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2015-08-06

The Divine Feedback Circuit

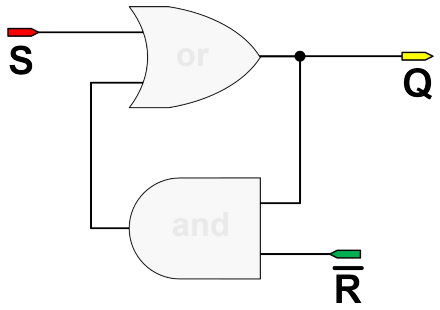
⇒ This article sketches a system theoretical approach on self-organization bridging between down-to-earth technology and an advanced understanding of live.

Starting point of the theory herein is that feedback circuits are the most fundamental conceptual building blocks in nature, as they are in technology as well. This leads to a cascade of conclusions on comprehensible steps towards self-organization and evolution.

Content

Flip-Flop Concept

The famous mathematician and philosopher Gottfried Wilhelm Leibniz (1646 – 1716) conceived the Dual System. His ideas and inventions are basic for today's information technology. Most important components in information technology are flip-flops.



Depiction: Flip-Flop

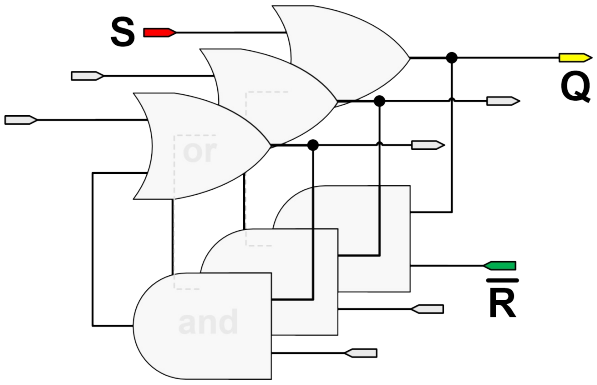
The basic coupling concept of a flip-flop enables a system to internally store the information about an input, herein called "S", has been activated or not. The captured information effects a permanent activation of an output, herein called "Q". The state of the flip-flop in its ability to

store information is controlled via the second input, herein called “inverted R”. A non-active “inverted R” de-couples the feedback-circuit of the flip-flop which in turn disables it to stabilize information about “S”. Turning the “inverted R” into active closes the feedback circuit feeding “Q” back to the OR gate with “S”. This in turn qualifies the information, about “S” has been active, to the complete time period of active feedback circuit. Once “S” is strong enough to pass through the OR and the AND gate “Q” will be steadily active until disconnection of feedback circuit. Note: The letters “S”, “R” and “Q” refer to flip-flop notation standard.

Nothing hinders us regarding the flip-flop concept as basic to every controlled coupling mechanism. It simply builds on a feedback circuit which captures a resonance upon an input effect. In addition it is controlled by any kind of stimulated amplification. Philosophical excursion: If the system had a soul it would seem likely calling the control mechanism “attention” or “concentration”. If the soul of the system was something impartible it would well accord with a so called monad again leading back to Leibniz. The Monadology is one of Leibniz’s best known works representing his later philosophy on metaphysics of simple substances, or monads. Monad conceived reportedly by the Pythagoreans meant divinity, the first being, or the totality of all beings (source: www.wikipedia.org).

Feedback Circuits

Further investigating the multi-purpose flip-flop will shed more light on internal coaction of a self-organizing system. Thereto it is helpful to imagine a set of feedback circuits in any order and interconnection. In this approach flip-flops can effect in parallel and penetrate into far-reaching areas of influence. Flip-flops can as well effect in serial connection and process information in differentiated contexts. In principle any output “Q” of a flip-flop can be taken as input “S” of another flip-flop or even as input “R” for concentration control.



