Re: Working Wrong Concepts

Source: http://sci.tech−archive.net/Archive/sci.physics/2005−11/msg00369.html

- *From*: Timo Nieminen <uqtniemi@xxxxxxxxxxxxxxxxx>
- *Date*: Sun, 6 Nov 2005 06:00:51 +1000

```
On Sat, 5 Nov 2005 jmfbahciv@xxxxxxx wrote:

        Timo Nieminen <uqtniemi@xxxxxxxxxxxxxxxxx> wrote:

             You [are] quite
             right in that avoidance can leave the mess as a festering pile for
             somebody else, but avoidance can also stop the mess from ever being there.

       Please note that the "somebody else" you refer to is usually the
       female.  In my job, every last male developer left 5% of his
       work undone.  (I think this is a general human trait and not a
       sexual trait.)  I picked up everybody's last 5%.
```

That's not mess prevention/avoidance, but shirking. Was this a case of: "It works well enough to fool the client, most of the time, so I'll just stop here."?

Solution: double the pay of those who didn't leave their work unfinished, and don't rehire those who did for the next project (assuming contract work for the project). Since the good people are way more than twice as produuctive, double pay is a bargain for the bosses.

```
             There are two different approaches to simple AC circuits. One is to write
             down the applied potential diff V(t), and then across R, C, L, you have
             V=IR, integral(I)=CV, dI/dt L = −V and string them together into a
             differential equation. Sit down and solve. Have at least 3 sheets of
             paper, and expect to make numerous transcription errors. Then, since you
             are interested in the steady−state AC behaviour, take the limit for large
             t. This is making a mess and cleaning it up.

             But since you know already that you want the steady−state limit, just
             write down the complex impedance of the parts, and the problem takes 3
             lines or fewer. No mess!
```

> > There is a third way. Just build it and let somebody else write
> > it down. :-)

Analog computing!

> > > This is a difference between physics messes and real-life messes. RL
> > > messes are generally made by other people and can't be avoided, while a
> > > physicist can make and avoid his own messes.

> > Is the nature of the avoidance unique to the person or to
> > the profession? It's at this point where I get bogged down
> > trying to separate personal work styles from the work aspects
> > of the discipline.

It's intrinsic to the profession (but also exists in related professions). You accept that you're not going to get an exact answer that actually describes a thing in the real world (except perhaps for the case of a single hydrogen atom), so, with some idea of what degree of accuracy is needed, you simplify and approximate.

Example: You want to calculate how wide a laser beam is after 10 metres; the goal is to have it less than x mm, and since the final width is affected by the initial width, x mm tells you what is the allowable range of initial widths.

What is approximated? Let us see:

1) The best available covering theory, QED, is quite possibly wrong, but its covering theory is currently unknown. Starting with QED may or may not be an approximation.

2) Since we have 10^N photons per second, all essentially identical, we can use the high-photon-number limit of QED, classical electrodynamics.

3) We pretend that the laser has an exact frequency. This is equivalent to assuming that (a) the laser is perfectly stable (b) was turned on an infinite time ago (c) will remained turned on and stable forever. Clearly unphysical, but close enough to adequately represent reality. This gets you to the vector Helmholtz equation.

4) Deciding that it's still too difficult, replace the vector Helmholtz equation with the scalar Helmholtz equation, tacking on polarisation afterwards as a crude hack. Then take the paraxial limit of this, getting the scalar paraxial wave equation. I kept these together, since the former doesn't adequately model things without the latter limit, in

general.

5) Write down a general solution of the SPWE. Assume that the laser beam is described by the lowest-order solution. Unphysical, since there are finite apertures. But close enough. This gives the standard equation for propagation of a Gaussian laser beam that the end-user looks up in a book and plugs the numbers into. In most cases, the errors in the measurements giving the initial numbers, or the fuzzy space in the requirements giving the original numbers exceed all approximations made in order to obtain the simple result.

Students sometimes have a hard time trying to understand this. They get conditioned to think that they can get "exact" solutions, limited only by the precision of input data. After all, this is what they do on exams. Real-world problems are generally complicated, too much so for a standard exam. So students usually never see them, and never learn until they stop studying and start learning. I did some experimental assessment for my students; gave them pseudo-real-world problems. Median time taken was three days per question.

The real trick is to know when you _can't_ take shortcuts.

--
Timo Nieminen - Home page: http://www.physics.uq.edu.au/people/nieminen/
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
.