

Christianity and Control Theory

If you do not understand Christianity, or if you do not understand control theory, then you may not understand this essay; it may just appear to be nonsense. Someone hearing a foreign language being spoken for the first time might think they're hearing babbling nonsense, even though the words might in fact have a deep meaning. But if you think you understand both Christianity and control theory, or if you wish to plunge ahead despite your lack of prerequisites, I invite you to read.

At first glance, Christianity and control theory may not seem to have a lot in common. But consider the following:

1. Christianity is based on theological truth;
2. Control theory is based on mathematical truth;
3. God created the universe and all that is in it, including both theological truth and mathematical truth.

Considering these points, it follows that there may be some underlying connections between these two seemingly disparate disciplines. If an artist paints a portrait and a landscape, there may not be any apparent connection between the two paintings. But since they were both painted by the same person, a close examination of the paintings will reveal similarities in style and other interesting connections. If an author writes a novel and a biography, there may not be any apparent connection between the two writings. But since they were both written by the same person, a close examination of the books will reveal similarities in style and other interesting connections. If the same God creates both theological truth and mathematical truth, there may not be any apparent connection between the two sets of truth. But since they were both created by the same God, a close examination of the two sets of truth will reveal similarities in style and other interesting connections.

Forgiveness and Noise Suppression

Forgiveness is an essential part of Christianity. God's nature is such that he forgives humans, and he also requires his followers to forgive others. Many Christians have a shallow view of forgiveness, thinking that forgiveness of an offense is equivalent to ignoring that offense (hence the popular but damaging phrase "forgive and forget"). A careful examination of the Bible shows that forgiveness is actually active rather than passive. Far from ignoring or forgetting an offense, Biblical forgiveness consists of confronting the offense, recognizing it as the wrong that it truly is, seeking to benefit the offender, and consciously revoking any attempts at revenge. A person who refuses to forgive hurts himself more than the offender, for the unforgiving person allows a destructive root of hate and bitterness to grow inside him.

Noise suppression in control theory is similar to forgiveness. A control system that does not consider noise is incomplete. In fact, noise suppression can be considered as one of the primary purposes of feedback control. A control system design that ignores the presence of noise might exhibit undesirable oscillatory behavior or even instability. The system might operate wonderfully in a noise-free environment, but the introduction of

noise could render the system useless. A control system that is designed to perform well in the presence of noise is like a Christian who acknowledges the presence of sin in the world but does not allow it to ruin him. Just as the Christian deals with that sin in a constructive and active way, the control system is designed to minimize the effects of noise.

Discernment and Bandwidth

Christians are required to be discerning. In order to grow spiritually we need to listen and learn from a variety of sources, both Christian and non-Christian, because we never know when and how God may try to speak to us. In that sense we need to be essentially open to the data that comes into our lives from others. But if we listen to everything that is within earshot we will “tossed back and forth by the waves, and blown here and there by every wind of teaching” (Ephesians 4:14). We need to reject unhealthy data in order to prevent ourselves from being misled. In other words, we can’t believe everything we hear or read. We need to strike a healthy balance between skepticism and acceptance of the views of others. That is, we need to exercise discernment in order to allow ourselves to be influenced by beneficial information while rejecting data that may be detrimental.

The band limited frequency response of a control system is similar to spiritual discernment. A control system needs to be responsive to input commands, yet it also needs to reject input signals that are outside of its desired bandwidth. A control system that rejects all input signals is clearly ineffective. Yet a control system that responds equally to all input signals will be “tossed back and forth by the waves, and blown here and there by every wind of input signal.” The control system needs to strike a healthy balance between acceptance of desired inputs and rejection of extraneous inputs.

Fellowship and Persistent Excitation

Christians need to be actively involved in fellowship (i.e., spiritually constructive friendships with other Christians). In order to grow spiritually, we need to interact with other Christians, share insights and burdens, and receive the encouragement that others offer. Some Christians adopt the “lone ranger” approach to religion and consider themselves beyond the need for fellowship. But they are like the scientist who tries to conduct research without considering the contributions of the past. We need to be aware that interaction with others will enrich our spiritual lives as we draw on the variegated experiences of others. We will make more progress in our spiritual lives if we stand on the shoulders of the giants who went before us (or even if we stand on the shoulders of the average sized people who accompany us).

Persistent excitation in system identification is similar to spiritual fellowship. In order to control a system we need to have a mathematical model of that system (in general). Even in those systems that can be controlled without a mathematical model (via intelligent control) the availability of an accurate system model will always improve control system performance. One way to obtain a system model is to execute some sort of system identification algorithm. But in order for the system identification algorithm to be

effective, it must be excited by an adequate variety of input signals. This is called the “persistent excitation” condition for system identification methods. The system model will not be accurate unless the inputs are persistently exciting. Likewise, our lives as Christians will not be all that they can be unless we receive sufficient input from other Christians.

Spiritual Growth and Learning Control

Christians need to grow spiritually. Many Christians appear to be satisfied with their present spiritual status, but God requires us to grow on a continual basis throughout our lives. In fact, an examination of the Bible indicates that God is more concerned about the direction that we are moving spiritually than he is with our present spiritual condition. In other words, he is more concerned with velocity than position. We should adopt a mindset that is never complacent but rather continually looks for areas where we can grow and improve.

Learning control is similar to spiritual growth. Some control algorithms are static and unchanging in their dynamic characteristics. But a variety of learning control algorithms have been proposed over the past few decades that exhibit continuous improvement in performance. These learning control algorithms are never satisfied with their present performance, but continually adjust their parameters in order to obtain incremental improvements over time. These learning controllers promise the benefit of improved performance and robustness relative to more traditional controllers. In a similar manner, the Christian who constantly maintains a lookout for areas of possible growth has the promise of many spiritual benefits, both in this life and the one to come.

Spiritual Perfection and Control System Optimality

Christians are required to be perfect. This is a controversial statement. Many Christians will disagree with it, and some Christians will claim to have already arrived at the pinnacle of perfection. To the control engineer this statement raises the questions, “Perfect in what way? What is the standard for perfection?” Jesus told his followers, “Be perfect, therefore, as your heavenly Father is perfect” (Matthew 5:48). So we see that it is God himself who provides the standard for perfection. God himself is the divine objective function. The reason many Christians will disagree with the statement that “Christians are required to be perfect” is because of the statement’s obvious impossibility. But in spite of its impossibility it is a standard toward which Christians are required to strive. We will never reach the standard, but we can continually get (asymptotically) closer to the standard throughout our lives. Those Christians who claim to have already achieved perfection are referred to the Spiritual Growth topic above.

Optimality in control theory is similar to perfection in Christianity. An optimal control system attempts to minimize some objective function. Theoretically, optimality can be achieved. But practically speaking, optimality will never be attained. This is because of modeling errors, incomplete knowledge of noise statistics, sampling and resolution limitations, and other deviations from ideal conditions. Although optimality will never be

exactly attained, optimal controllers and estimators are still quite effective in practice. We do not give up on the notion of optimality just because it is not completely attainable. We continue with our efforts toward optimality, thankful for the performance that we can obtain. The optimal controller churns away in its quest for optimality, never quite attaining it, yet continually getting closer and never giving up. In a similar manner, the Christian churns away in his quest for perfection, never quite attaining it, yet continually getting closer and never giving up.