Christian Engineers and Scientists in Technology Newsletter

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IN THIS ISSUE

From the Editor

This newsletter is intended to facilitate camaraderie and exchange of information among CEST members. Reader responses and other inputs are welcomed. Please send me **your** input for this newsletter.

- Send an account of a project you worked on.
- Send a note about something you've seen in the news that you think others would be interested in.
- Send a response to one of our math, physics, engineering, etc. challenges.
- Send a challenge question of your own.
- Send an article about something you've been thinking about.
- Send a photo you took.
- Send a comment on something you read here.

My thanks to those who contributed to this issue, i. e., Dennis Feucht, Dave Kramer, John Osepchuk, Charles (Chuck) Paul, Harold Reed, Jack Swearengen, and Bob Thoelen. BY ■

Monty Hall Challenge! Readers Know How to Game the Show!

This problem was posed last time:

> The **Monty Hall problem** is a probability puzzle loosely based on the American television game show *Let's Make a Deal* and named after the show's original host, Monty Hall.
>
> Suppose you're on a game show, and you're given the choice of three doors: Behind one door is a car; behind the others, goats. You pick a door, say No. 1, and the host, who knows what's behind the doors, opens another door, say No. 3, which has a goat. He then says to you, "Do you want to pick door No. 2?"
>
> Question: Is it to your advantage to switch your choice? Provide your rationale for your answer.

(There is an unwritten rule that the reader must assume in order to solve this. That is that the game is **always** played the same way. The contestant is **always** given the option to switch his choice after Monty reveals a goat. Otherwise the contestant might suspect Monty was intentionally trying to get him to switch from the winning door.)

Two readers sent in the correct answer and provided rationale to support it. Those readers are Harold Reed of Mobile, AL, and Dave Kramer of Chelmsford, MA, and the correct answer is **Make the switch – pick door No. 2.** You will double your chances of winning.

Consider this rationale: For Monty to reveal a goat after the contestant has made the first choice is just a distraction because the contestant already knew that at least one of the two remaining doors hid a goat. Ignore that. What he is really offering is the option to pick two doors instead of one. Since each door had a 1/3 chance of hiding the car, you will double your chances of winning by making the switch.

BY ■

Most Important Technologies Readers' Choices

In the Fall 2012 issue readers were asked what, in their opinion, are the most important technologies ever developed. And I suggested that the following broad definitions of technology be used:

> the practical application of knowledge [merriam-webster.com]
>
> the application of scientific knowledge for practical purposes [oxforddictionaries.com]

I received two responses.

Charles (Chuck) Paul said, "Unquestionably, the technology that has had the largest impact on human society is the **flushable toilet**." And he sent along rationale to support this choice – see ***Impact of Flushable Toilet***, below.

John Osepchuk identified the **printing press** as the most important technology ever developed.

Now, as I said last time, I already had my top three picks and would state them this time. They are:

1. **Spoken language**
2. **Written language**, and
3. The **printing press**.

I can imagine some would question my number one choice on several grounds. First, weren't humans created with the spoken language capability built in? After all, the Bible has Adam and Eve conversing with each other, the serpent, and with God in Genesis chapter 3. Second, spoken language doesn't involve any tools or create and mechanism.

My view is that Adam and Eve may not have existed as literal people, but that if they did, they came from a long line of hominid ancestors in whom spoken language developed over many generations. (Remember, I am speaking for myself, not CEST or the ASA.) As to not involving tools or mechanisms, the definition we are using does not require them. Wouldn't you count FORTRAN or Java or Matlab as technologies? Then why not spoken language? Speech does use our lungs, larynx, tongue, lips, ears, and brain! BY ■

Impact of Flushable Toilet
by Charles (Chuck) Paul

As mentioned in the previous item, Charles Paul provided rationale to support his choice of the top technology ever developed. Here it is:

Hi, William:

Unquestionably, the technology that has had the largest impact on human society is the flushable toilet. Literally tens of millions of people have been able to live because of this invention.

The first practical flushing toilet was invented by Sir John Harrington, who, lived between 1561 and 1612. He described it in his publication "A New Discourse of a stale Subject, called the Metamorphosis of Ajax." Ajax was the forerunner of the modern flush toilet, and he had it installed at his home in Kelston, England. The design had a flush valve to let water out of the tank, and a wash-down design to empty the bowl. Interestingly, his godmother was Queen Elizabeth I, and he installed an Ajax at Richmond Palace for her, but she refused to use it because it made too much noise.

