Defining control. Review of literature

Unedited posts from archives of CSG-L (see INTROCSG.NET):

Date: Mon, 29 May 1995 14:31:38 -0600
Subject: Defining control

[From Bill Powers (950529.1410 MDT)]

It seems that all we have to do to distinguish the PCT meaning of control from other meanings is to call it "negative feedback control." My reference texts aren't very up-to-date, but this is what I found in two of them:

Phillips, C. L. and Harbor, R. D. (1988). _Feedback control systems_.

> To control any physical variable, which we usually call a _signal_, we must know the value of this variable, that is, we must measure this variable. We call the system for the measurement of this variable a _sensor_... We define the _plant_ of a control system as that part of the environment to be controlled. (p. 1)

Ogata, K. (1970) _Modern Control Engineering_.

> FEEDBACK CONTROL. Feedback control is an operation which, in the presence of disturbances, tends to reduce the difference between the output of a system and the reference input (or an arbitrarily varied, desired state) and which does so on the basis of this difference. Here, only unpredictable disturbances (i.e., those unknown beforehand) are designated for as such, since with predictable or known disturbances, it is always possible to include compensation within the system so that measurements are unnecessary.

Maybe some others can look up more definitions.

Best, Bill P.

Date: Tue, 30 May 1995 02:46:48 -0400
Subject: Re: Defining control

<[Bill Leach 950530.02:03 U.S. Eastern Time Zone]
>[From Bill Powers (950529.1410 MDT)]

To my shock and surprise, I only found one reference that properly defined the term "control". The McGraw-Hill Electronics Engineers Handbook does have a section entitled "Control Theory" and presents the basic control loop in diagrammatical form with which we are all so familiar (including proper labeling).

All of the electronic "dictionaries" were abysmal in their treatment of the term "control" or "control system".

The physics books and Dictionary for Science Writers that I have were equally abysmal.

Unfortunately, even the term "negative feedback" is treated poorly for our purposes. The problem of course is that for an amplifier that is "stabilized" with negative feedback IT IS the actual value of the output signal itself that is "desired" to match the input times some transform and it is the feedback (with appropriate inverse function) and almost unlimited "open loop" gain that produces this result.

Additionally, negative feedback in amplifiers is not nearly as straight forward in principle as what we are trying to deal with. That is, we don't concern ourselves with feedback within a single stage or between a few stages as do the electronics folks. Also we are not dealing with "cathode" feedback and the like where the feedback signal has a significantly different affect upon the circuit as the reference on the grid. If the "electronics" definition of feedback dealt only with Operational Amplifiers then their definition would look much more like ours.

-bill

Date: Thu, 1 Jun 1995 18:00:38 -0400
Subject: Definitions

<[Bill Leach 950601.14:34]
>NET/Bill Powers (request)

My comments (if any) are in []. Leading & trailing underscore implies emphasized text in the source.

From "Electronics Learning Dictionary" Howard W. Sams:

Control
Also called a control circuit.

1. In a digital computer ...

2. Sometimes called manual control. In any mechanism, one or more components responsible for interpreting and carrying out manually initiated directions. [this is certainly gives as a great deal of concise and unambiguous information -- lets see now, control is ahhh]

3. In some business applications, a mathematical check.

4. In electronics, a potentiometer or variable resistor.

5. In an alarm system, any mechanism which sequences the interrogation of protected site units, resets latched alarms and performs similar functions.

Controller

1. An instrument that holds a process or condition at a desired level or status as determined by comparison of the actual value with the desired. [not too bad but unfortunately the use of the word "actual" for the perception doubtlessly is a source for misunderstanding]

2. A device of group of devices, which serves to govern in some predetermined manner, the electric power delivered to the apparatus to which it is connected. [this is of course the "component" called a "controller"]

Feedback

1. In a transmission system or a section of it, the returning of a fraction of the output to the input.

2. In a magnetic amplifier, a circuit connection for which no additional magnetomotive force (which is a function of the quantity) is used to influence the operating conditions. [Yes I DID recheck my typing on this one! My My that is profound. ... influence the operating cond.]