Depiction: Bunch of Flip-Flops

Flip-flops are conceptual building blocks for all purposes. Transferred to living creatures various coupling mechanisms can be identified building on metabolism, blood circulation, proteins, nerve-cells and synapsis. And nature is extremely creative in applying them all. Looking into underlying control mechanisms unveils the soul of the system. Metabolism and blood circulation connect between symmetric organs and amplify the exchange of growth controlling signal-proteins between them. This allows for self-synchronized growth of a creature. Nerve-cells of the eye’s retina from both eyes, but representing the same visual point effect in parallel and thus gain influence into deeper layers of processing. Nerve-cells of the visual cortex bundle into differentiated effects depending on static pattern recognition or dynamic movement recognition. Both lead to specific brain areas for a distinguished further processing. Back-coupling from these areas back to primary sensory brain areas is known.

Self-stabilizing Systems

In technology feedback circuits are applied to regulate a pre-given output. Examples are thermostat-controlled heating, servomotor-adjusted distance control etc. Those techniques regulate adherence of an output value compared to its preset target value. The most binary form of a feedback circuit is the above flip-flop controlling the retention of a captured input effect. It stabilizes information about occurrence of a fleeting effect and allows for somewhat time independent further processing. Difference between technology and living creatures is that in technology organizing of complete systems is planned ahead and components are deliberately dedicated to specific purposes. In nature living creatures evolve from co-occurrence of luckily successful frame conditions. Starting point of this theory is that feedback circuits are the most fundamental conceptual building blocks in nature, as they are in technology as well.

Every live form arising in nature is more or less survivable, some creatures more, some less. In focusing on feedback circuits the topmost subject for regulation is stability and fitness to survive. This applies from start of development for all species as well as for every individual during lifetime. Evolution-made concepts can vary between short lifetimes of an individual at fast and long lifetimes at slow reproduction rates. Concepts can also vary between highly developed ruggedness against environmental impacts at low adaptability and less ruggedness at high adaptability and so on. Thousands of developments can be imagined. However, the central theme is stability and fitness. Contrariwise, disturbance of stability would inevitably increase mortality. Evolution towards more complex creatures copes with this precondition. Further development of a species builds on the regulating mechanisms of its past - no new development without its instant integration into an overall stability system right from its very beginning. This even includes development of new stability mechanisms themselves, provided they start being integrated with the legacy system. The ability for self-stabilization is precondition and character of all living creatures.

The need for stability on one hand under the constraint of instant provision of fully-fledged feedback circuits on the other hand makes evolutional progress difficult to understand. The tin-opener for this brainteaser lies in separating the handling of feedback circuit irrespective of the higher semantics of regulation mechanisms arising on top of it. In that a bridge between man-made information technology and evolution-made feedback circuits is found. Both separate between autonomous information and a technique underneath which puts the right information at the right moment into effect. Contrariwise to ahead planned technology, evolution-made progresses penetrating new realms of development always start with zero knowledge. That means that control targets, control subjects and a complete semantic field have to be put in place at once. Only foundation is the “divine feedback circuit” which itself hasn’t any own knowledge. It is a control-tool same as man-made flip-flop. This leads to a cascade of conclusions.

Male and Female

From central theme stability derives the need to overcome mortality by reproducibility. Reproduction by cell division is a successful concept in the first place. It achieves this target while at the same time leaving room for mutations providing for trial and error. The probability for cutting-edge changes is extremely low but the simple concept of trial and error succeeds over the course of a lot of generational steps. Darwinian principle of survival of the fittest regulates stability via rough confrontation with the living environment. Single-celled organisms evolve and even little more complex organisms. Mutations are not planned ahead and they are indifferent to stabilizing the organism and its reproducibility. Starting from a stable organism the probability of destabilizing changes is much higher than of stabilizing changes. If changes lead to successful innovations in a new field they are most likely bought

dearly for the price of weakening an originally stable building plan. In simple words trial and error always leads a few steps forward but at the same time some steps backwards. The concept of separating into male and female and forcing two individuals for coaction stabilizes genetic material via merge of chromosome sets. With the concept of male and female the proving of a mutation is shifted from live-or-die to much more smooth selection processes within an individual during its growth. Thus negative mutations will not turn into being less probable than positive ones. The decisive advantage of the method is ending of new life in a mutation-induced earlier embryonic stage. This saves substantial efforts for an otherwise ongoing but mortality-bound growth. This turns the concept of male and female into a fundamental principle for higher developed organisms. Foundation is the differentiation that prevents single individuals from reproduction on their own. The feedback circuit is closed by pollination. Control target is a stabilized building plan and control subject is genetic material.