In the 1880s Thomas Crapper improved the flush toilet significantly, by adopting a siphon system for emptying the tank, replacing the floating valve system which was prone to leaks. Contrary to popular jokes about his name that were in use during my university engineering days in the 1950s, the common name crapper that we use for the toilet is not attributed to his name.

My submission of the flushing toilet is not made academically, but with empirical evidence of death and sickness due to its absence in some 26 developing countries in which I have worked. When I worked in Africa, South America, and southeast Asia in the 1970s and 1980s, infant death rate from contaminated water exceeded the death rates for all other diseases combined. In west Africa, it was at 4.4% of the total population, and it is probably not much better today. One of my responsibilities was identifying areas for hydrological drilling using satellite and aircraft imagery, and much of the water subsequently found and brought to the surface was contaminated by poor sanitation systems and practices by the populations. It was a recurring and sometimes insurmountable problem without the concomitant provision of modern toilets.

Thank you,

Charles (Chuck) Paul

In further support of the importance of the flush toilet, I'm including a quote from an article in the November 26, 2012 issue of Bloomberg Business Week, pp 75-76. In the article Mehul Srivastava describes his experience as he spends two weeks in his father's boyhood home in India, living as the current residents live. He writes, "*My life in the village quickly fell into a pattern that in many ways has remained unchanged for centuries. Rising with the sun, my stomach already growling with hunger, I'd seek a secluded spot to empty my slowly cramping bowels. With little running water, and almost no indoor toilets, entire fields were open latrines. Women rose earlier still, defecating in the dark in the hope of some privacy. Open defecation is a national crisis for some 665 million Indians; soiled water and food supplies are a major contributor to the spread of pathogens that kill about 1000 children a day from diarrhea, hepatitis, and other diseases.*" BY ■

Engineering Challenge #1
Voltage Tripler

Here is a challenge for all you EEs. Send me a sketch of a circuit that will provide at least 350 VDC from a 120 VAC input. You may use only diodes and capacitors (no transformers). Send a jpg of your sketch to LWYoder@ieee.org. I will post an answer in the next issue (if I receive at least one!). BY ■

Engineering Challenge #2
Distinguish Engine Types by their Sounds

This is especially for MEs. Someone with a trained ear can easily distinguish the exhaust sound of an inline 4 or 6 cylinder engine from that of a V8 (if it is not too strongly muffled). But can you distinguish the sound of a V6 from an inline 4 or 6, or a V8? Here's what I want. Provide descriptions, with drawings if you like, of the time sequences of the 6 or 8 exhaust pops from a V6 engine and a V8 engine respectively, over the time period it takes for the crankshaft to rotate two turns. For an inline engine, the pops will be equally spaced, but for a V8, and I'm almost certain for a V6, the pops will be staggered. Your job is to quantitatively describe the stagger sequences. Send your answer to LWYoder@ieee.org. I will post an answer in the next issue (if I receive one!). BY ■

Devotions for Engineers:
God's Provision and Love
Psalm 36:5-10

by Robert Thoelen

I sat with my youngest son a few weeks ago, gazing out the window at the sky. It was nighttime, I was putting him to bed, and we were observing the stars. A blinking light moved across the sky, and my perceptive five year old asked if the light was an airplane. I told him it was, and then I began to reflect on what I was seeing as he drifted off to sleep. Since my work experience is with aerospace control systems, my mind was drawn to think on how humans have discovered laws of physics and science that allow for things like air travel and flight into space. These accomplishments, along with other scientific discoveries, are God's gift and provision to us, a form of common grace. Looking at the wide sky, and the tiny, blinking dot of the strobe light on the airplane, filled me with feelings of awe and reverence for God.

In Psalm 36:5, the Psalmist tells the reader that God's steadfast love and faithfulness extends to the heavens. Contemplating on the sky as my son and I looked up, it filled me with a sense of amazement as to how large and how expansive the universe is. Sometimes, I forget and need to be reminded that His love is far greater than what I can begin to understand, as it is so vast like the night sky. Further reflecting on the poetic simile of mountains in verse 6, God's righteousness is also large and great. This is a tremendous encouragement to me, as my plea when I appear before God will not be that I am righteous, but that God has given me faith and righteousness in Christ (Philippians 3:8-10). I can approach and worship God only because of what He has graciously given to me.