3. In a control system, the signal or signals returned from a controlled process to denote its response to the command signal. Feedback is derived from a comparison of actual response to desired response, and any variation is used as an error signal combined with the original control signal to help attain proper system operation. Systems employing feedback are termed closed-loop systems; feedback closes the loop. [this is really pretty good except again for the assumption that the perception is the actual value as opposed to the sensor output]

4. Squeal or howl from speaker caused by speaker sound entering microphone of a recorder or amplifier.

5. The return of a portion of the output of a circuit or device to its input. With positive feedback, the signal fed back is in phase with the input and increases amplification, but may cause oscillation. With negative feedback, the signal is 180 degrees out of phase with the input and decreases amplification but stabilizes circuit performance and tends to lower an amplifier's output impedance, improve signal stability and minimize noise and distortion.

Feedback Control

1. A type of system control obtained when a portion of the output signal is operated upon and fed back to the input in order to obtain a desired effect. [another completely unambiguous explanation!]

2. An automatic means of sensing speed variation and correcting to maintain a constant speed or close speed regulation.

Feedback Control Loop

A closed transmission path which includes an active transducer and consists of a forward path, a feedback path, and one or more mixing points arranged to maintain a prescribed relationship between the loop input and output signals.

Feedback Control Signal

That portion of the output signal which is returned to the input in order to achieve a desired effect, such as fast response.

Feedback Control System

A control system comprising one or more feedback control loops; it combines the functions of the controlled signals and commands, tending to maintain a prescribed relationship between the two.

From "Dictionary of Electronics" Funk & Wagnalls

Control
No Entry [believe it or not]

Feedback

The return of a part of a system output to the system input, causing, in general, a profound change in the characteristics of the system. [can't say as I know a whole lot more than before reading this] If the returned signal is in phase with the input, it is called _positive_ or _regenerative feedback_; if it is out of phase it is called _negative_ or _degenerative feedback_. Negative feedback improves the stability and linearity of a system at the expense of GAIN, while positive feedback increases gain and speed of response but makes the system less stable and more oscillatory. Consider ... [of course this description is not considering control system design where the open loop gain of the output function is often 1e7 or greater]

Feedback Control System

A system containing a set of devices that measure its output or outputs against an appropriate set of reference signals, generating a set of error signals which in turn control the system in such a way that its outputs conform to desired performance criteria. The performance, that is, the ratio between output c and reference r, of the generalized system shown is given by

$$c/r=KHG/(1+KFHG).$$

The system becomes unstable if 1+KFGH=0, that is, if the phase shift around the loop H-K-G-F is zero when KHFG=1. See FEEDBACK

```
            -----    -----    -----
     /-\    |   |    |   |    |   |
 --->SUM--->| H |--->| K |--->| G |------>
     \-/    |   |    |   |    |   |   |
      ^     -----    -----    -----   |
      |   Series     amp    Ctrlled   |
      |   comp.               Plant   |
      |           -----               |
      |           |   |               |
      |-----------| F |---------------|
                  |   |
                  -----
                 Feedback
               Compensator
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From "Oxford Dictionary for Scientific Writers and Editors" Oxford Press

Control and Feedback both have entries without definition.

From "Control Technology and Personal Computers" Van Nostrand Reinhold

[A disappointment in the extreme but no where in scanning the book did I find a single example of the use of the term "control" such that one could conclude that the author had even the vaguest idea of what a control system is and what it is supposed to be doing.]

From "McGraw-Hill Encyclopedia of Science & Technology" [guess]

> [And if you have ever wondered why government "control" of the economy is most generally a disaster... here is the model:]

```
                             private business
                                investment
                                     |
                                     |
             gvt spending-----|      |
                              |      |+
                   ---------- v      v      ------------
desired     /-\    |          |  +  /-\     | business |
national-->|SUM|-->|government|--->|SUM|--->|production|---->
income      \-/    |          |     \-/     |          |     |
             ^     ------------      ^      ------------     |nat'l
             |                      +|                       |income
             |                       | consumer              |
             |                       | spending              |
             |                       |                       |
       --------------          -------------                 |
       |            |          |           |                 |
       | management |          | consumers |                 |
       |            |          |           |                 |
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             ^                       ^                       |
             |                       |                       |
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             |                      /-\ - |    tax      |   |
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[Actually the presentation in this book set looks to be decent (hundreds of pages devoted to various control system issues).]

From "Encyclopedia of Physics" VCH Pub.

Servomechanism

...

The basic configuration of a servomechanism is shown by the solid lines in Fig. 1. [not included as it IS the basic control diag] A position control system may be required to drive the output, C, to some commanded position R. It may also be required to act as a regulator and keep the output C at the desired R despite the application of some load disturbance D (a typical load disturbance is a wind load on a radar antenna). A basic requirement is that the output C be measured at least as accurately as required by the positioning specifications. [not bad at all] ...

