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Engineering perfection. What does it mean for a system to be perfect?

Giovanni Camardi

Department of Humanities, University of Catania, Piazza Dante, 32, Catania 95124, Italy

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1. Introduction

In his unconventional proof of God's existence, Descartes argued that only a perfect being may have produced the concept of perfection and placed it in the human mind, as an innate idea. According to Descartes, who applied to the issue certain principles of Medieval logic[1], it should have been impossible for a human being, *qua* imperfect, to conceive an idea of perfection. Only perfection can produce perfection. It is a metaphysical *circle of perfection*. Indeed, the concept of perfection originates from medieval theology. The perfect entity is the divine entity, which must have a set of characters "than which no greater can be conceived of." Hence, it cannot but be thought of as existent. Also, if it is possible, then it is necessary. In the most traditional versions of ontological proof, like St. Anselm's, the existence of a perfect being is demonstrated by the imperfect human intellect, via a deductive procedure that, at any rate, does not cancel the ontological difference between the imperfect demonstrator and the perfect target of demonstration. This process may be called a *logical conception of perfection*.

Let me, now, consider a third possibility. We may attribute the character of "perfection" to a product of human activity, for which a maximal standard or an upper bound has been apriori determined. In such a context, we may ultimately define "perfect" the maximum outcome of a perfecting process. We have a case of *construction of perfection*. Such a construction can be accounted as the mutual interaction of an apriori determined ontological notion, and an a-posteriori modeling action, orchestrated by the imperfect but creative human intellect. A clear-cut example of an ontological definition of "perfection" is the notion of "fidelity" in a transmission process. In Shannon's Information Theory, the fidelity of a perfect channel is ontologically defined as the total correspondence between a sequence of signals transmitted from a source over a channel and the sequence received at the destination.

Apart from the perfect transmission, is it possible to set up a general, ontological basis for all the processes aimed at constructing perfection? Of course, constructing an ontology related to different computational models [22,31] for perfect systems, is problematic. As Jonathan Lowe has put it, "the apriori categorial distinctions of ontology [ought to] combine with the a-posteriori deliverances of observation and scientific theory to yield and justify our conception of the world." ([19]: 174) But we are in no circle of perfection, at all, and a logical procedure, carried out using natural deduction, is not enough if we aim at modeling actual cases of "perfection." We must also recall that in the Twentieth Century, the metaphysical concept of perfection has been recoded. Perfection became "consistency" and "completeness" in Logic, as well as "effective computability" in Computer Science. Moreover, I have already mentioned "fidelity," in the theory of information. But, the idea of a noiseless – hence perfect – channel is an ideal which works as a limit for the variety of noisy channels. None of the above disciplines has ever encoded an *actual* state of perfection as an upper bound of an orderly succession of imperfect states. It is well known that there is no consistent and complete logical system, no fully computable problem, no noiseless channel. In systems analysis and electrical engineering, no type of system, circuit or channel is ascribed the character of perfection. Engineers and system analysts mostly pay little attention to it. They instead

E-mail address: gcamardi@gmail.com

[1] See the "causal perfection principle" in ([20]); see also ([10]).

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focus on correcting mistakes and lowering the noise. All we have got is the ontological concept of fidelity, in a transmission channel. How and to what extent can we use it to get a deeper understanding of the ontology of perfection?

Interesting developments may come out from a late work by Kurt Gödel, an austerely deductive demonstration of God's existence that he carried out via the S5 system of modal logic. Unfortunately, Gödel's proof remains confined to the implicational segment of modal logic. He did not discuss the constructive potential of the latter, namely its interactions with ontology ([34,32]). Indeed, Modal logic, with its double level of quantification, its capacity for sorting objects and properties across possible worlds, different domains, and states of affairs may serve as a connection ring between the available philosophical analyses of perfection, and the tentative ontology I intend to develop.

Let me summarize what I am going to do. In the next section, I will assess the concept of a transmission channel to see whether and under what circumstances it may be credited with the property of perfection. I will answer in positive, but some doubts will remain. I will explore the possibility that, if I reformulate the problem in modal terms, there could be a way out of such uncertainties. I will need to circumscribe accurately the concept of perfection I use, through modal, and ontological characters. For supporting my plan, I will need to make sure what did "perfection" mean to philosophers and logicians. I will briefly examine the way how St. Anselm, Leibniz and Gödel used the concept of perfection for proving the existence of God. As I said, Gödel's modal concepts should lead us to define perfection as an ontologically possible property. Under such conditions, the concept of perfect channel or system that can be found in engineering and computational disciplines may interact with real, imperfect systems. We just ought to flesh out the semantic content of the word "perfection" and bestow it ontological density. Then we may be able to make a bridge between philosophy and science.