My thinking with this short devotional is to help you consider God's greatness, love, and provision for us as represented in the world He has created, and also through His Word. I chose this particular passage because at the time of this writing, churches that follow the liturgical calendar are in the season of Epiphany, where Christians ponder God manifesting

Himself to mankind. It helps to know during good and difficult times in our lives, that God is far greater and above us, but yet He is also is present with us. Creation, as well as the Bible, speaks loudly to mankind, revealing our need of Christ. We can think, understand, and reason, especially with spiritual matters, because even this is a gift from God (vs. 9). I pray with the Psalmist, that God would continue to show His love for me(vs 10) in my life and its pursuits. My prayer for those of us in engineering and related scientific fields, is that we would ask God in a spirit of humility to guide our exploration and application of technology for the benefit of those in society that we serve. As we continue to learn and apply what we know about the world to our teaching or work projects, let us never lose that sense of being awestruck by what we find. There is truly an "abundant feast" to be seen in God's provision for us in the world that He has given us.

Robert E. Thoelen III, January 2013 ■

An Ineffable Experience

by Bill Yoder

Do you ever use the word 'ineffable'? Do you even know what it means? The online Merriam-Webster dictionary says it means: incapable of being expressed in words**:** indescribable.

There is a stanza to the hymn *O Worship the King* that is left out of many hymnals. It goes like this:

> *O measureless might, ineffable love,*
> *While angels delight to hymn thee above,*
> *The humbler creation though feeble their lays,*
> *In true adoration shall sing to thy praise.*

Truly God's love is indescribable, ineffable.

Recently I reread Jonathan Edwards' sermon, *Sinners in the Hands of an Angry God*. Edwards uses ineffable to "describe" the *ineffable extremity of your [the sinner's] case*, and the *ineffable strength of your torments [in hell]*.

I had an experience once – about 25 years – ago that I would apply that adjective to. For some, such an experience is probably just a normal nature experience, like the first time you saw Niagara Falls or a total eclipse of the sun.

It was on a cold winter day in Alaska at a remote radar site – Tatalina Air Force Station. The temperature was around -10 °F, and it was bright and sunny. We were in a four wheel drive pickup truck coming down the mountain from the mountain-top radar site. Near the base camp we were all of a sudden surrounded by a brilliant display of points of light in the atmosphere around us. The rays of light were somehow aligned with the rays from the sun. I just can't describe what an amazing sight that was. I've never seen anything like it before or since. I wish I could have taken a picture of it. I wish I could see it again.

Well, what to me was ineffable, was to the other guys in the truck just a ho-hum thing. How could that be? BY ■

PRISONERS OF HOPE
a book review by Jack Swearengen

Jack Swearengen was commissioned to write this book review for ASA's journal *Perspectives on Science and the Christian Faith*. We've been given permission by PCSF's Book Review Editor Patrick Franklin to offer a preview here. What a scoop!! It will appear officially in the March issue of PSCF.

PRISONERS OF HOPE: How Engineers and Others Get Lift for Innovation by Lanny Vincent. Bloomington, IN: WestBow Press, 2011. 252 pages. Paperback; $ 19.95. ISBN:9781449728267

Something inexplicable keeps happening to me: friends and colleagues bring a steady stream of significant books to my attention, at *kairos* times when the subject matter is germane to something I have been grappling with. In this case Arie Leegwater was the recommender (requester), and the book, *Prisoners of Hope*, by Lanny Vincent. The current grapple is a three-year effort to bring a technology start-up into being; and behind it my thirty-year career in engineering R&D and education. I wondered how Vincent's account would stack up with my experience.

Many books have been written on innovation—what it is or is not, how the process works, whether it can be taught, and how to stimulate it. Vincent was an ordained Presbyterian minister before he went into industry—so we might well expect a cross-disciplinary (or even cross-realm) perspective. Building an analysis of innovation from Scripture, however, makes *Prisoners of Hope* unique—and probably controversial. Innovators become *prisoners of hope* (Zech 9:12) when their innovations are first introduced to the customer. Whether an invention, a new solution, a better value, or a more elegant design, the innovation "is an offer, sacrificed on the altar of customers' opinions" (p. 184).

Innovators differ from inventors, Vincent explains, in that innovators are more oriented toward business considerations, while inventors are more focused on technical issues (p. 132). Innovators must appreciate the innovation's economic context and conditions, whereas inventors must appreciate the invention's *Sitz im Leben*—the surrounding physical and technical ecosystem. Thus innovators may see potential where even the inventor may not (p. 159). Successful innovators are often "T-types": people with deep expertise in one or more areas of a specialty and at the same time have experience with a breadth of connections in other areas (p. 13).