Symmetry

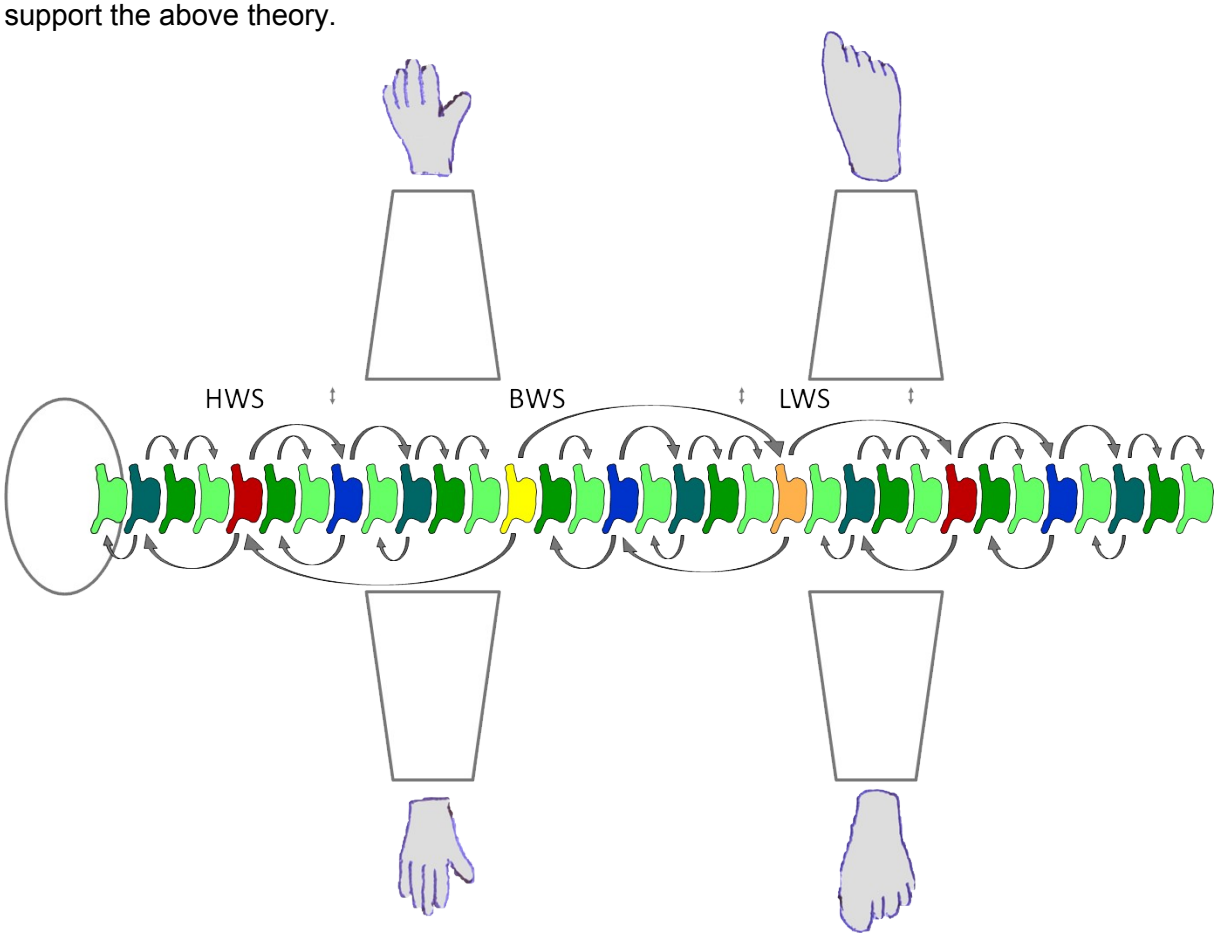
From central theme fitness derives the need to flexibly react on environmental stimuli. Growth by cell division is again a successful concept in the first place as it achieves penetration into environment thus extending an excitable contact area. In addition the concept of growth leaves room for evolution of differentiated functions. Key is cell-differentiation based on the functional conversion of original stem-cells. That means that a differentiated cell still has the same genetic core but is adjusted to produce distinguished effects in form of e. g. specific protein production or physical properties. Simple differentiations evolve on this basis. The combination and interplay of several distinguished functions is not planned ahead. And growth is indifferent in shielding competing cells with competing functions against mutual influences out of getting in the way of each other. Thereby probability of negative influences is much higher than of positive. With the concept of separating a new functional element into two symmetric physical parts while at the same time forcing both parts for coaction during growth, new functions and spatial determination of growth are stabilized. The sophisticated mechanism behind mutual growth control is assumed to build on growth driving FGF-signal-proteins. Those proteins are transported via the blood circulation. They effect a signaling cascade into corresponding target cells via the so called JAK-STAT signaling pathway stimulating cell division. Key property of this mechanism is the ability to reach exactly those cell-types which are intended to reach. At the hull of target cells FGF proteins interact with specific receptors called FGFR. 10 types of FGFR and 23 of FGF proteins exist and only specific combinations between them interact. Details of this mechanism need further exploration, but it indicates a powerful mean for closing a circuit between corresponding symmetric body parts and organs. Control target is to stabilize best fitting allocations of body parts in order to avoid uncontrolled growth. Control subject is the self-synchronizing growth of symmetric body parts. Symmetry turns out to be the key to polymorphic organisms enabling for more and more distinguished functionalities.