[The entire article is quite good as it is intended to be descriptive as opposed to design information and yet "hits" the issues well]

I believe someone once said something along the lines of "Be careful of what you ask for... you just might get it!"

-bill

Date: Thu, 1 Jun 1995 18:01:12 -0400
Subject: Thought I was done Huh?

<[Bill Leach 950601.14:35] >NET

[Bet y'all thought that last missive was all of it huh?]

From "Electronic Engineer's Handbook" McGraw-Hill

[This book contains the best and most complete control system theory treatment of the books that I have. ie: There is more on Kalman filters than any of us would ever want to see!]

Modeling

> By and large, models constitute the realm of discourse within which system engineering is carried on. More pragmatically, a model is a prerequisite to the use of analytical methods in engineering design.
>
> By _modeling_ we mean any deliberate intelligible cognitive activity aimed at abstracting, and reproducing in some convenient realm of discourse, features of an object or system (the prototype) of interest to the modeler. The activity is deemed cognitive ...
>
> Of late, models are becoming generally recognized as indispensable tools for effective understanding of the behavior of complex systems. Yet mathematical modeling is still, at best, an art. There is no comprehensive, consistent body of theory which constitutes a theory of modeling. ...
>
> Engineering systems modeling is a blending of physical and mathematical theory. It is a sterile activity if either is left out. In the sciences, models are sought which illuminate natural phenomena. The objective is to strip away all that is not essential so that our observations of reality can be characterized and understood in terms of some ultimate simplicity. ... In this context a model is a _THEORY_ constituting a set of propositions of laws from which facts exhibited in nature can be deduced.
>
> This last notion illustrates what has come to be called the _scientific method_. The scientific method of establishing an understanding of any physical phenomenon is generally identified as consisting of three phases (1) _initial observation_, (2) _formulation of a theory_, and (3) prediction of new observations and experimentation. Moreover, the completion of the last stage frequently suggests refinements ... The

emphasis on observation has its roots in the empiricist philosophy which has been at the heart of modern science.

...

One useful classification of models distinguishes three types: (1) _native models_ (the past trends of a single variable are used to predict future behavior of that variable); (2) _simple correlative models (past observations are used to correlate several interrelated variables in order to forecast future trends); and (3) _causal models_ (the response of certain variables due to changes in others is predicted).

...

A fundamental distinction can be drawn between the first two model types and causal models. Naive and simple correlative models are _descriptive_, whereas causal models are _explanatory_. ...

...
...
...

Compared with ontological issue of parsimony, an even thornier issue the epistemological problem of model _validation_. Without a clear understanding of the relationship between a model and its prototype, it is not clear how necessary and sufficient conditions for validation can be established (or even how "validation" can be defined unambiguously). The problem of how a model, e.g., a mathematical system, relates to its prototype, e.g. a physical or a social system, is rarely addressed. In consequence, discussions of validation are diverse and inconclusive. ...

CONTROL THEORY

In Par. 5-1 we asserted that systems engineering deals with the understanding of system as such, for which an understanding of the components is necessary but not sufficient. From this point of view, perhaps the epitome of systems engineering is the sense of an exemplar of archetype, is _control theory_, and the essence of control theory is found in the concept of _feedback_.

...
...
...

[And Bill P. will truly _love_ this next one]

Compensation

The basic idea of feedback is intuitive and simple. From the perspective of a human operator attempting any control action, whether that of positioning a lamp on a table, steering an automobile, or any of the innumerable actions we take continually and instinctively, our action is almost invariably tempered by our continuing observation of any discrepancy between intent and status thus far. [The next one however is in serious error unless the author meant "results" when he said "output"] This is negative feedback: The control action is a function of the difference between the desired output and the actual output.