Vincent asserts that the desire for fame, fortune, or career advancement seldom prove sufficient for successful innovation. Instead the biblical qualities of faith, hope, love, trust, humility, gratitude, awe and wonder, perseverance and forgiveness are required in full measure. Each of these qualities is introduced and illustrated with Scripture passages. The youthful David is described as an experienced shepherd who had repeatedly given himself permission to try and to fail. The account of David and Goliath becomes a parable for innovators (Chapter 1), for example, because every element of the innovation process is portrayed: conditions of necessity, positioning for serendipity, atmospheres of fear, reframed experience, permission to fail, motivations of love, and emergence. Successful innovators do not succumb to the fear that surrounds them; they are able to give themselves permission to fail. The Good Samaritan demonstrates *agape* love for the customer, in contrast to the priest and the Levite who are parts of an incumbent administrative hierarchy. The parables of the prodigal son, the talents, and the landowner illustrate forgiveness, persistence, risk-taking, sacrifice, and assessing information from the market. Abraham and Isaac illustrate how introductions (to the market) are sacrificial altars upon which innovators

submit their offering (p. 181). The account of Jonah illustrates risk-avoidance; Moses at the burning bush illustrates awe and wonder; and Ezekiel's vision of the dry bones illustrates inspiration.

Vincent's descriptions are consistent with my experience with innovation. Many years ago my capstone engineering design professor taught us to saturate our conscious minds with information and then sleep on it—letting the subconscious mind work on the problem. According to Vincent that method is a key to innovation, and I can report that it has worked for me. On a more recent note, the book has been very helpful for sorting through the complex psychological and legal issues associated with the technology venture that is presently demanding much of my time and energy. Vincent explains how risk, unknowns, and uncertainties are more socially acceptable stand-ins for what really is fear, fear of failure in particular.

Vincent's definitions are heavily market oriented—not surprising in view of his background at Kimberly-Clark, Hewlett-Packard, Sony, and other corporations. "No matter how clever the inventive solution may be" he writes, "if it can't be reduced to practice and made marketable, it will remain disconnected, 'in a distant country,' unable to benefit from an initial failure. But Vincent's faith in the market approaches the religious when he asserts that "the response from the market is trustworthy and purifying" (p. 46). The market perspective is not sufficient, in my opinion, for dealing with technologies not intended for commercialization—as are many for national security, public safety, emergency response, or creation care. In fact "green tech" *per se* is dead on arrival these days. Finding investors for technology that doesn't show a profit in five years or less is nearly impossible. Reducing greenhouse gases, displacing fossil fuels, producing more food, saving threatened species: unless driven by a government mandate, the market is not interested.

Surely innovation is part of our earthly mission. God directed humans to continue his work of (or in) creation, to cultivate it for human flourishing, and he equipped us to carry out the mandate. Nonetheless I have no doubt that Biblical literalists will struggle with the author's use of Scriptures in the way that he does. By *faith* Vincent means "a nonreligious, a-spiritual capability available to all humans … the belief the innovator has in an idea for an innovation without any real proof that it will work, at least to begin with" (p. 27); it is potential energy residing in the human system waiting to be released in concrete action (p. 37). Vincent's faith seems to be in faith itself rather than a benevolent Creator God. *Righteousness* is equated with meeting the customer's needs (p. 200); and insubordination—going against the employers' directive—may sometimes be necessary. The latter point is problematic for the field of engineering ethics, and in conflict with the principles of accreditation for engineering schools.

Prisoners of Hope is a unique and useful book. I highly recommend it to innovators who are not biblical literalists. The book contains several typos; finding them is left as an exercise for the reader.

Reviewed by Jack C. Swearengen, Professor of Engineering (Ret.) Washington State University Vancouver, 98686. ■