Multiplied Use

Symmetry provides for a constructive step-wise evolution of complexity. More functions and more complexity need space. And penetration into space needs stability in terms of a balanced metabolism at all body parts via a supply cycle. It seems likely that evolutional enlargement of an already complex organism works similar as primary cell division. It is assumed that proven DNA sections are copied or multiply used. Control target is to stabilize partitioned body parts. Control subject is the balance between growth and step-by-step stretching the reach of vital supply cycle. Multiple-use builds on already viable substructures enlarging the sphere of organisms towards promising growth directions.

Vertebrae of Spine

Increasing bodies need physical stabilization in order to protect them from collapsing. The concept of multiplied use is the most likely candidate for copying suitable substructures with stability supporting properties. Simple shielding and shape supporting substructures evolve. The concept of division of work develops a separation of nutrient supply and a control center for balancing work-sharing functions. This two-center concept specifies a clear direction between a head of control and its supply unit whereas the supply unit serves for the rest of the organism as well. Key of this concept is the cleared direction organizing spread into space without being interfered by competing and weakening other growth advances. Control target is to keep up nutrition supply of the head while at the same time keeping up and building nerve-connections from head to all body parts. Control subject is generally the link-up to the head. The control target thus counteracts an uncontrolled multiplication of vertebrae and enlargement of spine. The herewith developed theory draws the conclusion that this leads to a step-wise evolution of spine switching in one step to enlarging the distance between head and center, originally the supply unit, and in the subsequent step switching to enlarging the distance opposite to the head, in excess to the center leading to a tail. This leads to a remarkable side-effect when correlation occurs between numbers of copied vertebrae at specific steps. It could well be assumed, that the sum of copied vertebrae of the last two steps, which complete a full circle of enlargement in both directions, head and tail, correlates with the number of vertebrae of the next step of enlargement. This was a rule of clearly numbered enlargements according to famous Fibonacci sequence. Fibonacci sequence starts with the numbers 1 and 1 and develops step-wise by adding the two preceding numbers: 1, 1, 2, 3, 5, 8, 13, 21, 34 … As vertebrae towards tail are grown together the number of vertebrae of human spine is not clearly discovered, but narrowed down to in between 32 and 34. The number of 34 as according to Fibonacci sequence could support the above theory.