Before starting, I have to issue a caveat. I wish to put some distance between the concept of perfection we are going to consider and the concept of idealization that has proved elusive in epistemology as well as in mathematics.[2] After Max Weber, an "ideal type" was a benchmark concept, resulting from emphasizing and understating selected traits of a complex phenomenon, according to a given research program. Such traits are explicitly selected with an epistemic interest, on the basis of what we do know, can know and want to know. Apparently, an ideal type is an epistemic tool. To the contrary, in this paper, a *perfect* element is not conceived in epistemological but in ontological terms, as a possible universal structure that claims an apriori position in the process of knowledge production. Therefore, an ideal type is different from a perfect element, which we are going to approach as the maximal element of a well-ordered set.[3]

2. Perfection is possible (not actual)

Let us start scrutinizing the idea of perfection. My aim is first to make it rigorous, and then serviceable in the field of systems engineering. Compelling support to this attempt is derived, as I said above, from a theory very close to systems engineering, namely the "mathematical theory of communication" or information theory. In the domain of information transmission, we do have a situation that incorporates a plausible character of perfection. This is the identity between a source-message (M_s), namely a sequence of input pulses (P_s) transmitted through a channel, and the message (M_d) or the sequence (P_d) received at the destination. M_d or P_d must reach the destination (the output) carrying the same properties (the same sequences of digits) they had at the time of transmission. As a result, we should get the equalities

$$M_s = M_d$$

$$P_s = P_d$$

Thus, the concept of fidelity encodes the idea of perfection in a communication system. Even more so, the input-output equality brings into existence a state of affairs we can legitimately define as "perfect" and provides a true ontological identity to the idea of perfect message. No entity without identity, Quine said.

In synthesis, we can count on:

1. a real definition of a *theoretically perfect* transmission channel, which is based on an ontological identity criterion (see [19]);
2. various tools – such as signal/noise ratio, entropy, and channel capacity, among others [28] – to provide a measure of information transmitted in *imperfect* messages and orderable in a quantitative scale, up to totally faithful, theoretically perfect message.

However – beyond very simple cases, such as the transmission of a message formulated in a natural language – there is no perfect, noiseless channel! A dynamical complex system does not perform like the simplest cases. But the clear-cut definition of a perfect channel I provided is an important ontological upshot, even though we know that complex dynamical systems do not perform "perfectly." I submit that, although imperfection of complex systems is certainly an *epistemic* problem, the existence and definability of a perfect performance of simple systems is an *ontological* datum that, far from being downsized, deserves deeper consideration. The very existence of an upper bound, though approachable only by the simplest systems, makes meaningful a perfectibility walk that, otherwise, would be just random. To this effect, it is possible to approximate noiselessness and reduce noise to a minimum adding a correction channel to the main channel. This is Shannon's famous Theorem 11: "Let a discrete channel have the capacity C and a discrete source the entropy per second H. If $H \leq C$ there exists a coding system such that the output of the source can be transmitted over the channel with an arbitrarily small frequency of errors (or an arbitrarily small equivocation). If $H > C$ it is possible to encode the source so that the equivocation is less than H – C + ε where ε is arbitrarily small. There is no method of encoding which gives an equivocation less than H – C." ([28]: 71)

Nonetheless, the noise remains, and the cost of reduction can spiral up. In a later paper, Shannon argues that "Naturally there is a rub in such a delightful sounding theorem, and the rub here is that the error probability can, in general, be made small only by making the coding constraint length large", especially in channels with memory or feedback ([29]: 66).

A viable way to answer epistemic doubts is to improve the ontological constitution of perfection, by means of modal logic and Possible Worlds Theory. Intuitively, when we use modal logic, we are requested to accept that even though something is true and consistent in the modality of possible, it has not to be necessarily true in the actual world. Indeed, perfection is possible, but this does not imply it must be actual. For making full sense of the above, we will start with a philosophical reconstruction of the idea of perfection. But then a second step will follow, and this will involve an in-depth reconsideration of our understanding of "existence." We will need to learn that – contrary to Kant contention – existence can be assumed as a property [2]. In a modal context, truth-functional existence does not necessarily imply actual existence, but if something is possible, then it is necessarily possible

[2] The concept of perfection is used in number theory ("perfect numbers") for reasons of geometric elegance. I am not going to deal with this matter.

[3] I suspect that the enduring use of the word "ideal" in number theory might be a consequence of the not-so-subterranean Platonism, still enduring in the Philosophy of Mathematics. Gödel, for one, notoriously claimed to be a Platonist himself.

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