Analogies Between Scripture and Engineering: The Law of God and Control Theory

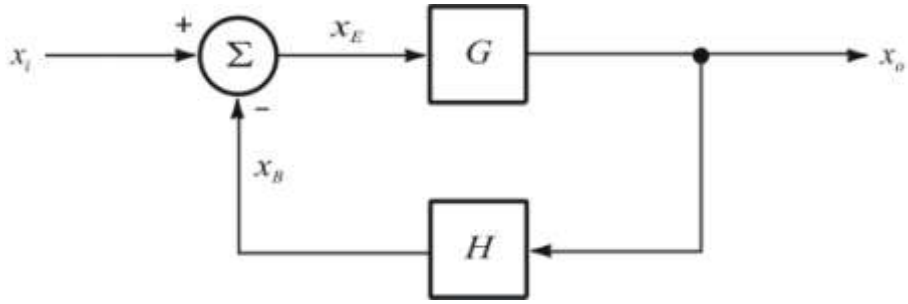
An article by Dennis Feucht

In multiple branches of engineering there is a sub-discipline known as *control theory*. It is found most commonly in electrical engineering but also in mechanical, chemical, and aerospace engineering. The control of devices arose in modern times in the 19th century (though earlier examples abound) with the development of steam engines. It was necessary to find means for throttling them or controlling their output torque or power. Similar needs arose in the control of electrical power. Various mechanical means (some rather ingenious) were invented, such as the centrifugal *governor* used on steam engines or the more familiar carburetor used in internal combustion engines for controlling the mass of the air-fuel charge and hence the temperature of the burn which controls the pressure of the gas pushing on the cylinder over its stroke length and hence the output power. Another is the solar tracker sold by Zomeworks in Arizona. Solar panels are mounted on a frame and moved in or out so that the frame is balanced on center bearings connected to a mechanically grounded pole. On each end of the frame are tubular canisters containing a gas that are connected by a tube. The canisters have aluminum reflectors on the outside, as shown below.

As the sun shines on the canister on the end shown, the aluminum reflector directs sunshine onto the canister and the

gas is vaporized and travels down the connecting pipe to the other canister, thereby shifting the weight and moving the canister shown above upward so that the panels point toward the sun. The reflector on the other end reflects sunshine off its outer surface, keeping the other canister from being heated. The scheme is not entirely foolproof. A cloudy day can leave the trackers in the wrong position for later sun which takes a while to rotate the panels. Yet it is eminently practical and effective in function.These simpler control mechanisms have become eclipsed in complexity (though not necessarily in importance) by the use of electronic circuits to effect more complicated control that is essential for most of electronics and astronautics. Control theory was developed for electronics in the early 20th century by Bode and Black, and developed more quickly during WW II by the Radiation Laboratory at MIT. By the 1950s, control theory emerged as a distinct discipline and has continued to develop.

The dominant control method that had developed historically and is still central to much of applied control is that of *feedback*, illustrated by the following block diagram. The goal is for x_o to be like x_i.



The input quantity, x_i, (usually a voltage or current in electronics) is compared by subtraction with a representation, x_B, of the desired output quantity, x_o, and the difference, being an error, x_E, is amplified by the forward-path *transfer function*, *G*, which is a scaling factor or *gain*. The output is fed back through a feedback path involving *H*, which usually scales x_o to be compatible with the scaling of x_i. The block diagram is an equivalent representation of some algebra:

$$x_o = G \cdot x_E$$

$$x_E = x_i - H \cdot x_o$$

When combined, the resulting *closed-loop transfer function* is

$$\frac{x_o}{x_i} = \frac{G}{1 + G \cdot H}$$

One of the clever conditions for feedback is to make *G* very large, for then

$$\lim_{G \to \infty} \left(\frac{x_o}{x_i} \right) = \lim_{G \to \infty} \frac{1}{1/G + H} = \frac{1}{H}$$

If *H* is made to be an accurate sensory processing block, then *G* can be nonideal - nonlinear and varying - yet as long as it is large, the resulting closed-loop result does not depend on its value. (In electronics, *op-amps* are based on this principle.)

Scriptural Analogies

Control is a very important concept in scripture, no less in the social order generally. While the Bible does not use the word as such nor appeal to modern control theory, some of the biblical concepts are analogous. The Law of God is like the input of a feedback control system where God's people, both individually and collectively, are the system comprised of the blocks. By "Law of God" I am referring inclusively to all that God has told us of what he expects from us, whether from the Mosaic covenant or from the re*New*ed (*καινος*) Covenant with its radical implications of the Law as made explicit by Jesus. The goal is to reproduce as output the behavior given as input from God's Law. The Law is not itself the behavior but is a representation of the desired or intended behavior. When we (the control system) input the Law, the fidelity of the output relative to the input depends on the quality (or *righteousness*) of the control system itself.