Depiction: Development of spine via subsequent steps of vertebrae copying (hypothesis)

Neuronal Processing

The two-center concept of head and rest of the body achieves a basic order in terms of spatially and timely coordinated activities. More and more successful growth and reactivity on environmental impacts evolve. The neuronal mechanism builds on strengthening synapses linking between neurons according to the extent of repeated usage of those synapses for stimuli conveyance. The more specific neurons and synapses co-act the more develops their sensitivity under similar conditions in future. Control target is to stabilize advances of earlier developments in evolution of co-ordination tasks. Control subject is a preserved set of reflex circuits linking between sensory and motoric areas of the brain, and leading to successful behavior patterns. In addition the concept of neuronal processing allows for information processing comparable with man-made information technology. Key is the ability to flexibly build and even retreat millions of feedback circuits at all levels of complexity. This again refers to the storage concept of flip-flops. Effects and stimuli from anywhere in- or outside the brain can be captured and retained for short or even long periods of time. This gains a degree of time-independence which allows for standardized neuronal processing patterns. Inability to store at least for short periods would in contrast force the neuronal processing to provide exclusive processing patterns for literally all situations. This can't efficiently be controlled and would end in infinity. It is the combination of flexibly strengthening synapses and neurons on one side and applying feedback circuits for neuronal storage on the other side, which makes neuronal processing powerful. This allows for reasonable blur between similar reflex circuits which in turn allows the brain to manage much more different situations compared to a rigid interconnection between neuronal in- and output.

Theory of Thinking

The concept of neuronal processing as based on blurring between similar situations which can efficiently be reacted upon with more or less standardized reflex circuits is fundamental for thinking. In addition to that the concept of blurring between unnecessary distinctions is further complemented by reasonable sharpening of frequently relevant pieces of knowledge. A better term for these pieces could even be the term idea as reportedly conceived by the famous philosopher Platon. Ideas are assumed to be realized as feedback circuits in themselves. Control target is filing a relevant set of ideas which are characterized by mirroring the real world in a useful way and thus supporting improved alignment of behavior patterns. Control subject is stabilization of relevant ideas.

However, the question of what makes an idea relevant needs some further explanation. Beside internal feedback circuits thinking is naturally always influenced by somatic stimuli, as controlling the organism is the main task. The herewith developed theory assumes that the mammalian brain has at least two aggregation mechanisms for somatic stimuli, both driving a different direction of reactivity concepts. One aggregation mechanism is spreading into distinguished concepts referring to an emotion of fright. The neuronal element referring to this fright driving mechanism can be seen in the so called amygdala of the limbic system. A second aggregation mechanism is spreading into distinguished concepts referring to an emotion of happiness. The neuronal element referring to happiness is the so called nucleus accumbens, a part of the limbic system as well. This theory further assumes that these two separated centers resembling two origins of driving stimuli into the brain lead to perse-verative mutual interactions. Stimuli out of both aggregation mechanisms convey intrinsic knowledge about the organism itself – from where the stimuli started. And interaction of effects from both centers reveals correlations. They coin neuronal efficiency in specific areas of the brain and thus develop knowledge about the organism itself. Sharpening of this "self-awareness" develops ideas about the self. This paves the way for aligning and sharpening of further ideas. New ideas are filed in in respect of their nearness to the self and other ideas.

Reference for further Deliberations

The above article offers conclusions which can be regarded as a bottom-up series of logical steps towards self-organization. The divine feedback circuit is taken as explanatory pattern to illustrate a recurrent concept. This helps studying the mystics of evolution without diverting into foreshortened appearing or delusive conclusions. Basic deliberations supporting conclusions herein are collected in a comprehensible article on growth, symmetry and integration (written in German language), source/web-address:

www.kruegergold.de/texte/wachstum-integration.pdf

Far reaching further deliberations deal with thinking and differentiating, which deliver a comprehensible system theoretical approach to neuronal mechanisms (in German), source/web-address:

www.kruegergold.de/texte/sechster-sinn.pdf

Contributions helping to deliver readable editions in English are highly welcome. Please send text-parts in English to bruno(at)brunok(dot)de. Thank you so much for reading this.