From "Electronic Engineer's Reference Book" Butterworths

[From a descriptive standpoint there is almost nothing worth quoting from this book however, the diagram for "closed loop control" is worth reproducing:]

```
        Summing
       junction  ____________  __________  _________
          /-\   |            ||          ||         |
 0i ----->|X|-->| Controller |->| Actuator |->| Process |------>0o
          \-/   |            ||          ||         |     |
Reference  ^     ------------  ----------  ---------      |
 signal    |                                              |
           |______________________________________________|
                                                  Signal from
                                                     sensor
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-bill

Date: Thu, 1 Jun 1995 18:09:47 -0500
Subject: Recent Definitions

[From Bruce Abbott (950601.1805 EST)]

>Bill Powers (950529.1410 MDT) --

> Maybe some others can look up more definitions [of control].

I keep forgetting to bring my text on designing linear control systems in to work; its definitions are similar to those you quote from Phillips and Harbor (1988). But here's some interesting definitions in Chapter 3 (Control Theory Overview) of a 1990 text in reference to controlling a motor:

> "To control" is defined as "to manipulate an object (motor) so as to serve a certain purpose" (so as to make it work as required).
>
> In the aforementioned case, the motor is called the controlled system. The physical quantities (voltage, current, frequency, torque, angular velocity, and angle) are called the controlled variables, the required manipulations are called the controls (voltage, current, and frequency), and the instruction to be given is called the control reference.
>
> Control is classified into feedback control and feedforward control. Feedback control detects the controlled variables, then compares them with the control reference to determine the control variables.
>
> Feedback control is insensitive to disturbances (load torque fluctuation, source voltage fluctuation, etc.) which disturb the behavior of the system, and to the parameter variation (change in inertia, resistance, etc.). Feedback control also changes the structure of control systems.
>
> Feedforward control makes the response of the control system faster because it determines the controls using future information. Example: when you drive a car on the road, you will see what the road ahead looks like. The control reference is the desired value or input, and the controlled variable is called the output. The difference between the desired value and the controlled variable is called error.
>
> Dote, Yasuhiko. (1990). _Servo motor and motion control using digital signal processors. Englewood Cliffs, NJ: Prentice Hall.

There is quite a bit more I could add but this is probably enough for present purposes. Early in the book the word "plant" is used to refer to the motor but "plant" does not appear in the index and there is no glossary. Published by Prentice Hall, book is part of a series sponsored by Texas Instruments.

Many years ago (when I was in high school) I had an idea for an automobile suspension system in which some kind of sensor would monitor the distance from the chassis to the road surface (independently at each wheel). This was to be mounted immediately IN FRONT of the wheel. If a bump in the road went under the sensor, then the system, acting by means of a hydraulic piston/shock, would begin to pull the wheel up just as the bump began to pass under the wheel. So long as there was sufficient travel, the force supporting the car would remain constant and there would be no chassis movement in the vertical plane. The reverse action would occur for dips or potholes. By virtue of its sensor position, this device would have functioned something like the feedforward control system described above. I thought the lead-time would be needed to compensate for system inertia.

Regards, Bruce

Date: Fri, 2 Jun 1995 02:08:44 -0400
Subject: Re: Recent Definitions

<[Bill Leach 950602.01:35]
>[From Bruce Abbott (950601.1805 EST)]

I really should not have "pulled down" that next batch of messages...

>> Feedback control is insensitive to disturbances (load torque fluctuation, source voltage fluctuation, etc.) which disturb the behavior of the system, and to the parameter variation (change in inertia, resistance, etc.). Feedback control also changes the structure of control systems.

This is absolutely false based upon the listing you gave of the controlled variables. A closed loop negative feedback system monitoring the variables you listed and changing the voltage, current and frequency WILL keep the motor running at the desired conditions within the physical capability of the motor and the available power (ie: I am presuming that the controller can deliver full overload current to the motor without itself failing).

The feedforward that they are probably referring to in that article (at least with respect to the motor controller) is a derivative feedback loop (or conversely a rate sensitive output device, that is an amplifier that increases its' gain as a function of the rate of change of input).

Another aspect of control that is sometimes used and generally considered to be "feedforward" control (and in my mind is actually the only REAL feedforward control that can exist) is that large industrial motor controllers (usually several thousands of horsepower) that also have very large percentage "step" change in load but still must control to a close tolerance will often have an additional input to the controller from one or more of the load devices to indicate that the load is being applied or removed.

This is really a "model" design aspect and both the timing and magnitude of effect have to be "tuned" in actual operation (though digital systems will now do the tuning on their own -- ie: learning).

