

## Education – Revisiting an Old Topic and Starting a New One

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About four years ago, I initiated a minor tornado of agreement and protest when I wrote an editorial titled “A Commentary on the State of Engineering Education.”<sup>1</sup> In that discussion, I questioned whether the colleges and universities that were providing engineering education were requiring (not just offering) adequate “dirty-hands” education.

The editorial precipitated a flurry of responses from educators and practicing engineers. They came in the form of five editorials in this magazine and about 100 e-mails from readers. I also questioned students in my short courses, many of whom were recent graduates, what they thought of their education.

As reported in a subsequent editorial,<sup>2</sup> the news was generally good. There are many engineering schools that have enhanced their curriculums in the past 20 years to include dirty-hands requirements. To give credit where credit is due, recent graduates and/or faculty of the following schools have convinced me that their institutions are doing a good job (the list has grown somewhat since the second editorial two years ago):

- Carnegie Mellon
- Cal Poly
- Cooper Union
- Cornell
- Michigan State University
- Michigan Tech
- Stanford
- Texas Christian University
- University of Massachusetts, Lowell
- University of Minnesota, Twin Cities
- University of Missouri, Rolla
- Wayne State

I assume (and hope) that this is a very incomplete list. For instance, I have not been able to get any feedback from MIT. Its graduates do not seem to run in my (our?) circles. I even sent an inquiry to the institute’s notable graduates, Click and Clack, the Tappet Brothers of NPR’s Car Talk fame, but they did not respond.

Several well-known schools are still receiving poor marks. I will not list them here but questions or comments about specific schools that are not on the list will be entertained via e-mail.

### The New Subject

Enough about that for the moment. What is bugging me now? It’s education again – but a different aspect.

We all got out of school some time ago – some longer ago than others, but the concept still holds. Time and technology march along. Our college education goes out of date far faster than we ever imagined. Where

do we get our information about what’s new and wonderful? There are several options:

- Go back to school (on the rash assumption that the instructors have done the following tasks)
- Read magazines and cruise the web
- Go to technical meetings
- Take short courses (again with the caveat for “go back to school”)
- Listen to the vendors in your regimen

I find that technical meetings are the best place to find out what is going on. I don’t mean the technical sessions, although they are crucial. Hobnobbing with the vendors or, better yet, schmoozing with real users of the products, is a gold mine of information. However, the meetings are expensive and take a lot of time.

For most of us, the second and fifth options are the easiest (and least expensive) approach. Obviously, we should all be reading S&V from cover to cover (including the ads), and we must click on all of the web pointers we can find. The [www.SandVinfo.com](http://www.SandVinfo.com) reader service is a quick and easy way to surf the ads and product releases and request additional information from the vendors.

So who do we rely on most to keep us up to date? Most of us rely on the product vendors. Many of them offer seminars displaying their technologies or are more than willing to appear on your doorstep with a presentation. Obviously, their objective is to sell their wares. The questions are:

- What method will sell their products best?
- What method will do the users the most good?

The fundamental problem is that vendor’s people who interface with the customer base are salesmen and marketers. Some of them have a technical background but not very many. In fact, it is my experience that most companies do not want their best high-technology folks on the marketing front lines for two reasons: 1) they might be “too honest” about the capabilities (and shortcomings) of the product; and 2) they usually are much more valuable doing something useful back at the plant.

To help this fundamental problem, many companies hold seminars in which their “more technical” marketing staff (or technical folks on a boondoggle) make presentations displaying their products and their view of the state of the art. I went to one of these presentations recently and the following discussion is the result.

The seminar that I attended was presented by one of the prominent data acquisition manufacturers/vendors who has also ventured into the analysis market supporting a

variety of technical regimens. The vendor is well known (and a prominent advertiser in this magazine) and I was looking forward to an enlightening day.

It was attended by about 30 obviously bright engineers and technicians. Most of them were relatively young (at least compared to this codger) and were obviously there to learn something. So, what did they learn?

The main presenter introduced himself and immediately stated the philosophy of the seminar: The vendor had developed a set of hardware and software black boxes that performed the required tasks and that there was no reason to be concerned with what was in the boxes.

To my surprise (shock) I was the only one who commented on this statement. I think that all of the participants recognized and understood my objection, but in later conversations, it was obvious that they did not really care. Just an old codger dredging up objections to the wonderful new technologies.