To indulge the analogy further in reference to *G*, the biblical teaching is that the control system is flawed, or *fallen*, and incapable of meeting the specification (*sinful*) relative to the suite of inputs that is the Law. One simple way for the feedback loop to be inadequate is for the gain of *G* to be too low. In the restoration of redeemed humanity to an unfallen state, x_o (which is better analogized as a vector quantity, as is x_i) will follow x_i more faithfully. The analogy of a restored humanity is one with *G* increased to infinity. Whatever difference there is between our behavior and the Law is corrected an infinite amount by *G* so that x_E is infinitesimal.

The analogy also requires consideration of imperfections in *H*, our perception of the nature of our behavior in a context where it can be accurately compared to the Law of God. In fallen humanity, *H* is also faulty in that our ability to perceive our behavior accurately is inadequate. And so is the Σ summing block, which compares the Law with our perceived behavior. This involves our ability to compare the two and conclude correctly what the error is. Our moral reasoning, especially when it concerns ourselves, is faulty. Woe are we from a feedback control standpoint.

However, all is not lost. As we look to the Law and its accomplishment for us in the gospel, we are able to make adjustments to the blocks in the system. The adjustments are inadequate to perfectly effect the desired output, though they improve it. In the end, the indication of what saves us is the trend of the control system toward the perfect, and what makes that possible is the input from the gospel, which brings into play an entirely new level of control of the *G* and *H* blocks by more blocks not shown in the original feedback scheme. These blocks are part of a newer control theory called *adaptive control*. It involves improvement of the *G* and *H* blocks. While God's spirit in those effecting adaptation (otherwise known as *faith*) guide the adaptive function in adjusting *G* and *H*, the process will be completed when the *G* and *H* blocks are themselves replaced by better hardware (or software) along with the adaptive blocks, which are also imperfect in that none of us perfectly follow the leading of the Spirit.

As control systems advance, one of the more interesting applications is in robotics, a field that combines mechanical, electronic, and software engineering with a set of principles

distinct to robotics engineering, those of advanced perception, actuation, and cognition in machines. Some of the more remarkable achievements in robotics include the efforts that have been headed by Marc Raibert (at Carnegie-Mellon U., then MIT) in building bipedal walkers. His latest "Big Dog" behaves quite similarly to a quadruped animal, including the way it gets up after being pushed over on an ice pond. Machine vision and other perceptual modalities such as ultrasound have made one of the goals of robotics essentially achievable, that of building a *world map* of the environment. Algorithms for computing world maps have existed and been refined for some time, awaiting the advancement of computation for their implementation. For years, the Mobile Robotics Laboratory in the Robotics Field Center of Carnegie-Mellon U. has been headed by Hans Moravec. His life-long work has recently reached the point of commercialization of carts that can navigate in an industrial environment by seeing familiar objects, much as humans do, without artificial markers to guide them. Ken Salisbury at MIT built a three-finger hand that can hold and rotate a cylinder, using artificial touch.

Moravec has written a book, *Mind Children*, in which he extrapolates in grandiose manner the continued development of artificially-intelligent machines until they exceed human capabilities. With space-friendly bodies, they take to the heavens, converting lifeless matter to machine intelligence. Ultimately, the entire universe becomes a giant intelligence. Physicist Frank Tipler independently hit upon the same idea in his book, *The Physics of Immortality*. Tipler has Baptist roots while Moravec was raised among Jesuits. His wife Ellen has a theology degree from a Pittsburgh Presbyterian seminary, and Hans is not adverse to theological discussion. I thought Donald MacKay's book, *The Clockwork Image*, might stimulate his thinking in this area. Years later, he has not yet said anything about it to me. Robotics poses another emerging area for lively topics intersecting technology and theology, and it is replete with control systems of various kinds.

It is possible to build a much grander analogy out of control theory. Indeed, ASAer Dan Simon, a professor of electrical engineering at Cleveland State U. in Ohio, specializes in control (Kalman filtering, to be precise) and has written a book on *Optimal State Estimation* (Wiley-Interscience, 2006). It is about an advanced version of the *H* block. In it, he has included Appendix C (pp. 493-499), "State Estimation and the Meaning of Life" where he continues the control analogy. In this appendix, some section headings are: "Forgiveness and noise suppression", "Discernment and bandwidth", "Fellowship and persistent excitation", "Spiritual Growth and adaptive state estimation", "Spiritual perfection and estimator optimality", and "The one true way and the single best estimator". He concludes the appendix and the book (as does this article) with the final sentence: "Although God is certainly complicated and cannot be proven to be necessary, the addition of one complicated factor to explain a million simple observations is appealing from both an aesthetic and an engineering viewpoint."

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Bill Yoder, ed. ■

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