> cars suspension

This is "doable" but you don't really gain much for the effort since the wheel so moved must be restored to its original relationship with the chassis -- not to mention that you would probably have to haul the hydraulic plant in a trailer if the car was to remain smaller than the Enterprise!

-bill

Date: Fri, 2 Jun 1995 07:46:14 -0600
Subject: Re: PCT research

[From Bill Powers (950602.0600 MDT)]

Bill Leach (950601.14:34)--

Great! Thanks for the many horrible examples of defining control and the few good ones. I'd particularly like to see what engineers are being taught, and have been taught in the last 20 years or so. All you have to do is look at the first few pages of textbooks. In my experience, after an extremely brief introduction textbooks plunge right into transform methods or other mathematical treatments that give essentially no feel for how control systems actually work.

The McGraw-Hill "Electronic Engineer's Handbook" entries were great.

> [The next one however is in serious error unless the author meant "results" when he said "output"] This is negative feedback: The control action is a function of the difference between the desired output and the actual output.

In engineering parlance, the "output" is the controlled variable. The link between the physical effector and the measure of the output is often lumped into the effector unless there is something, like a long shaft subject to torsion, between the effector and the "output" that is desired to be controlled. Engineers, for obvious reasons, like to keep the link between the primary effector and the controlled variable as short and simple as possible, which may be why some of them have trouble understanding the idea of control of _input_. For them, the controlled variable is most closely associated with the effector output, and the sensors are just the means of getting a feedback signal.

Bruce Abbott (950601.1805 EST) --

More good (horrible) stuff from the literature!

> "To control" is defined as "to manipulate an object (motor) so as to serve a certain purpose" (so as to make it work as required).

This is a very popular one: Francisco Varela uses it. It fails to mention WHOSE purpose is involved, and how using something for a purpose works. Basically, it's the output blunder: confusing the means of control with control itself.

Neat idea for a bump-suppressor. The lead of the sensor would indeed make the control problem simpler - but you'd have to be able to move the bump sensor ahead and back as a function of speed. Also, you'd have to limit the frequency response, to avoid hitting the stops when going over a long bump or dip. If you could design the system to use minimum energy (storing most of the energy in springs), this might be very feasible.

Bill Leach (subsequent posts)--
BILL! GO TO BED!

Best to all, Bill P.

Date: Sat, 3 Jun 1995 15:38:27 -0500
Subject: Re: Defining control

[from Bruce Buchanan 950603:1540 EDT]

As an occasional lurker I have noted Bill Powers promotion of discussion inter alia of terminology related to Control and Negative Feedback...

A number of definitions have been cited. The problem with many of them is that they are of a technical nature and derivation, not at a level of general principle which carries well to other fields or has potentially larger implications...

So here are some thoughts - in the spirit of Bill Leach [950601.14:34 EDT] - (per the Sorcerer to the Apprentice?)

> I believe someone once said something along the lines of "Be careful of what you ask for... you just might get it!"

An article in the June/95 Scientific American ("From Complexity to Perplexity") suggests that the current approaches to questions of complexity, which include systems of dynamic control, are far from successful. So a discussion of some fundamentals may not be out of place.

I take it that a principle objective of science is the creation of abstract models valid for classes of systems. For example, physics, at its highest level, deals with matter as energy, manifested fundamentally in heat and played out through variously organized structures in the photosynthetic, oxidative and metabolic processes which support life. One does not require mathematical precision to understand this much.

In describing these things, we of course discuss conceptual models of reality, not Boss reality itself. Nevertheless, such processes must involve organization in space and time - presumably in the world and certainly in the concepts. And any models or patterns of which we can speak must also reflect information and some selectivity or choice. So what are the irreducible fundamentals of our information about things?

The thesis I have in mind (not as original, but for emphasis and discussion) is that the most basic and primary level is the cybernetic model of negative feedback. Below this level of organization events do not exist for us (unknowable because unrepeated), there are no identifiable elements, no possibility of patterned relationships to be conceived. Events and elements become identifiable insofar as they participate and can be accessed repeatedly and via feedback processes, which are essential to any structure of relationships involving time, hence any perceivable or knowable data. (I am probably repeating thing Bill Powers has written somewhere.)

Considerations:

An essential primary process/condition for any existent or existence itself is some persistence through time. It has been believed, and still is believed by many, that the external world consisted of objects, e.g. rocks and people and 'facts', and certainly we can perceive the world in this way. More discriminating or selective perception reveals, however, that underlying and within primary experience are dynamic processes, including perceptual processes, in constant renewal and interaction, both in the world and within the organism. Persistence and renewal through time requires the action of circular causal processes through which the enduring world and the repeatability and consistent identification of perceptions become possible.