In any case, the presentation continued and a variety of interesting techniques and results were presented. They were all in technical areas where I had some experience, and I thought that most of the results looked reasonable. But there was no method of assessing their accuracy. The results were presented as the truth. There was no discussion of errors or uncertainty in measurements.

Perhaps worse, details (that produce 20% differences in results even when “correct/accepted” techniques are used) were swept under the rug. The company markets a variety of data acquisition systems with aliasing-protection strategies including none, analog Butterworth filters and sigma delta. The features, benefits and shortcomings of these approaches were not discussed. The possibility that these systems would produce different (or corrupt) results was ignored. All that was indicated was that they produced the correct results.

### A Side Rant

During the discussion, a detail surfaced that was probably only noticed by this writer. When they were describing one of their data acquisition systems, they said that the user selects the analysis bandwidth (good!) and the system sets the sample rate to 2.56 times that. Where did this value come from? I first saw this magic number in a request for proposal in the middle ’80s. It made sense there. The author of the RFP was trying to spec in the Precision Filters LP8 elliptical anti-alias filter for which the minimum sample ratio (sample rate/desired

frequency range) for adequate aliasing protection is 2.56. It is not right for any other filter. So why does it keep coming up? It sounds very scientific. It is ( $2^8/100$ ). But unless you are using a Precision Filters LP8, it is not the right choice.

In fact, my recommendation is that you never use a sample ratio of less than 3. And that can only be used if the alias-protection hardware allows it.

**Bottom Line.** One of my litmus tests for data acquisition system vendors is that if they hype a sample ratio of 2.56, I know that they don't have a clue – unless, of course, they are using the LP8.

### Back on Topic

The shock and vibration characterization area is a rapidly developing science/art. New products and concepts are appearing every day. Simultaneously, new methods of making errors are being invented at a comparable rate. These are being buried inside black boxes and are hidden from the user.

An old example comes to mind. A long time ago many of us in the shock-analysis world were concerned about the accuracy and repeatability of shock response spectra results. To clarify the analysis part of the process, I sent an ASCII time history of a real, high-bandwidth shock to several of the vendors and laboratories doing these characterizations.<sup>3</sup> Most of the results agreed, but two of the (well-known, and also prominent advertisers in this magazine) vendors had algorithms that were producing results

that were significantly off at low frequencies. Their smart scientists had developed algorithms that were very fast (not a real consideration) and produced good results for the classical inputs (impulse, half sine) but did not handle real data properly. I discussed the problems with the vendors, and they agreed with the discrepancy. But I don't know whether the problem was ever fixed. If you are curious or suspicious about the algorithm your system is using, I will be happy to send you the time history and help you evaluate the results.

In my short courses, I stress the need to perform tests on any new black box that you get. The box may be a data acquisition system, a LabVIEW VI, or anything that you can't see what it does without peering inside. I suggest that the hardware and software be tested with a variety of signals including sine, square, and real signals. If you have an old (or different) black box, the tests should be run on both and results compared. I can almost guarantee you that they will be different. If they are very different, you have a problem. Which is right? My answer is neither, but that is another subject.

So, back to the questions at hand:

- What method will sell the vendors wares best?
- What method will do the users the most good?

I have always thought that a well-educated customer is the best customer. Only those who understand the process can appreciate

a good product. However, after the seminar described here, I am convinced that this vendor disagrees. There is no doubt that they sell a lot of stuff. They are sure proof that ignorance is bliss.

I hope the readers here feel differently. You should demand good information from your vendors and perform tests yourself on the processes. That is the only way you can be confident of your results.

This is certainly not to say that all of the technical seminars that I have been to have not been adequately scientific. Many vendors (including other prominent advertisers in this journal) have provided presentations with excellent technical information and have had staff present that can answer the hard questions. That is how it should be done. It is up to us, as potential system purchasers, to select a vendor that does not work with smoke and mirrors. Demonstrable technical competence must be a prime criterion in our system selection process, and it should be appropriately rewarded with our orders and dollars.

As always, comments are welcome. Send them to [strether.smith@comcast.net](mailto:strether.smith@comcast.net).

1. Smith, Strether, "A Commentary on the State of Engineering Education," *Sound & Vibration*, July 2004.
2. Smith, Strether, "More on Engineering Education – A Renaissance in the Offing?," *Sound & Vibration*, March 2006.
3. Smith, Strether, "Why Shock Measurements Performed at Different Facilities Don't Agree," Proceedings of the 66th Shock and Vibration Symposium, October 1995. 