Re: Experiments that measure frequency domain

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- *From*: Timo Nieminen <uqtniemi@xxxxxxxxxxxxxxxxx>
- *Date*: Tue, 11 Apr 2006 05:56:56 +1000

On Mon, 10 Apr 2006, Jan Panteltje wrote:

> On a sunny day (Tue, 11 Apr 2006 04:30:00 +1000) it happened Timo Nieminen
> <uqtniemi@xxxxxxxxxxxxxxxxx> wrote in <20060411042548.O12714@xxxxxxxxxxxxx>:
>
> > (b) the system has a very narrow resonance, so you get all the important
> > information with a small number of frequency domain measurements.
> > Narrow
> > features in the frequency domain translate into very broad features in the
> > time domain − think about how many samples in the time domain over what
> > time are required to resolve a narrow resonance.
>
> Actually that is a bit 'shady'.
> Suppose you have a metal plate, and it resonance (or one of its resonances)
> is 100Hz.
>
> First it is not only 100Hz, there is such a thing as bandwidth (and Q).
> me, I would tap the plate, and then see a 100Hz damped oscillation on
> the scope (measure 10mS period time), done that++ times.

A handful of frequency domain measurements will give you both f0 and Q, if you know approximately what f0 and Q are. Suppose that f0 is equivalent to a wavelength of 1 micron, and Q is equivalent to a time constant of 10^{−8} seconds. Difficult to measure both frequency and damping with a single set of time domain measurements. One could do it with a couple of measurements, but if the _shape_ of the frequency response curve is of interest, then the demands that the Fourier transform places on the time domain data is severe. The cool thing is that it's still easy to go from frequency domain to time domain, since only the region near the resonance does anything interesting, so you can get away with very sparse data away from the resonance.

I met this case in theory, and it was a case of calculating frequency response rather than measuring, but it still came down to about 2 hours in frequency domain, or a minimum of months in time domain.

If you're only interested in f0, then the time domain measurement is excellent; there's a reason why bells work the way that they work. If the shape of the frequency response curve matters, OTOH ...

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E−prints: http://eprint.uq.edu.au/view/person/Nieminen,_Timo_A..html
Shrine to Spirits: http://www.users.bigpond.com/timo_nieminen/spirits.html
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