In relation to the external world we speak of causal processes, which are selections we make both among (1) interactive relations among events as these play out in time (which in engineering may include Feedforward), and (2) retroactive or circular causal loops which link elements and events to repeat patterns in time, dampened depending upon Negative Feedback, but always with some delay (e.g. hysteresis) which is required and provides the existential condition for possibilities for adaptive change. The relation with time is crucial. Disturbance must actually occur, then be organized via negative feedback, for random contingencies to be overcome, and for life to arise and endure.

Examples of relatively stable cyclic processes in the inorganic world, which also impact upon other events and life in changing ways, are the hydrologic cycle, the magnetosphere, jet stream, etc. etc. For negative feedback also underlies the stability of universal processes.

In relation to man's thought and the conceptual world e.g. science, it may be recognized that sensation and perception occur over many levels which are all, in principle, subject to control by feedback in terms of various criteria.

Perhaps the most accurate overall view of this process is that which recognizes that it is the activity or behavior of the organism which controls perception (cf. B:CP). (I am just trying to paint the picture as I see it, in order to clarify ideas, not preach to the converted!)

External stimuli may be perceived, but they do not control, since they are not as such properties of the system. Subsequent events and memory may change this, and the picture may be confused if the chronology is not recognized.

So there are other views (e.g. S-R) which see behavior as determined simply by What is perceived. Such views are employed because they appear to the proponents be useful for special purposes, and may be validated by repetition within tightly constrained conditions. However, they do not take into account the actual nature of the fundamental dynamic processes at work, and do not meet criteria for science that reach for valid formulations which are the most comprehensive.

Terminology:

Standard definitions of negative feedback appear mostly to be based upon experience derived from specialized and applied fields of engineering and control systems. A more comprehensive theoretical view of the principles of feedback and control may also require more adequate nomenclature and less restrictive definitions.

Being very tentative, and harking back to an earlier thread in bit.sci-purposive-behavior, [CSG-L] and as an alternative to the term Control (which tends to suggest control in isolation, by some agency of something else, I offer for discussion the (made-up) term COMCONACTION, to connote e.g.:

COM - communication, common/together, selectively guided
CON - control, connect, con/with, consciousness (knowing together)
ACT and ACTION - actual event, selectively directed.

Comconaction is intended to suggest some independent action by some entity, as well as by groups of entities coordinated and guided by common purposes, i.e. activity of system-based vector(s). The word is a little complicated, as is appropriate to what it expresses.

Since a scientific term should be primarily denotative I suggest (again for purposes of discussion): COMCONACTION is the integration of action in space and time, through negative feedback, of dynamic processes within systems at any level of organization or complexity, which enable relatively stable and persisting output or behavior despite the effects of unpredicted contingencies.

Other implications:

Since selectivity based upon criteria for error correction is inherent in the irreducible primary conception and model for anything that can exist, structures required for evaluation and feedback must be present in any systems which continue to live and function.

While the values may be unspecified, the structural conditions exist, and there may also be functional requirements for appropriate specific values. Indeed, many problems may ensue if the criteria utilized are inappropriate, e.g. at too low and restricted a level of the organization, rather than criteria devised to reflect strategies which can benefit the whole. Indeed the highest value may attach to the processes by which such strategies may be developed - e.g. those required for a sustainable civilization on earth.

It is said by some that the highest values attach to the long term evolution of life and intelligence. However, in general, ideals which are too abstract to be applied operationally do not provide useful criteria for the guidance of current decisions, i.e. they may not provide an ethical basis in practice for existential judgements. The contention that such unapproachable values provide useful guidance has been historically fraught with disaster, so that the onus is on the proponents to prove their case.

I would of course be interested in comments and any discussion. My whole purpose is to try to suggest alternative approaches for consideration while the discussion thread is still alive. However, I will be out of the country until June 24, and may miss Newsgroup postings, so I would appreciate email copies of anything for which follow up or response from me is requested.

In any case, cheers and best wishes.

Bruce B.
Bruce Buchanan
We are all in this together!

Date: Sun, 4 Jun 1995 12:16:34 -0400
Subject: Re: Defining control

<[Bill Leach 950604.00:31]
>[Bruce Buchanan 950603:1540 EDT]

> A number of definitions have been cited. The problem with many of them is that they are of a technical nature and derivation, not at a level of general principle which carries well to other fields or has potentially larger implications...

