also a lot of noise in the signal as it is from an optical  
encoder,  
seems mostly mechanical, I need to reduce this by averaging over a long  
time  
too.

Re: Q about noise in time interval measurement averging

I'm trying to work out the optimum rate of pulses per revolution to use.

The optimum number of pulses per revolution is probably one, unless your need to know the sense of the rotation as well as it's speed.

not too worried about the sense of rotation as I know that anyway,  
however im seeing a standard deviation of about 10ns per revolution averaged  
over 2000 pulses per rev,  
Im working on fixing the mechanics to reduce this,  
but 1 pulse per rev would give me 25ns error,

im looking for .1ps resolution,  
to reduce my SD of 10ns to this amounts to  $100000^2$  revolutions wich would  
take 3 years at 6000rpm  
id rather it only took a few days, as im not quite that patient.

3 days would mean i would have to get my SD down to 500ps per rev wich is  
probably highly optimistic  
and id need at least 625 pulses per rev too.

I could try timing both edges and see how the SD changes with twice as many  
samples.

I tried feeding the same signal into both A and B, and the SD came out at  
about 25ps  
wich is lower than one would expect but its probably not a valid thing todo.

the error also seems proportional to 1/shaft speed.

Colin =^.=

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