Review of: "Thermodynamics, Infodynamics and Emergence"

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Potential competing interests: No potential competing interests to declare.

I consider this topic very intersting. I spent a lot of time on similar arguments and I know that some concepts are not so easy and not totally clear. I disagree with some assumptions, even if I consider them very itnersting for constructive dialogue.

In general I found typing errors, I suggest a general review of the paper to fix them.

Here some relevant suggestions in some chapter

Abstract

- Why emergence is a fundamental properties in nature? I suggest to explain this concept from the beginning of the document to give an complete overview.
- “Information may increase free energy by reducing entropy in the system, or by capturing free energy from the surroundings”. Actually I'd like to explain better this concept and your assumption introducing the concept of “system” and “subsystem”. I've, indeed, a different opinion: even information respects thermodynamics laws, it is just a scale point of view. Starting with the concept that $\text{deltaS}_{\text{universe}}$ increases always, collecting information means modifying the free energy of a sub-system while the entropy tends to reduce in a small sub-system while increases as universe physical concept: a molecule formation that request energy reduce entropy by the energy requirment, while we are observing an entropy of the universe increasing. In thermodynamics is the total deltaS cannot be lower than 0, but it is possible for a subsystem.

Introduction

- "Among the fundamental physical forces of nature we recognize the existence of the following […]" I suggest to use not “forces” but “interactions”. Inertia should not be considered becasue is not a fundamental interaction, it represents a natural evolution of a system from a point A to point B.
- “We can define energy as the ability to exert a force causing displacement of an object or other kind of work.” This defintion is too specific. I suggest to say that Energy can be defined as the capability of a system to do work or modifying its initial conditions (constantly).

Energy

- “diverse” → “different”

- I don't think the different definition of types of energy are useful for the reader. The explations are very general and not so clear. I suggest to revisit this chapter.
- talking about “the zero law”: I suggest to remove the last sentence. I think it is useful, just to explain the concept, to say how the zero law underlines the tendency of a system to reach the equilibrium
- talking about “the second law”: I suggest to use not disorder but possible configurations ? This concept is in accord with the Boltzmann approach and definition of entropy

Free Energy

- I disagree with the simplified concept that “Entropy is the energy that can not be used to produce work”. It is not a general definition of entropy. Entropy is a descriptor of configurations of a system. Entropy describes how a system is capable to modify its configurations using the energy from an external source for example (mixing of two substances).

Infodynamics and Thermodynamics

- When you say “We might formalize these relationships generalizing Helmholtz equation […]” the temperature disappears from orginal formulation. Why? I was expecting an analogy. This question because in the recent past I was thinking about this concept analyzing the beehaves structures (structure is information) approaching the geometry from a thermodynamic point of view, and I start to think to different possibility.