This is absolutely meaningless to me. Addition of real numbers is a very precisely defined term. It is technical in the extreme and combined with the rest of the similarly strictly defined terms of mathematics provides us with the most precise language that we have. Is it useful? I think that a reasonable case can be made that it is useful.

This almost sounds like "Terms" must be ambiguous enough in meaning to allow one to make 'profound' statements without having to work very hard."

The term "control" itself is "context sensitive" even here on CSG-L where there really is an effort to maintain a precise meaning. For example my own recent use of the term without my having made a careful effort to explain that my use was not quite in the "classic" (to PCT) meaning is likely the major reason that Martin replied to my "control of a perception not currently perceived" discussion.

> The thesis I have in mind (not as original, but for emphasis and discussion) is that the most basic and primary level is the cybernetic model of negative feedback. Below this level of organization events do not exist for us (unknowable because unrepeated), there are no identifiable elements, no possibility of patterned relationships to be conceived. Events and elements become identifiable insofar as they participate and can be accessed repeatedly and via feedback processes, which are essential to any structure of relationships involving time, hence any perceivable or knowable data. (I am probably repeating thing Bill Powers has written somewhere.)

If Bill Powers wrote this somewhere then I certainly missed it. Indeed, if I had read this in one of his works over a year ago I would still be asking him what he meant!

> ... More discriminating or selective perception reveals, however, that underlying and within primary experience are dynamic processes, including perceptual processes, in constant renewal and interaction, both in the world and within the organism. Persistence and renewal through time requires the action of circular causal processes through which the enduring world and the repeatability and consistent identification of perceptions become possible.

That causal processes must exist to be able to develop a model of the world I accept. That all processes must be circular causal processes for such to occur I do not accept.

> ... (2) retroactive or circular causal loops which link elements and events to repeat patterns in time, dampened depending upon Negative Feedback, but always with some delay (e.g. hysteresis) which is required and provides the existential condition for possibilities for adaptive change. The relation with time is crucial. Disturbance must actually occur, then be organized via negative feedback, for random contingencies to be overcome, and for life to arise and endure.

Arg! Bruce, you are in an entirely different world from PCT here.

Patterns that repeat in time may not be retroactive causal loops with respect to the observed pattern. The actual circular causality may not be observed at all but rather only causal results (several times removed from the "ultimate" initiating cause).

In addition, generalizing "negative feedback" to exist in all processes is unreasonable for several reasons. In the first place while the limiting caused by system nonlinearities in oscillating system can be refereed to as negative feedback, doing so without mentioning the nature of the system and the presence of positive feedback in a significant portion of the operating cycle is highly misleading.

Using the term "negative feedback" in reference to systems with an open loop gain of less than one is also not generally productive. Systems without a continuous energy input are not well described in feedback terms.

Are you saying that "Delay" is hysteresis for negative feedback? Or that there is a hysteresis in loop transit time values? Your statement appears meaningless to me.

Disturbances to CEVs are resisted not organized by control systems.

The inorganic _exampleS_ that you give are arbitrary classifications by humans. It is highly likely that these examples are interacting systems that defy analysis in isolation.

> So there are other views (e.g. S-R) which see behavior as determined simply by What is perceived. Such views are employed because they appear to the proponents be useful for special purposes, and may be validated by repetition within tightly constrained conditions. ...

The "special purpose" that you are referring to is, to the proponents, the same one as for PCT -- create a general theory of behavior.

> Terminology:

> Feedback

The precise mathematical definition for feedback in a closed loop control system is THE ONLY proper definition for purposes related to PCT. That even we often error in our verbal communications with respect to the meaning of the term do not invalidate the correct meaning.

For some reason, there seems to be a general "movement" toward what I call relaxing the definitions of terms. It seems that a significant number of people want to be able to "say things" and "use terms" that will "make them sound impressive and knowledgeable" without also being subject to critical scrutiny. That is they specifically do not want terms to have precise enough definitions so that someone else could possibly make a valid challenge to what they say (ie: No one could claim that they might be in error).

While it might possibly be true that demands for strict use of terms might be a source for conflict between people, I personally view this situation as vastly superior to the situation where no one can hope to achieve even a modest understanding of the ideas of another because "it is pretty much OK for 'you' to mean whatever you want to mean by what you say"!

Even though it is true "that it's ALL perception" and that I, for example, can not know with certainty that I really understand what someone else is expressing (at best), it is also equally true that it is the serious attempts by one person to understand another that is the source of all of the knowledge that is worth considering.

I personally now recognize that in practice, engineering use of the term control is also sloppy. Even work in Control Theory tends to possibly improperly use the term. However, the meaning with respect to the fundamental closed loop control system is exacting.

Thus, I still believe that we are better off, to stick with this existing definition and point people to the source when needed rather than trying to invent a new symbol.

In addition, I see your proposal as one that would create a significantly diluted replacement.

The statement "which tends to suggest control in isolation, by some agency of something else" IS A CORRECT DESCRIPTION OF THE PHENOMENON OF CONTROL from the viewpoint of an observer. "Some agency of a system is forcing some other external 'thing' to maintain some constant condition, that is isolating this 'thing' from the affects of other forces." Such is (correctly) the external observers view of what happens when a control system is functioning upon a CEV.

> Comconaction is intended to suggest some independent action by some entity, as well as by groups of entities coordinated and guided by common purposes, i.e. activity of system-based vector(s). The word is a little complicated, as is appropriate to what it expresses.

And by meeting this requirement set is useless for purposes of saying anything "concrete", in my opinion.

> Since a scientific term should be primarily denotative I suggest (again for purposes of discussion): COMCONACTION is the integration of action in space and time, through negative feedback, of dynamic processes within systems at any level of organization or complexity, which enable relatively stable and persisting output or behavior despite the effects of unpredicted contingencies.

Control systems most explicitly DO NOT "enable relatively stable and persisting output or behavior despite the effects of unpredicted contingencies"!! It IS BEHAVIOR that is changed by control action to maintain the desired perception!! Perception is what is constant in the presence of "unpredicted contingencies" or disturbances.

Arg!!

> Since selectivity based upon criteria for error correction is inherent in the irreducible primary conception and model for anything that can exist, structures required for evaluation and feedback must be present in any systems which continue to live and function.

And just where does this "axiom" come from?

Double Arg!!

> While the values may be unspecified, the structural conditions exist, and there may also be functional requirements for appropriate specific values.

for what?

> Indeed, many problems may ensue if the criteria utilized are inappropriate, e.g. at too low and restricted a level of the organization, rather than criteria devised to reflect strategies which can benefit the whole.

Are you saying that a living control system that is "intended by design" to live by foraging for berries in the forest that is equipped with only a "gill type breathing system" is inappropriate? Also "whole" what?

> Indeed the highest value may attach to the processes by which such strategies may be developed - e.g. those required for a sustainable civilization on earth.

By whom and to what purpose? What is "sustainable civilization"? (give three examples) :-)

> However, I will be out of the country until June 24, and may miss Newsgroup postings, so I would appreciate email copies of anything for which follow up or response from me is requested.

I'm not sure that you would appreciate an email copy of this posting (just be thankful that I too "ran out of time").

-bill

Date: Tue, 6 Jun 1995 02:44:18 -0600
Subject: control defs; abstractions

[From Bill Powers (950606.0000 MDT)]

Bruce Abbott (950605.1545 EST) --

Interesting quote from _Design of feedback control systems_, especially this:

> Such an open-loop control system has the advantage of simplicity, but its performance is highly dependent upon the properties of the plant, which may vary with time.

The alleged "simplicity" depends to an extreme degree on the simplicity of the plant. If the plant has even a single time integration in it, the open-loop system has to be provided with computing capacity to calculate the inverse of the plant response to inputs, so that the reference signal can be passed through a computation that puts the inverse of the plant dynamics into the controller. For even modestly complex plants, calculation of the required inverses can soak up huge amounts of computing power and time. In general, a feedback model will accomplish the same result in a far simpler and faster way requiring very much less computation.

> [Bill P. will be happy to see this next one included:]

> 4. Increased speed of response and bandwidth. Feedback may be used to increase the range of frequencies over which a system will respond and to make it respond more desirably. A satellite booster rocket, for example, has aerodynamics resembling those of a giant broomstick. It may, with feedback, behave with beauty and grace.

You bet I'm happy to see it. So how did this "feedback is too slow" shit get such a foothold in the literature?

Bill Leach (last few days or a week) --

I haven't been acknowledging your great posts much, but the reason is that I get tired of saying yes, yes, yes.

One thing, though, that I must acknowledge: your comments on Bruce Buchanan's latest offerings. It would be very easy to sit back and let you stick your neck out while I avoid the flak from saying the same things. But I agree totally with your assessment of Buchanan's abstract wanderings. With respect to any kind of knowledge I'm interested in, or anything I'm interested in doing, they are useless. Thanks for saying it so clearly.

Best to all, Bill P.